United States Department of Agriculture

Forest Service

Environmental Assessment

Utility Corridor Vegetation Management

July 2009

Project areas occur primarily in rural electric cooperatives' rights-of-way that cross Ozark and Ouachita National Forests in limited portions of the following Arkansas counties:

Baxter, Benton, Crawford, Franklin, Johnson, Logan, Madison, Newton, Pope, Sebastian, Scott, Stone, Yell and Washington

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SUMMARY

The Ozark and Ouachita National Forests propose to allow the utilization of USDA-approved silvicultural herbicide treatments on target vegetation in four rural electric cooperatives' rights-of-way (ROWs). The activity area consists of approximately 425 miles of distribution and transmission lines that cross National Forest lands in portions of fourteen counties in north central, northwest and west Arkansas.

This Proposed Action Alternative is needed to increase the efficiency, effectiveness and environmental soundness of vegetation management in rural electric cooperatives' ROWs that cross National Forest lands. The proposed herbicides, currently used by participating rural electric cooperatives on non-Forest Service properties, are proven to be safe, effective, efficient, and environmentally sound when used according to manufacturers' label directions and when Best Management Practices (BMPs) are employed. The proposed herbicides are registered and approved by the US Environmental Protection Agency (EPA) for silvicultural use. EPA-approved herbicides are currently in use by the USDA Forest Service and other agencies on public lands across the country. Approval of the Proposed Action Alternative will allow the rural electric cooperatives to utilize these beneficial techniques on established ROWs on National Forest lands, providing a consistent vegetation management program throughout their service areas.

Mechanical methods are currently the only treatments used in the rural electric cooperatives' ROWs that cross the Ozark and Ouachita National Forests. The proposed action, unlike the mechanical methods, is highly localized and specifically targeted to woody stem vegetation only. Application of approved products by individuals on foot with backpack sprayers has a significantly lower impact to soils and vegetation and is significantly less disturbing to wildlife inhabiting the area than the use of heavy equipment mechanically clearing the entire ROW.

The process of applying herbicides by hand sprayers to target vegetation is designed to stop the growth of individual woody stem plants only, allowing desirable grasses and native non-woody vegetation to become more strongly established. This limited hand application process also eliminates or minimizes the potential for herbicides to reach the ground surface and affect other non-target vegetation or nearby water resources.

The initial herbicide treatment will leave a temporary visible contrast between treated woody stem vegetation and other untreated vegetation. This suppression of target vegetation is the desired result of the Action Alternative process, and no significant adverse effects to human health, the environment, natural resources, cultural resources or Threatened, Endangered or Sensitive flora and fauna species are expected. As re-vegetation occurs, desirable habitat expands, ultimately improving the habitat within ROWs and increasing the area's natural resources and visual appeal, thus assisting in meeting many USDA Forest Service goals. Specifically, the goal of managing grassland/open areas by establishing additional desirable grassland habitats that support quail, turkey and other desirable native wildlife is met through the proposed action. This in

turn supports the goal of providing opportunities for those seeking a variety of outdoor recreational opportunities, including wildlife viewing.

Since mechanical maintenance methods affect all vegetation in the ROWs, including desirable vegetation species, the many woody stem plants that re-sprout rapidly maintain their dominance in the ROWs and require frequent re-treatment. The proposed action would target only the woody stems for treatment with herbicides in order to eliminate or significantly limit re-growth. This action also reduces or eliminates the need for heavy machinery and significantly extends the time between re-treatment activities, benefiting the public in a variety of ways, including lower maintenance costs and subsequently lower electric costs. Less physical impact to the lands from less invasive methods and fewer re-treatments or maintenance activities all lead to a healthier environment and less disturbance of sensitive flora and fauna, while also continuing to provide a reliable source of power.

In summary, the Proposed Action Alternative of targeting only woody stem vegetation is anticipated to:

- provide consistency of vegetation management on National Forest and non-Forest lands;
- extend the periods between required re-treatment, while also providing ongoing protection for the integrity of the power lines;
- reduce or eliminate the need for mechanical or motorized vegetation maintenance activities in the ROWs, which lessens the potential adverse effects from heavy equipment such as erosion, water sedimentation and disturbance of fish and wildlife, particularly sensitive species;
- provide increased habitat for game and non-game species of wildlife such as quail, turkey, songbirds, butterflies and bats;
- provide the most environmentally sound alternative for vegetation management in the ROWs; and
- lower the cost of providing electricity to consumers by reducing the cost of ROW management.

In addition to the Proposed Action Alternative, the Forest Service also evaluated the following alternative:

- No Action Alternative: the continued use of mechanical means only for vegetation management in rural electric utility corridors

The potential effects of implementing either of these alternatives are discussed in the following Environmental Assessment (EA), which was conducted and prepared by ATOKA, Inc. under the guidance and direction of the US Forest Service. Based upon these potential effects, the responsible Forest Service official in each National Forest will decide if using approved silvicultural herbicides on target vegetation in the rural electric cooperatives' ROW corridors that cross National Forest lands is the most efficient and environmentally sound method of vegetation management for the area of concern.

In addition to the Proposed Action Alternative, the Forest Service will also evaluate the No Action Alternative cited above, in which only existing management plans would continue to guide the rural electric cooperatives' vegetation management within the ROWs of concern. The potential effects of existing vegetation management methodologies on Forest Service lands were considered and are provided as a baseline for comparison to the Action Alternative.

Based upon the information in this EA and the supporting project planning record (including consideration of all public comments), the responsible official for each National Forest will decide which, if either, of the developed alternatives best meets the purpose and needs disclosed. If the Proposed Action Alternative is selected for implementation, the decision may include minor modifications or additional measures as appropriate or necessary. Documentation and rationale of included modifications and additional measures would be identified in the decision.

INTRODUCTION

DOCUMENT STRUCTURE

The Forest Service has prepared this final Environmental Assessment (EA) document in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. NEPA regulations require that Federal agencies proposing actions that may have the potential to significantly affect the quality of the human environment must analyze the potential environmental effects of these actions and of the alternatives. This EA was conducted by ATOKA, Inc. under the guidance and direction of the Forest Service. The document discloses the direct, indirect and cumulative environmental effects that would result from the Proposed Action and No Action Alternatives. The document is organized into five parts:

- ***Introduction**:* This section includes information on the history and background 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.

- ***Comparison of Alternatives, including the Proposed Action**:* This section 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 an evaluation of significant issues raised by the public and/or other agencies. This discussion also includes proposed surface water sampling and analysis, and possible mitigation measures as appropriate. A summary table of the environmental consequences associated with each alternative that was evaluated is also provided.

- ***Environmental Consequences**:* This section describes the environmental effects of implementing the Proposed Action Alternative as well as continuing the current methods in the No Action alternative. This analysis is organized by specific resources evaluated, including: Geology and Soils; Hydrology and Water Quality; Climate; Air Quality and Noise; Vegetation Communities; Riparian Areas; and Fish and Wildlife, including Threatened, Endangered, and Sensitive Species Proposed for Listing; Cultural Resources; Socioeconomic Considerations; Recreation and Scenic Integrity; and Human Safety. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative, which provides a baseline for evaluation. An evaluation of the Action Alternative, which provides the effects of the proposed action on that environment, concludes each section.

- ***Agencies and Persons Consulted**:* This section provides a list of preparers and agencies consulted during the development of the environmental assessment.

- ***Appendices**:* The appendices provide detailed information and data to support the analyses presented in the environmental assessment. References are provided in Appendix 1, and the Glossary is found in Appendix 2. Appendix 3 supplies information on how to obtain larger versions of the maps included in the text. The Sampling and Analysis Plan is located in Appendix 4. Appendices 5 through 8

contain specific scientific information related to ecoregions, geology, soils and biological studies.

Additional documentation, including detailed analyses of analysis-area resources, may be found in the project planning record located at the Ozark-St. Francis National Forest Headquarters, 605 West Main Street, Russellville, Arkansas.

BACKGROUND

In the regular and routine course of business, rural electric cooperatives must maintain their distribution and transmission line rights-of-way (ROWs), keeping them clear of obstructions. Trees, brush and other potentially obstructive and damaging vegetation must be effectively managed to maintain power line integrity and to ensure a reliable supply of electricity for public and private use. The rural electric service cooperatives participating in this project are:

- Arkansas Valley Electric Cooperative Corporation
- Carroll Electric Cooperative Corporation
- North Arkansas Electric Cooperative, Inc.
- Ozarks Electric Cooperative Corporation

Figure 1 gives an overview of each cooperative's general service areas within the National Forests.

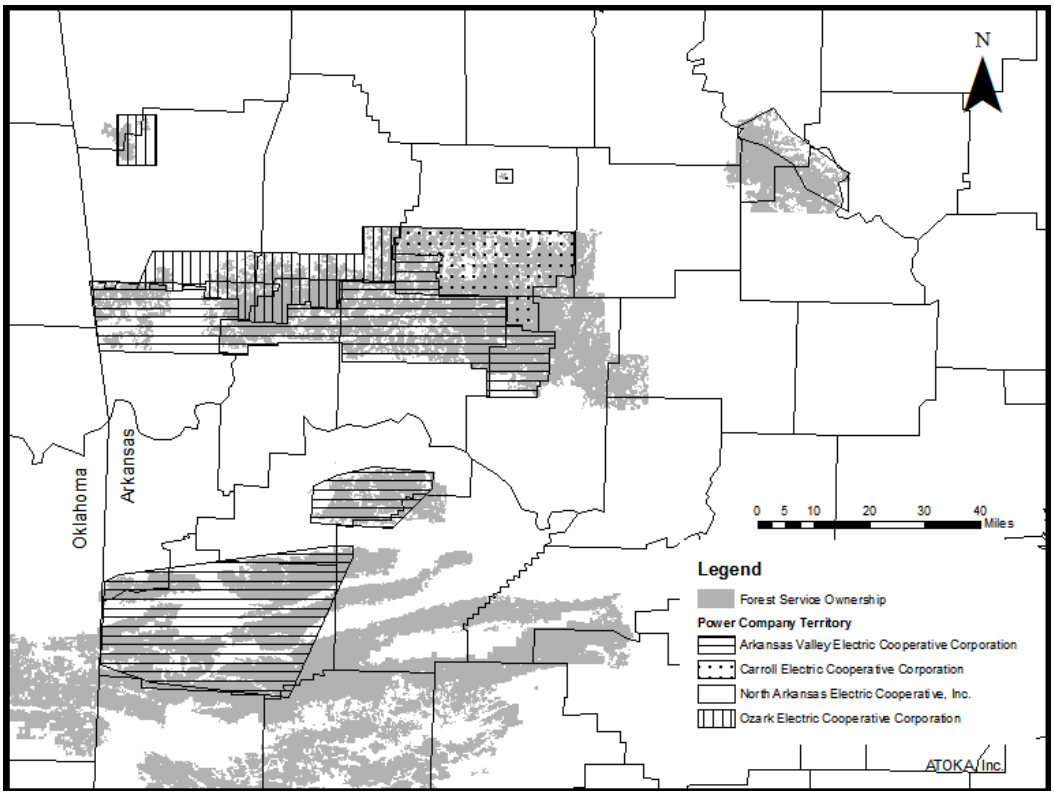

Figure 1 –Overview of Participating Cooperatives' General Service Areas within the National Forests

The utility companies participating in this project are collectively responsible for the service, maintenance and accessibility of approximately 425 miles of electrical distribution and transmission lines located in the Ozark and Ouachita National Forests in the west, northwest and north central portions of Arkansas.

The Ozark National Forest covers 1.2 million acres, primarily in the Ozark Mountains of northern Arkansas (www.fs.fed.us/oonf/ozark/index.html). The Ouachita National Forest covers 1.8 million acres in central Arkansas and southeastern Oklahoma (www.fs.fed.us/r8/ouachita/).

The Ozark-St. Francis and Ouachita National Forests Land and Resource Management Plans (Forest Plans) guide all natural resource management activities for the respective National Forests. These documents are incorporated into this EA by reference. The Forest Plans establish long-range goals (desired conditions) and short-range objectives (generally for a period of 10 to 15 years). They specify management areas and associated priorities and objectives, and establish monitoring and evaluation requirements that provide a basis for periodic determination and evaluation of the effects of implementing the Forest Plans.

The respective Forest Plans are posted online at:

http://www.fs.fed.us/oonf/ozark/projects/planning/planning.html.
http://www.fs.fed.us/r8/ouachita/planning/documents/revised_plan.pdf
http://www.fs.fed.us/r9/forests/marktwain/projects/forest_plan/

The activities and practices of the Proposed Action Alternative are used for vegetation management on private and public lands, including National Forests, throughout the US. Extensive risk assessment studies for the proposed silvicultural herbicides have been performed and are available online through the Forest Service website (www.fs.fed.us/foresthealth/pesticide/risk.shtml). These studies, and numerous others, are referenced throughout this document.

The utility companies currently accomplish vegetation management on non-public lands using both mechanical and chemical methods. Maintenance of ROWs for each of the participating rural electric cooperatives on National Forest lands has previously been accomplished using only mechanical methods. The utility corridor ROWs on National Forest lands consist of approximately 2,563 acres within the analysis area.

Purpose and Need for Action

Keeping distribution and transmission power line ROWs clear of line-damaging obstructions and maintaining accessibility for maintenance and repairs are vital and continuous responsibilities of the electric service providers. Trees, brush, and other potentially damaging vegetation must be effectively managed to maintain line integrity and to ensure a reliable supply of electricity. The purpose of this initiative is to allow the use herbicide methods, which have proven effective, efficient and environmentally friendly on non-forest lands, to the established power line ROWs of participating rural electric cooperatives located in the Ozark and Ouachita National Forests.

The rural electric cooperatives currently maintain ROWs on National Forest lands in Arkansas entirely through mechanical methods. The mechanical methods consist of both hand cutting with chain saws and axes, and the use of heavy machinery equipped with industrial cutters and trimmers on extendable booms. Heavy mowers and skidder type units are also currently utilized in the ROWs. Representative photos of some types of heavy equipment used in mechanical ROW vegetation management are provided below.

Escalating fuel and machinery costs, as well as the required frequency of mechanical maintenance on Forest Service lands, are increasing burdens to the rural electric cooperatives, their member customers and the public in general. Vegetation management by the electric cooperatives on non-public lands is accomplished through the implementation of both mechanical and chemical methods. The electric cooperatives have found herbicide treatment to be an effective and efficient option that is economically and environmentally sound.

Actual cost comparisons provided by the rural electric cooperatives of mechanical versus herbicide treatment on non-National Forest lands indicate that the average cost of herbicide treatment ranges from seven to 30 percent of the cost of mechanical treatment. This represents an approximate 70 to 93 percent cost reduction over mechanical methods for ROW maintenance in areas where herbicide treatment is utilized.

Extensive studies, including USDA Forest Service Risk Assessments, have been conducted on the safety and effectiveness of herbicides proposed for this project. When used according to manufacturers' label directions and Best Management Practices (BMPs), these herbicides are proven safe, and the application method has fewer adverse effects on the environment than mechanical methods.

Utilizing silvicultural herbicides for ROW vegetation management typically extends the time between re-treatment from approximately every two years for mechanical means to approximately every four to five years, or longer, for herbicide treatment, with fewer areas consistently needing re-treatment as desired vegetation becomes more strongly established. Hand-applied herbicide treatments to specific target vegetation will eliminate the need for heavy cutting equipment to control vegetation over the entire ROW area in utility corridors, thereby lowering maintenance costs. As noted above, the use of herbicides, as opposed to mechanical clearing, significantly extends the time between required re-treatments, which further reduces costs and limits the need to access the ROW areas for vegetation management activities. Since the proposed herbicide treatment activities are conducted by walking access, the potential adverse effects to

wildlife and the environment from more frequent access by heavy equipment are also significantly reduced.

The proposed action of treating target vegetation only within the ROWs will permit rural electric cooperatives to manage vegetation on National Forest lands in the same manner as, and consistent with, procedures currently employed on ROWs adjacent to National Forest lands.

In addition to consistency of treatment activities for the more effective and efficient protection and maintenance of electrical power distribution lines, the Proposed Action Alternative responds to goals and objectives for the desired future condition for the Forests as outlined in the Land and Resource Management Plans (Forest Plans) of the Ozark and Ouachita National Forests.

A desired forest condition of the Forest Plans is a "healthy ecosystem that provides a balanced and sustainable flow of goods and services for a growing, diverse population" (Ouachita and Ozark-St. Francis Revised Land and Resource Management Plans, Vision, September 2005). The proposed action supports this goal through seeking, researching, selecting and implementing economically and overall environmentally improved management practices for maintaining power line rights-of-way. Reliable electric service that is also cost-effective and environmentally sound meets immediate and essential public needs, benefiting local and regional communities now and in the future.

In keeping with these goals and conditions, the primary purpose for management in the proposed project area is to utilize the most effective, efficient, lowest impact activities to manage utility corridor ROWs, while maintaining the desired future conditions for the Forests as outlined in the Forest Plans.

The project will follow the Integrated Pest Management guidelines (FW19 through FW 32) in the Ozark-St. Francis National Forests Revised Land and Resource Management Plan (RLRMP), which are consistent and compatible with the Ouachita National Forest Land and Resource Management Plan.

PROPOSED ACTION

The Action Alternative proposed by the Forest Service is to use EPA, USDA and Forest Service-approved herbicides to treat only woody stem vegetation within the rural electric companies' ROWs on National Forest lands. The participating rural electric cooperatives participating in this project propose to use commercial herbicide formulations to control specific woody stem vegetation within existing constructed utility corridors located on Federal lands.

Forest Service management practices include the use of herbicides, and a risk assessment has been conducted by the Forest Service for each of the herbicides proposed in the Action Alternative. Each of these proposed herbicides is also registered and approved for use by EPA in accordance with the following:

> "Pesticide registration is the process through which EPA examines the ingredients of a pesticide; the site or crop on which it is to be used; the amount, frequency and timing of its use; and storage and disposal practices. EPA evaluates the pesticide

> to ensure that it will not have unreasonable adverse effects on humans, the environment and non-target species. A pesticide cannot be legally used if it has not been registered with EPA's Office of Pesticide Programs."
> (http://www.epa.gov/pesticides/regulating/registering/).

Therefore, throughout this document, the proposed herbicides are referred to as EPA and Forest Service-approved.

To meet the objectives for this project and to address the aforementioned needs, an interdisciplinary team of Forest Service resource specialists has assisted the companies' approved NEPA contractor, ATOKA, Inc., in developing this EA.

The Proposed Action Alternative will allow the use of approved herbicides, applied as mixtures of commercial formulations and water, in amounts and rates not to exceed manufacturer's recommendations, for the purpose of vegetation management within existing previously constructed utility corridors located on Forest Service lands.

The products being considered for use in the Proposed Action Alternative are commercial formulations that include the following active herbicides: glyphosate, imazapyr, metsulfuron methyl, triclopyr and picloram. Some common brand names, EPA registration numbers and CAS numbers for the active ingredients are provided for each of the common chemicals in Table 1.

The USDA Forest Service Risk Assessments referenced in this EA address the common active ingredients in the proposed commercial herbicide formulations. Various manufacturers offer multiple products approved for silvicultural use that include these active ingredients, and the risk assessments apply to these commercial formulations. Appendix 7 provides a biological review of the proposed herbicides.

Table 1 – Proposed Herbicide List

Active Common Name	Brand Name (Manufacturer)	EPA REG #	Scientific Name and MSDS CAS #
Glyphosate	Accord (XRT, Concentrate) *(Dow AgroSciences)*	62719-324 62719-517 62719-322	N-(phosphonmethyl) glycine, isopropylamine salt of glyphosate CAS # 038641-94-0
Imazapyr	Powerline, Arsenal Stalker *(BASF)*	241-346 241-398	2-[4,5-dihydro-4-methyl-4-(1-methylethyl) -5-oxo-1*H*-imidazol-2-yl]-3-pyridine carboxylic acid, Isopropylamine salt CAS #81510-83-0
Metsulfuron methyl	Escort XP *(DuPont)*	352-439	Methyl 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin -2-yl)amino]-carbonyl]amino]sulfonyl]benzoate] CAS #74223-64-6
Picloram	Tordon K *(Dow AgroSciences)*	62719-17	4-amino-3,5,6-trichloropicolinic acid, as the potassium salt CAS #002545-60-0
Triclopyr	Garlon (3A, 4) *(Dow AgroSciences)*	62719-37 62719-40	3,5,6-trichloro-2pyridinloxyacetic acid, triethylamine salt CAS #057213-69-1 3,5,6-trichloro-2pyridinloxyacetic acid, butoxyethyl ester CAS #064700-56-7

The proposed herbicide products may be used in either the Foliage Mixture Spray or Hack and Squirt (Frilling and Injection) methods of application described below. Application rates will not exceed those stated on manufacturers' labeling. Combinations

of products and water are for illustrative purposes only, and actual field configurations will vary as determined by licensed applicators. Specific combinations will be developed for each company by their licensed applicators and contractors to accommodate the site conditions of the particular area, buffer area considerations, if any, and in keeping with regulations and manufacturer's recommendations. Procedures for each herbicide application process and herbicide application BMPs are provided below and are further detailed in the Alternatives section.

Mixing of products with water would take place outside the ROWs, typically on roadways. Mixing and application procedures would be supervised by a licensed applicator, and monitoring would be conducted to ensure that proper mixing, application, clean-up, personal protection and safety procedures are followed. Some contractors utilize pre-mixed products that require only the addition of water, providing further handling safeguards. Mixture water, as needed, would be provided from off-site sources and would not be extracted from National Forest streams.

Foliage Mixture Spray and Procedures

Foliage Mixture Spray (herbicide and water mixture) is designed for application to the foliage of selected small-diameter, woody stem vegetation, including brush and small trees, within the utility ROWs. Grasses and other types of non-woody vegetation are not treated.

The Foliage Mixture would be applied by individuals using low-pressure backpack sprayers, walking the utility ROWs. The participating rural electric cooperatives typically use approximately 10 gallons of foliage spray mixture per acre for each application on non-public ROWs. Actual usage would vary according to the number and types of small-diameter, woody stem plants requiring treatment on any given segment of ROW.

Table 2, Sample Foliage Mixture Spray, depicts typical mixtures of approximately 94.5 percent water and 5.5 percent combined commercial formulations of chemicals. A typical 100-gallon mixture, applied at the estimated 10 gallons per acre, would include approximately only one-half gallon of combined herbicide products to one acre of land.

Table 2 – Sample Foliage Mixture Spray (100 gallons)

Brand Name	Active Ingredient Chemical Name	Percent of Total Volume	Volume
Accord	**Glyphosate**	5%	**5 gal**
Arsenal Powerline Stalker	**Imazapyr**	0.5%	**0.5 gal**
Escort XP	**Metsulfuron methyl**	0.03%	**.03 gal**
	TOTAL PRODUCTS	5.53%	**5.53 gal**
WATER	**WATER**	94.47%	**94.47 gal**
	TOTAL MIXTURE		**100 GAL**

In addition to dilution with water for application, the herbicide products proposed for the Action Alternative are also mixtures, each product being a combination of active ingredient and inert properties. Table 3 lists the percentages of active ingredients in each brand name product, as compiled from the manufacturers' product information sheets.

Table 3 – Active Ingredient Percentages in Commercial Formulations

Brand Name	EPA REG #	Active Chemical Name	Active Chemical CAS #	% Active Chemical
Accord Concentrate Accord XRT Accord SP	62719-324 62719-517 62719-322	Glyphosate	038641-94-0	53.8% 53.67% 41.5%
Arsenal Arsenal Powerline Stalker	241-346 241-431 241-398	Imazapyr	81510-83-0	28.7% 53.1% 27.6%
Escort XP	352-439	Metsulfuron methyl	74223-64-6	60%
Garlon 3 (salt) Garlon 4 (acid)	62719-37 62719-40	Triclopyr	057213-69-1 064700-56-7	44.4% 61.6%
Tordon K	62719-17	Picloram	002545-60-0	24.4%

Using the information from the tables above, Table 3 illustrates the approximate amounts of active ingredients in the 100-gallon Sample Foliage Mixture.

As illustrated in Table 4, 100 gallons of the sample spray would contain approximately 94.47 gallons of water, 2.69 gallons of inert ingredients and 2.84 gallons of active herbicide ingredients. Therefore, only 2.84 percent of the 100-gallon sample mixture would be active herbicide.

Table 4 –Active Ingredient Amounts in 100 Gallons of Sample Foliage Mixture

Brand Name	Chemical Name	Mix % of Total Volume	Amount added to water for 100 gals mixture	% of Active Ingredient	Amt of Active Ingredient In Mixture
Accord XRT	Glyphosate	5%	5 gal	53.67%	2.68 gal
Arsenal	Imazapyr	0.5%	0.50 gal	28.7%	0.14 gal
Escort XP	Metsulfuron methyl	0.03%	0.03 gal	60%	0.02 gal
Total Herbicide		5.53%	**5.53 gal**	*From above*	**2.84 gal**
Water		94.47%	**94.47 gal**		**94.47 gal**
Inert Ingredients					**2.69 gal**
			100 gal		**100 gal**

Woody stem vegetation larger than specified diameters and heights does not respond as successfully to foliar spray and requires a different method of application commonly referred to as the "Hack and Squirt" method or "Frilling and Injection." The general selection process and application procedures of this method are described below.

Hack and Squirt Mixture and Procedures

The Hack and Squirt method is used as a selective treatment for larger woody stem vegetation unsuitable for Foliage Mixture Spray treatment. Brush or trees six feet tall or greater, or three inches in diameter or greater, are typically more effectively managed by this method. A more concentrated mixture of commercial herbicide formulations, referred to herein as the Hack and Squirt mixture, is used for individual application to the stems of woody stem plants only.

Once these large woody stems are identified, the field crews cut, or hack, a ring around the stem into the cambium layer. The Hack and Squirt Mixture is immediately hand-applied to the cut stem area at an approximate ratio of 1 cc per one-inch diameter of stem (i.e. a four-inch stem would be treated around the cut ring with approximately 4 cc mixture) to prevent regrowth.

Table 5 shows approximate percentages of chemicals and water that are typical of, and may be used in, one gallon of Hack and Squirt mixtures. The approximate percentages of active ingredients are also shown. This more concentrated mixture is approximately 38 percent water, 32 percent inert ingredients and 30 percent active herbicides. In one gallon of Hack and Squirt mixture, less than one third would be active herbicide ingredients.

Table 5 – Sample Hack and Squirt Mixture (one gallon) with Active Ingredients

Brand Name	Common Name	Amt added to water for 1 gallon mix	Amt of Active Ingredient in Mixture	% of Active Ingredient
Accord XRT	Glyphosate	0.50 gal	0.270 gal	*53.67%*
Arsenal	Imazapyr	0.09 gal	0.026 gal	*28.7%*
Tordon K	Picloram	0.03 gal	0.007 gal	*24.4%*
Total Herbicide		**0.62 gal**	**0.30 gal**	**30%**
Water		**0.38 gal**	**0.38 gal**	**38%**
Inert Ingredients		**--**	**0.32 gal**	**32%**
TOTAL		**1.00 gal**	**1.00 gal**	**100%**

As detailed above, the products proposed for use in the Action Alternative are mixture formulations that include a percentage of the active ingredient. Prior to use, these mixtures are further diluted with water to create the Foliage Mixture Spray and the Hack and Squirt Mixture. The USDA Forest Service has conducted risk assessments for the active ingredient in each of the proposed products. These studies are referenced throughout this EA, and focus on the active ingredients rather than commercial formulations or diluted mixtures. Other studies, which reference brand names or commercial formulations, are also cited.

If approved, this Proposed Action Alternative would be conducted in compliance with all federal, state and local laws, regulations or requirements and the standards of the current Ozark and Ouachita National Forest Land and Resource Management Plans. Implementation of this proposed action of treatment of power line ROWs would be conducted in a phased approach beginning in the growing season of 2009.

DECISION FRAMEWORK

This EA does not document a decision. The purpose of this document is to disclose the effects and consequences of proposed management actions.

The Forest Supervisors of the respective National Forests are the Responsible Officials for the portions of this proposal that would take place on each National Forest The decision to be made is whether to approve and implement the activities of the Proposed Action Alternative or not. The Forest Supervisors may decide to 1) select either the Proposed Action Alternative or the No Action Alternative, 2) modify the proposed action or 3) defer making a decision at this time.

Given the purpose and need, the deciding officials review the proposed action and the other alternatives in order to make a final decision.

In order to make a final decision on this proposal, the deciding officials may consider the following questions:

- Is there documented scientific evidence that the Proposed Action Alternative is an environmentally sound practice?
- Does the proposed action have the potential to produce a significant adverse effect to biological resources?
- Are any protected species likely to be adversely affected by the proposed action?
- What are the most severe potential adverse effects of the proposed action?
- How likely are these potential adverse effects to occur?
- What are the most likely beneficial effects of the Proposed Action Alternative?
- Are any species or habitats likely to be beneficially affected by the proposed action?
- Does the proposed action have the potential to produce a significant effect to human health and safety?
- Is the proposed action already in use on private properties?
- Is the proposed action already in use on any public lands?
- Is the proposed action already in use on National Forest properties?
- Does the proposed action produce any beneficial or adverse effects on National Forest properties?
- How do the potential effects (immediate, cumulative, beneficial and adverse) of the Proposed Action Alternative compare to those of the No Action Alternative?
- Does the Action Alternative support Forest Plan goals, directives and desired forest conditions?

PUBLIC INVOLVEMENT

The proposal was listed in the Schedule of Proposed Actions on June 29, 2007. The proposal was provided to the public and other agencies for comment during scoping June 27, 2007. In addition, as part of the public involvement process, agencies and groups were contacted for commentary. A list of issues to be addressed was developed from these sources and was incorporated into the EA process.

ISSUES

The Forest Service separated the issues identified during the scoping process 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, 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 (CEQ) NEPA regulations requires this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…"

A list of non-significant issues and reasons regarding their categorization as non-significant may be found at the USDA Forest Service offices in Russellville, Arkansas, in the project record. Regarding significant issues, the Forest Service identified seven general topics that were raised by the public during the scoping process and compiled these comments into seven categories of issues, which are addressed throughout this EA. These issues include:

1. **Water Quality--Erosion/Siltation:** **Treatment will cause unacceptable erosion *Treatment will cause unacceptable siltation **There will be residual leaching of herbicides into soil and water **Water runoff will be contaminated and affect people and animals **Herbicides should not be used on sensitive soils **Herbicides should not be used on steep slopes.
   Drinking Water: **Water quality in public drinking water watersheds is a concern **Herbicide use could affect groundwater and wells **Wells close to power lines will be contaminated

2. **Effects on Wildlife:** **Use of herbicides will endanger wildlife **Use of herbicides will reduce browse for wildlife **Use of herbicides will cause forest fragmentation **Herbicide use will reduce wildlife habitat **Use of herbicides will improve wildlife habitat **Mechanical maintenance is better for honeybees and beekeepers.
   Riparian Zones: **Riparian Zones should be excluded from herbicide treatment **Herbicides will contaminate streams used for irrigation and contaminate crops
   Sensitive Plants: **Application areas should be surveyed for sensitive plants before each treatment **Herbicide drift may affect off site areas.
   Non-Native Invasive Species: **Killing of native plants with herbicides will encourage non-native invasive species.

Caves and Karst: **Herbicides could affect caves and sensitive cave species **Karst areas are unsafe for herbicide use

3. **Herbicide Application:** **Herbicide clean-up and excess herbicide dumping is a concern **Application of herbicides should be restricted to June – October to avoid heavy runoff period **Consider the possibility that workers will not follow regulations when applying herbicides **Consider the possibility that workers will swim in water and pollute it **There will be mistakes made handling herbicides *Herbicides will be used at rates higher than is recommended **Worker putting out herbicides will be at risk **Need to address the qualifications of applicators

4. **Regulatory Compliance--NEPA:** **Need to justify the need for using herbicides vs. manual treatment.
   Wild and Scenic Rivers Act: **Herbicide use is contrary to the Wild and Scenic Rivers Act **Herbicides will affect Scenic Rivers.
   Organic Farms Act: *Herbicide use could affect the status of my Organic Farm **Use of herbicides is contrary to the Organic Act **Is the treatment area size correct?
   Monitoring: **Will monitoring reports be done annually? **Qualifications of monitors is an issue **Will there be a fund set up to compensate people for monitoring their property and health

5. **Scenic Integrity and ROW Use:** **I object to herbicide use from a visual standpoint **Mechanical methods are unsightly **Herbicide use will look better **The ROWs should be maintained manually as wildlife openings.
   Problems with openness: **Maintenance with herbicides will encourage illegal OHV use **Use of herbicide will lead to ROWs becoming firing lanes for unscrupulous hunters and gun users.
   Fire Fighting: **Control of woody vegetation with herbicides will reduce power line caused wildfires **Use of herbicides will improve access for fire fighting

6. **Economic Effects: ****Manual control methods are more labor intensive and better for the local economy **Herbicides are the most economical way to maintain the ROWs **Protecting soil and water is more important than saving money on ROW maintenance

7. **Health and Human Safety--Toxic Properties, Risk Assessments:** **Risk to workers putting out herbicide **Allergic reactions to herbicides should be addressed **Herbicides may be found to be a greater risk than now thought **Consider the effects of people breathing smoke from vegetation treated with herbicide **There is no risk assessment for herbicides that are proposed for use **The utility companies plan on using a tank mix of five herbicides. This goes far beyond what is covered in the risk assessment **I am sensitized to herbicides and can't stand the smell of even the residue of them **No one knows the long-term effects of herbicides.
   Bioaccumulation (Food Chain): **Herbicides can concentrate and cause cancer and sickness **Herbicide use may contaminate game species and the people who eat them **Herbicides will contaminate black berries that are eaten by wildlife and people.

Importance of Power Outages (Health): **I support herbicide use because keeping the electricity on is a health issue with me **I support herbicide use to prevent power outages

8. **Support for Alternatives:** I support using herbicides to maintain ROWs *I support the no action alternative *I am opposed to any use of herbicides *Mechanical treatment should be the only treatment used ***** Use of herbicides is the most effective way to control woody vegetation.

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This section describes and compares the alternatives considered for the Utility Corridor Vegetation Management Project. This section also includes a description of each alternative considered and maps of the project area. Figure 1 depicts the National Forests and each rural electric cooperative's general service areas within the forests.

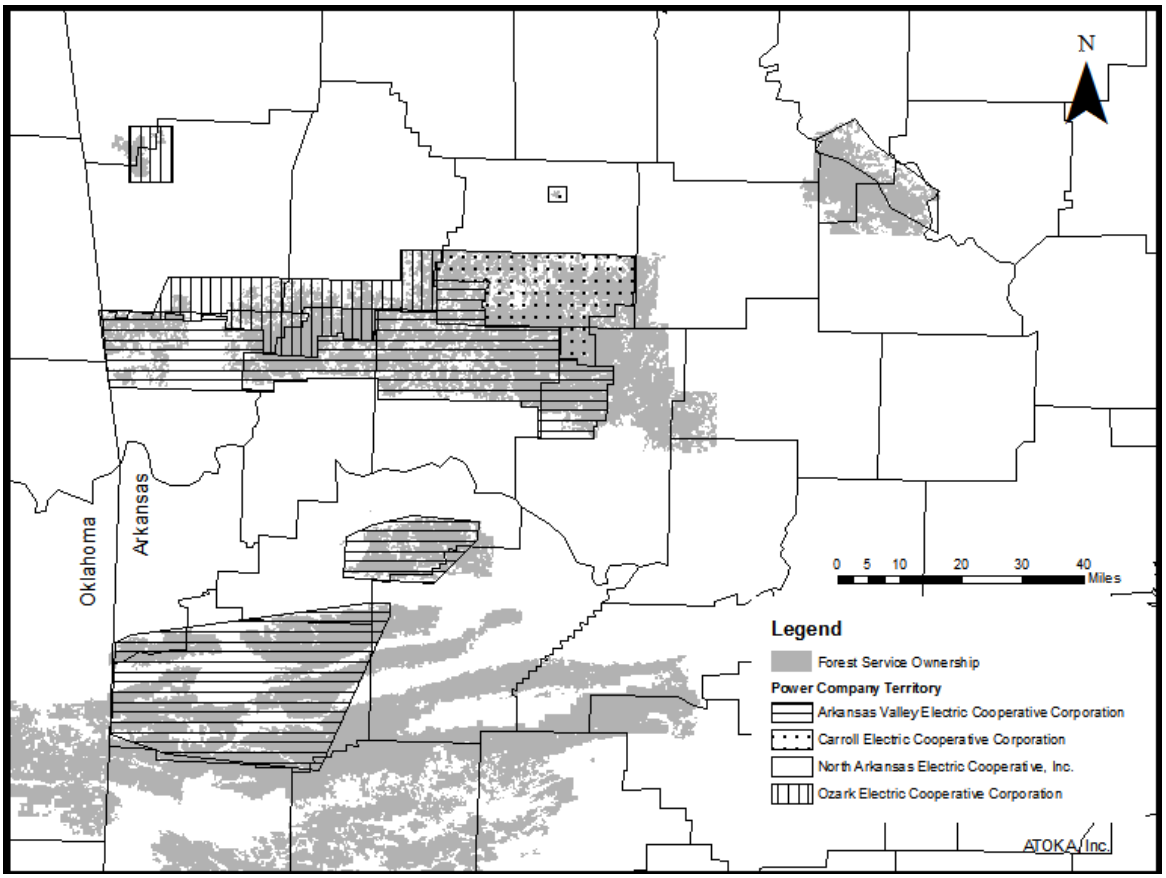

Figure 1 –Overview of Participating Cooperatives' Overlap with National Forests.

The activity area, which consists of the existing ROW corridors, is applicable to all alternatives presented and includes approximately 425 miles of transmission and distribution line ROWs that cross National Forest properties. The majority of the lines are located in the Ozark National Forest, with smaller sections in the Ouachita National Forest. Right-of-way widths vary from as little as 20 feet to as much as 100 feet, with the average being 40-60 feet. For the purposes of this project, estimated ROW area acreages to be treated were determined by using an average width of 50 feet. Approximate mileages of power lines were obtained by digitizing each rural electric company's truck maps and using ArcView GIS to calculate the mileage and acreage for each company's ROWs within the activity and analysis (study) areas.

Mileage and acreage details by forest are provided in Table 6. Where multiple power lines exist within the activity or analysis area, acreage figures have been calculated to include overlap areas only once. As noted below, the four participating rural electric cooperatives have approximately 2,563 acres in utility corridor ROWs that cross National Forest lands.

Table 6 – Analysis Area Measurements

National Forest	Approximate Utility Line **Mileages**	Approximate **Activity Area ROW Area Acreages** (average 50 ft width)	Approximate **Analysis Area Acreages** (600 ft width)
Ozark	361	2,171	24,781
Ouachita	64	392	4,600
TOTALS	**425**	**2,563**	**29,381**

In keeping with Forest Service criteria for a Biological Evaluation (BE), which is incorporated as a part of this EA, the analysis area acreages for scientific studies were estimated by adding a 300-foot buffer area on each side of the center of the power line for a maximum study area width of 600 feet. Vegetation and geologic studies were conducted on areas 100 feet on either side of the power line, and wildlife studies were conducted over the entire 600-foot estimated analysis area width as required in Forest Service BE guidelines (USDA Forest Service 2006c).

Although the analysis area includes a 600-foot corridor along power line ROWs, the electric companies propose to maintain the footprints of their existing power lines and use silvicultural herbicide treatment only on the established ROWs (activity area) of each respective line. As noted above, the approximate total ROW area, where vegetation management activities are required, is approximately 2,563 acres. The total analysis area, which includes the management and treatment area, as well as the study buffer area described above, is approximately 29,381 acres.

The analysis area maps provided below indicate the general areas where the participating cooperatives' electric power lines cross National Forest properties. Some segments of electrical transmission and distribution lines cross National Forest lands in short segments, which make them difficult to identify on the smaller scale figures. Information on how to obtain larger versions of these maps is provided in Appendix 3. Company truck maps and digital map files are available at the Forest Service office in the project record.

This section also presents the alternatives in comparative form, sharply defining the differences between the alternatives, and providing a clear basis for choice among options by the decision makers and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., herbicide treatment versus mechanical equipment) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (e.g., the amount of erosion and cost of mechanical maintenance with heavy equipment versus herbicide treatment by backpack spraying).

Regardless of the method used, power line ROW corridors must be managed to prevent damage to distribution and transmission power lines from potential obstructions such as trees. Therefore, the following analysis area maps are applicable to all alternatives considered in this project.

Figure 2 is an overview of the participating rural electric cooperatives' general ROW areas within each of the National Forest areas.

In all figures, National Forest properties are shown in gray, and the general areas where ROWs occur within the Forests are depicted in black. See Appendix 3 for information on how to obtain larger views of all maps.

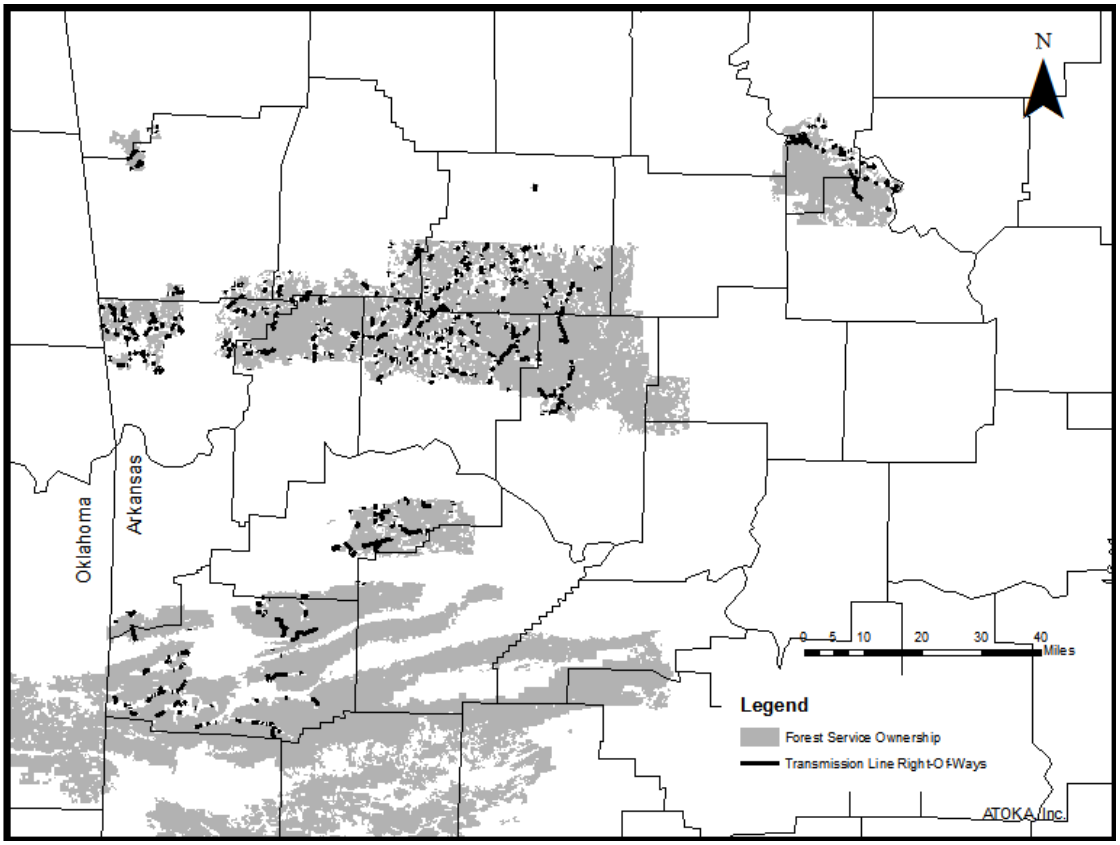

Figure 2 –Analysis Area Map Overview with Forest Service ROWs

Figure 3 is an overview of the Ozark National Forest. Figures 3a, 3b and 3c follow, giving sectional views.

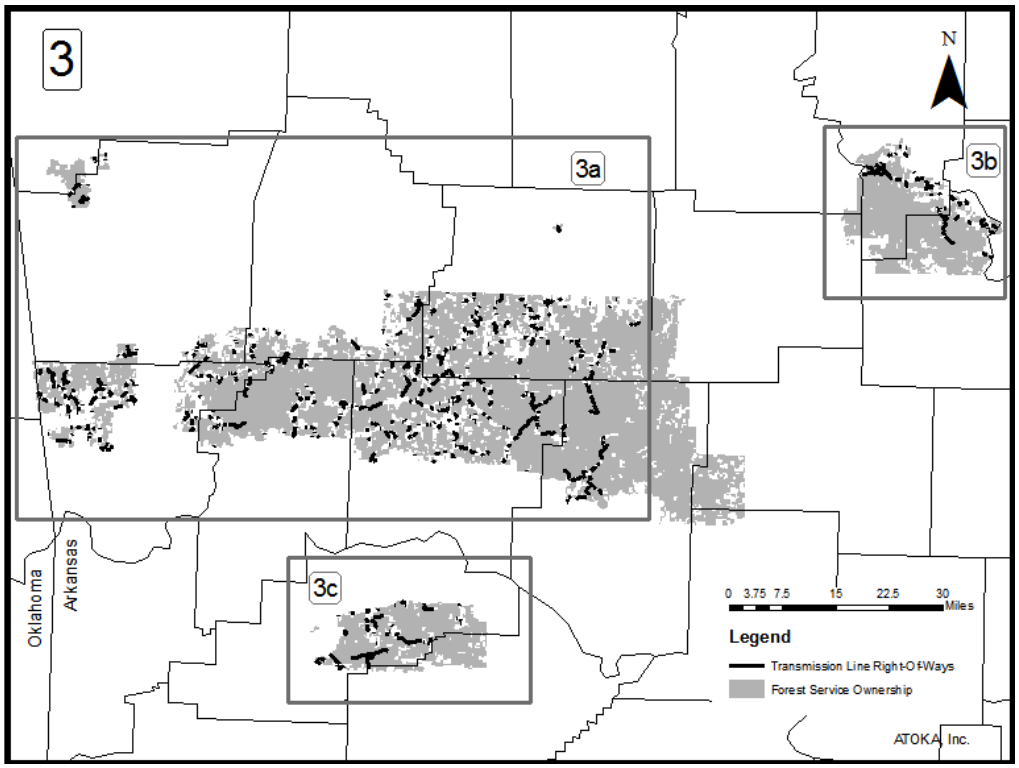

Figure 3 –Ozark National Forest Analysis Area Overview

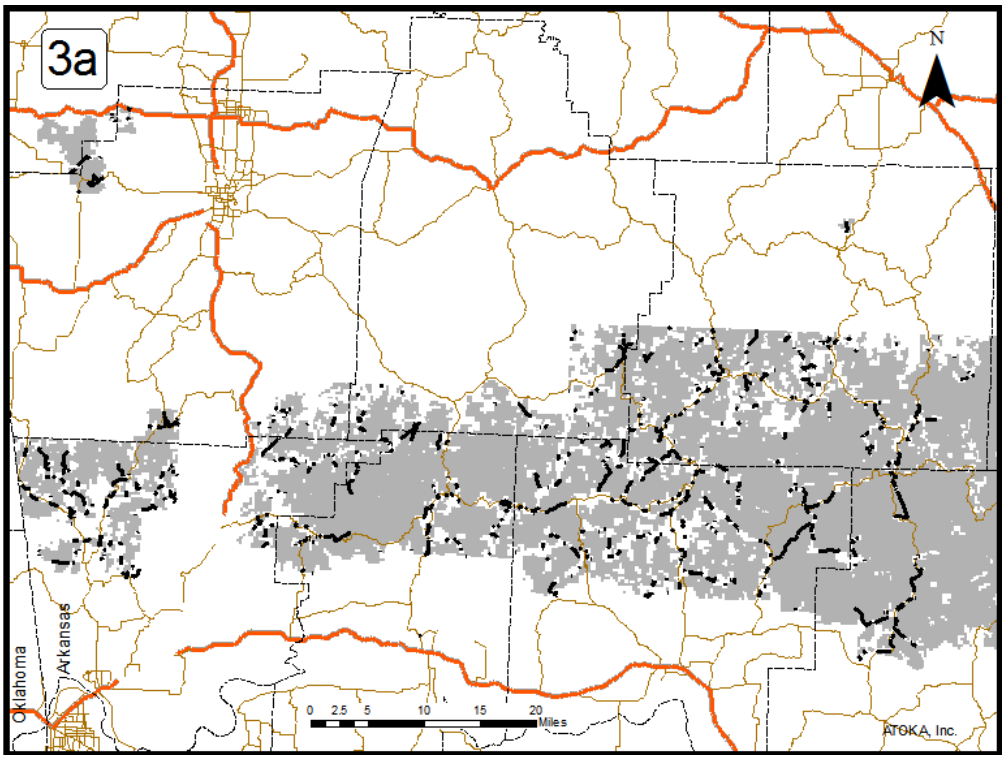

Figure 3a –Ozark National Forest

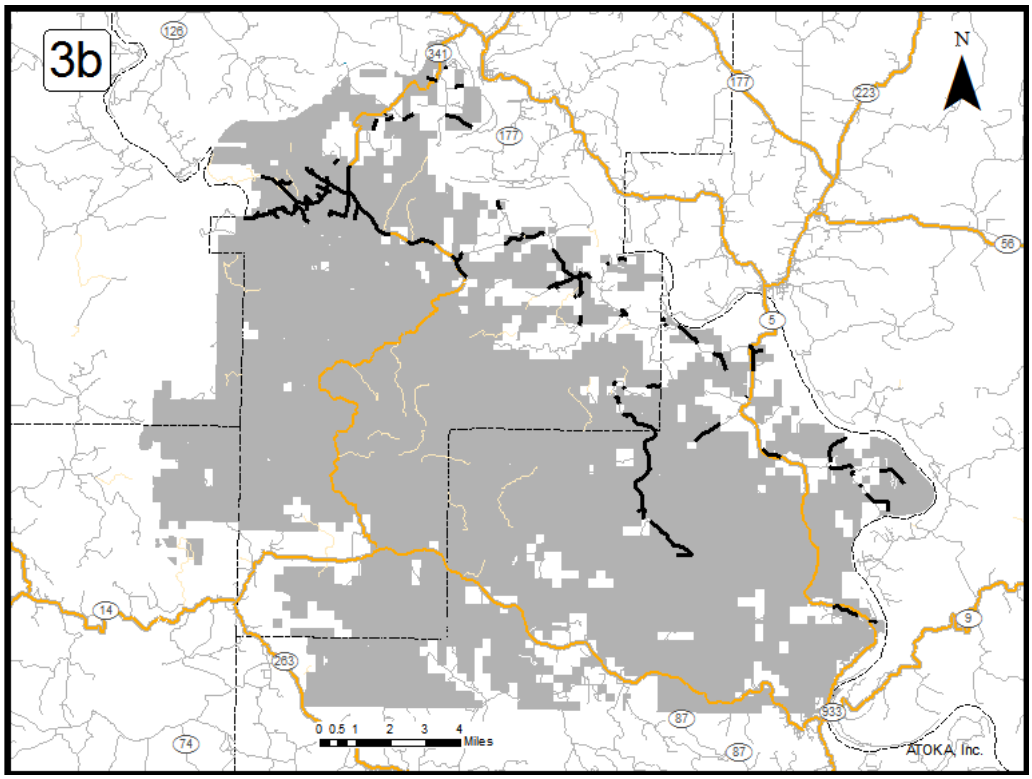

Figure 3b –Ozark National Forest

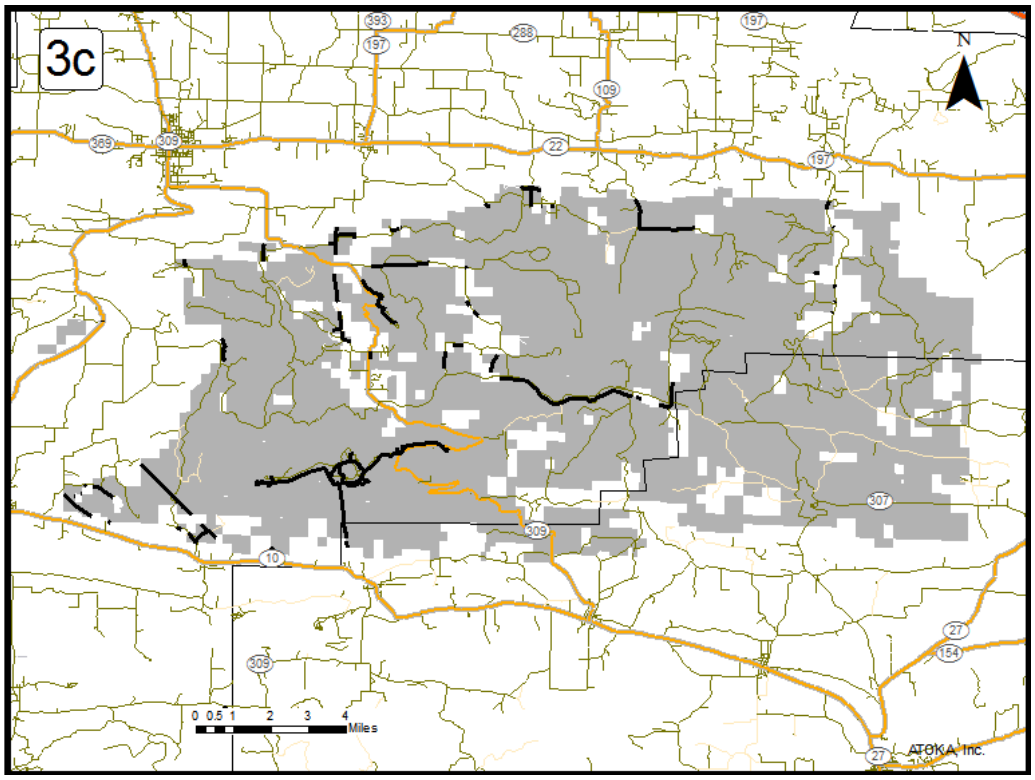

Figure 3c –Ozark National Forest

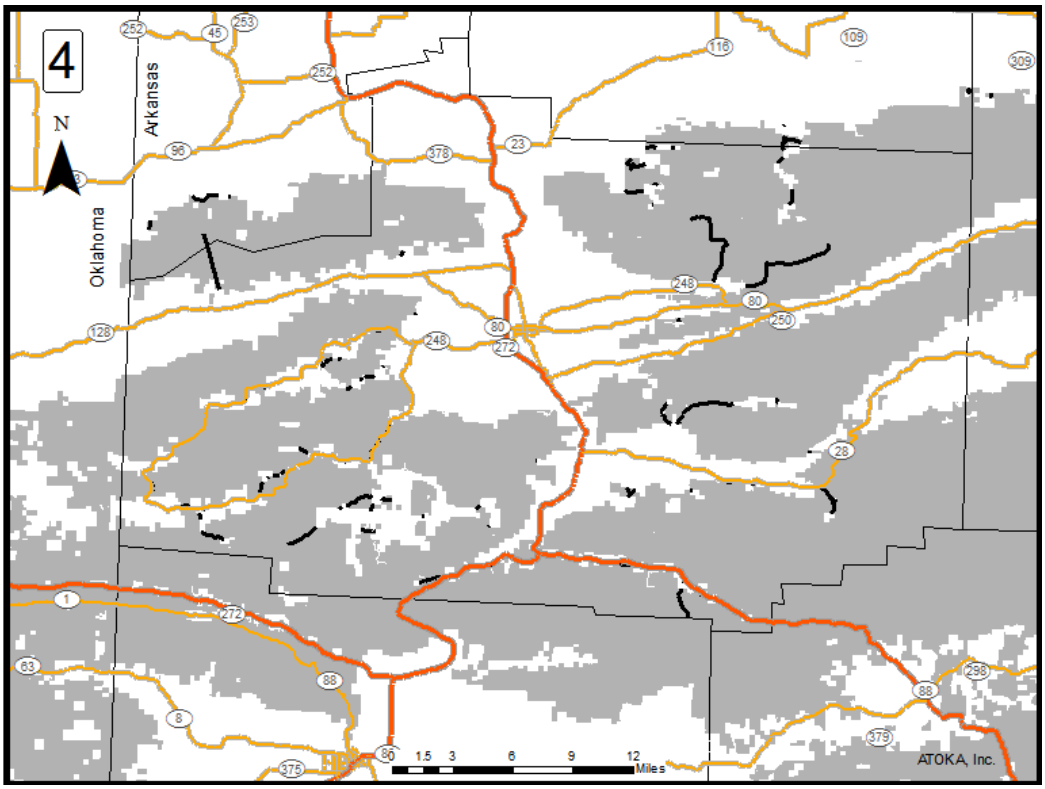

Figure 4 – Ouachita National Forest Analysis Area Overview

As previously stated, the rural electric cooperatives corridors through National Forest have been established for many years and the companies must maintain these ROWs to ensure reliable electric service to cooperative members, communities and the public. The following sections, Alternative 1 (No Action) and Alternative 2 (Proposed Action), describe the processes of each vegetation management option and compare the differences between them.

ALTERNATIVES

Alternative 1 - No Action

Under the No Action Alternative, current management plans and existing permits would continue to guide management of the ROWs. No herbicides would be used for vegetation management on ROWs crossing National Forest lands. Only mechanical methods of vegetation control would continue to be utilized in the ROWs.

The mechanical methods currently employed on National Forest ROWs consist of the use of various types of heavy equipment, extendable booms, cutters and trimmers, as well as skidder type units. Some handheld equipment such as axes and chain saws are also utilized. Representative photos of the heavy equipment used in ROW maintenance are provided below.

Heavy equipment with both tires and tracks is currently permitted for use to maintain vegetation control within the ROW areas. Extendable booms with cutters are used to target larger trees, and other types of equipment use heavy mower-like units to clear large areas of vegetation in the ROW, including the entire ROW.

The use of only mechanical methods requires that heavy equipment access all segments of the electric utility corridors approximately every two to three years to prevent the re-establishment of large trees that could affect power line integrity. To maximize the time between required treatments, the most cost effective mechanical approach is to clear the entire ROW areas, typically by cutting and/or mowing with industrial sized cutters on decks, booms and specialized equipment. This process affects all vegetation in the ROWs, both desirable and undesirable. Larger trees may be targeted for cutting with the extendable booms, however, this process leaves large stumps that are access obstructions and often continue to sprout and require frequent re-treatment.

Generalized cutting with heavy equipment immediately controls the potentially damaging woody vegetation, but does not stop the re-growth of woody stems. With mechanical cutting only, woody stem plants remain viable and typically re-sprout.

Alternative 2 - Proposed Action

The participating rural electric cooperatives propose to use Forest Service and EPA-registered herbicides and herbicide mixtures to control specific woody stem vegetation within existing previously constructed utility corridors located on Federal Lands. Application of herbicide mixtures would be by individuals walking along the ROWs, using low-pressure backpack sprayers to target woody stem vegetation only.

Photographer: ***USDA Forest Service - Region 8***

The rural electric cooperatives currently use, and previously have used, a variety of herbicide products and mixtures for the management of target vegetation on ROW corridors located on other public and non-public lands. The use of these herbicides and mixtures has been proven safe, effective and efficient, and the rural

electric companies desire to utilize these treatment methods on ROWs crossing National Forest properties.

As presented in the Proposed Action section, the proposed chemical herbicides include commercial formulations of glyphosate, imazapyr, metsulfuron methyl, picloram and triclopyr. Table 3 lists some common brand names of commercial formulations containing these active ingredients, the EPA registration numbers, CAS numbers and percentages of the active ingredients. The USDA Forest Service has prepared risk assessments for the active ingredients in the proposed commercial products and all are authorized for use by the Forest Service under the Revised Land and Resource Management Plans (USDA Forest Service 2005d,e). All proposed products are approved by the EPA and USDA for silvicultural use.

The proposed herbicide products may be used in either the Foliage Mixture Spray or Hack and Squirt (Frilling and Injection) method applications described above. Application rates will not exceed those stated on manufacturers' labeling. The combinations of products and water shown in Tables 2 through 5 above are for illustrative purposes only. Actual field configurations will vary as determined by licensed applicators. Specific herbicide and water combinations are developed for each company by their licensed applicators and contractors to accommodate the site conditions of the particular area, buffer area considerations, if any, and in keeping with regulations and manufacturer's recommendations.

Procedures would be supervised or conducted by a licensed applicator to ensure that proper mixing, application, clean-up, personal protection, and safety procedures are followed. Material Safety Data Sheets (MSDSs) are provided by the manufacturer for each product.

Sample mixtures and application procedures for the Foliage Mixture Spray and Hack and Squirt herbicide treatment processes are described in the Proposed Action section above and are summarized below.

Foliage Mixture Spray and Procedures

Foliage Mixture Spray (commercial herbicide formulations and water mixture) is designed for select application to the foliage of woody stem vegetation, including brush and trees, within the utility ROWs. Grasses and other types of non-woody vegetation are not treated. No broadcast or aerial spraying would be conducted, and no products would be applied on the ground or on surface waters. The Foliage Mixture is applied by individuals using low-pressure backpack hand sprayers, walking the utility corridor ROWs.

As noted below, typical foliage mixtures are approximately 95 percent water and five percent combined chemicals. Participating electric cooperatives estimate that an average of 10 gallons of Foliage Spray Mixture is used per acre on initial treatments of non-public ROWs. Accordingly, 10 gallons of the foliage spray mixture applied to each acre contains approximately one-half gallon of commercial herbicide formulations. The commercial herbicide formulations are themselves mixtures of active chemicals and inert properties, further reducing the actual amount of active herbicides applied to target vegetation.

Table 2 above provides an example of a Foliage Spray Mixture. Combinations of products and water are for illustrative purposes only, and actual field configurations will vary as needed. Specific combinations are developed by each company and their contractors to accommodate the site conditions of the particular area, buffer area considerations, if any, and in keeping with regulations and manufacturer's recommendations. Table 4 illustrates the approximate amounts and percentages of the active ingredients in the 100-gallon Foliage Spray Mixture.

As shown in Table 4, 100 gallons of the Sample Foliage Mixture Spray would contain approximately 94.5 gallons of water, 2.66 gallons of inert ingredients and 2.84 gallons of active herbicide ingredients. Therefore, less than three percent of the Sample Foliage Mixture Spray applied to target woody stem foliage in ROWs would be active herbicides.

Woody stem vegetation over specified diameters and heights requires a different method of application, which is addressed below as the Hack and Squirt method. This method may be referred to as "Frilling and Injection" in some documents.

Hack and Squirt Mixture and Procedures

The Hack and Squirt method is used as a selective treatment for larger woody stem vegetation unsuitable for Foliage Mixture Spray treatment. Brush or trees six feet tall or greater, or three inches in diameter or greater, are typically more effectively managed by this method.

The Hack and Squirt process includes the field selection of woody stems too large to be effectively treated with the Foliage Mixture Spray. Once these stems are identified, the field crews cut, or hack, a ring of cup-like pockets around the stem into the cambium layer. The Hack and Squirt Mixture is then applied directly into the cut stem area at an approximate ratio of 1 cc per one-inch diameter of stem (i.e. a four-inch stem would be treated around the cut ring with approximately 4 cc mixture). No herbicide or herbicide mixture would be sprayed directly on the ground or into any surface waters.

The Hack and Squirt Mixture is a more concentrated mixture of commercial herbicide formulations and water. Table 5 shows approximate percentages of chemicals and water that are typical of, and may be used in, one gallon of a Hack and Squirt mixture. The approximate percentages of active ingredients are also shown. This more concentrated mixture is approximately 38 percent water, 32 percent inert ingredients and 30 percent active herbicides.

As shown in Table 5, one gallon of a sample Hack and Squirt Mixture contains less than one third gallon of active herbicide ingredients. The amounts of the Hack and Squirt Mixture used over one acre of ROW depends upon the number of larger woody stems present that cannot be effectively treated with the Foliage Spray Mixture. Herbicide treatments decrease over time as woody vegetation is suppressed.

As detailed above, the products proposed for use in the Action Alternative are mixture formulations that include a percentage of active ingredients. Prior to use, these formulations are further diluted with water to create the Foliage Mixture Spray and the Hack and Squirt mixtures. The USDA Forest Service has conducted risk assessments for the active ingredient in each of the proposed products. These studies are referenced throughout this EA and are concentrated on the active ingredients rather than commercial

formulations or diluted mixtures. Other studies, which reference brand names or commercial formulations, are also cited in this EA.

The type of vegetation present in a particular area will determine which herbicide application method is used, and both the Foliage Mixture Spray and the Hack and Squirt treatments may be used in the same area.

The rural electric companies propose to maintain the footprints of the existing power lines and use silvicultural herbicide treatment only on the established ROWs of each respective power line. As noted above, the ROW area where vegetation management activities are required is approximately 2,563 acres, located in portions of the Ozark and Ouachita National Forests in Arkansas.

The suppression of the target vegetation is the desired result of the proposed Action Alternative process, reducing competition on, and support the propagation of, desirable, low-growing species. The treated woody stems will turn to mulch gradually over time, reducing the potential for heavy coverage of desirable species and providing soil nutrients through decomposition.

Some treated woody stems may re-sprout over time, and these would be retreated as necessary. The consistent use of herbicides on woody stem vegetation only as needed, along with the elimination of heavy equipment for mechanical cutting, allows the development of grasses and other desirable herbaceous species in the ROW areas.

Targeted herbicide use as proposed in this Action Alternative has reduced the level and frequency of maintenance activities required in the rural electric companies' ROWs on non-forest lands. One of the participating cooperatives, Arkansas Valley Electric Cooperative, received a finalist award for the 2006 Quality Vegetation Management Project Habitat for their efforts in ROW management with use of herbicides.

MITIGATION FOR THE ACTION ALTERNATIVE _____

For the purpose of this EA, mitigation is defined as an action taken to avoid, minimize, reduce, eliminate or rectify the impact of a management practice. Mitigation measures refer to actions implemented to reduce environmental effects of specific human activities.

In response to public comments provided during the Scoping Process of this EA and issues identified during this study, mitigation measures were developed, where applicable, to address relevant potential concerns regarding the proposed Action Alternative and its potential effects to the environment.

USDA Forest Service Risk Assessments and other studies conducted on the active ingredients in the commercial herbicide formulations proposed within the Action Alternative were reviewed and analyzed. The issues or concerns identified throughout the EA and the public input processes are summarized in the Issues section above and are addressed in the Environmental Consequences sections below. These concerns generally fall under the categories of human health and safety and the environment, and many can be addressed simultaneously.

Most of the concerns identified in the Issues section above will be mitigated by:

- Adhering to Forest Plan directives regarding herbicide use;

- Following all manufacturers' label, mixing and use directions;
- Ensuring that applicators are properly trained;
- Utilizing the proper personal protective equipment (PPE) for workers applying and mixing herbicides;
- Supervision by a licensed pesticide applicator; and
- Utilizing Best Management Practices (BMPs).

Potential risks to the environment as well as to human safety from herbicides proposed for use within the Action Alternative would typically be from spills or accidental exposure. Additional mitigation measures to reduce the potential for spills include using premixed products that require minimal handling; mixing and filling of application equipment outside the ROW areas on roadways or cleared areas; and ensuring that spraying crews and contractors have a spill prevention and emergency response plan.

Mitigation measures to reduce the potential for accidental exposure to workers primarily include proper training and use of PPE, as well as the other measures noted above. As noted in the USDA Forest Service Risk Assessments, the risk of accidental dermal or oral exposure to the public from forestry herbicide use is highly implausible, and no additional mitigation measures were identified.

Concerns regarding the ingestion of herbicide-treated fruits are addressed in the USDA Risk Assessments (USDA Forest Service 2003 a,b,d,e), and the potential for exceeding a level of concern was determined to be unlikely. Herbicides typically work on ways specific to plants, and the compounds have been found to pass through mammal digestion tracts unchanged. Wildlife ingesting freshly treated foliage would therefore not be at risk or present a risk through human consumption.

As noted throughout this EA, no aerial, broadcast, ground or water applications of herbicides would be conducted. Application by backpack sprayers to specific target vegetation significantly reduces the potential for non-target vegetation and off-site properties to be affected. Additional measures identified to mitigate the potential for airborne drift, or run-off to adjacent private properties or nearby water resources include:

- Employing training and supervision to ensure that only target woody stem vegetation is treated and that proper spraying techniques are used;
- Applying herbicides only when wind speeds are low and no precipitation is forecast;
- Training applicators to identify sensitive areas such as sinkholes and other karst features, and to contact the supervising licensed applicator for guidance as needed;
- Ensuring that herbicides are applied within National Forests only in the ROWs;
- Sampling of streams and water bodies adjoining the treatment areas, as provided in the Forest Service approved Sampling and Analysis Plan (Appendix 4); and
- Ensuring the supervision and coordination of all National Forest herbicide activities by Forest Service personnel.

In addition to all the above, mitigation measures for ensuring environmental and wildlife protection, including Threatened, Endangered, Protected and Sensitive Species, are:

- Adherence to Forest Service-directed streamside and riparian buffer zones where herbicides are not used, even those approved for aquatic usage.
- Managing target vegetation identified within non-treatable buffer areas through hand and mechanical means only;
- Picloram will not be used in American Burying Beetle Areas

As noted elsewhere, no PETS buffer or mitigation requirements are currently in effect for the analysis area ROWs vegetation management practices of using mechanical methods only. The application of herbicides provides significantly less potential for physical disturbance and impact to sensitive species than the current mechanical methods. Therefore, additional mitigation activities for the physical application process would not be necessary.

Picloram: According to the Forest Plan and Forest Service herbicide activities within the Ouachita National Forest, picloram may only be used to control kudzu. Due to the potential presence of invasive species in any forest, and the potential for the Forest Service to use picloram for its control, the use of picloram in the Ozark National Forest should be coordinated with the Forest Service to mitigate any potential for multiple treatments in the same area during the same period.

As an additional mitigation measure, Picloram will not be used in American Burying Beetle Areas. Picloram may also be eliminated from herbicide mixtures.

Additionally, selective herbicide use proposed within the Action Alternative can be considered a mitigation action to reduce the adverse effects to fish and wildlife populations within the analysis area from ROW management by mechanical means only. Along with direct individual mortality, nest destruction and degrading wildlife habitat, mechanical methods produce high levels of noise, which can have adverse effects on sensitive species and these adverse effects would be reduced or eliminated by the implementation of the proposed Action Alternative. Mechanical methods for ROW maintenance are also ineffective at controlling non-native invasive plants and are known to facilitate their spread into sensitive habitats, further degrading wildlife habitat.

The safety of silvicultural herbicides is an integral part of this study, and the proposed herbicides and their potential effects are addressed individually and collectively throughout this assessment relative to each affected environment. Accordingly, the Forest Service has long utilized herbicides for approved projects on Forest Service lands. Application of herbicides according to manufacturer's recommendations, in accordance with applicable BMPs and in compliance with Forest Service goals and directives regarding pesticide use further ensures that environmental resources and human safety are protected.

Adherence to Forest Service herbicide application standards, regulations and mitigation measures should help to maintain the ecological conditions that now support a diverse range of sensitive terrestrial, aquatic and semi-aquatic flora and fauna inhabiting the Ozark and Ouachita National Forests. These regulations are restated in the biological sections and are referenced as applicable for individual species.

COMPARISON OF ALTERNATIVES

This section provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 7 – Summary of Cumulative, Direct and Indirect Environmental Effects for the No Action and Action Alternatives

Resource	Alternative 1 No Action Alternative Mechanical Methods	Alternative 2 Proposed Action Alternative Approved Herbicide Treatment
Geology and Soils	Mechanical methods may provide minor cumulative adverse effects on the geology and soils through the increased potential for compaction, erosion and exposure of geologic features. Increased erosion could potentially expose karst features currently covered by residuum. However, no significant adverse effects to analysis area geology and soils are expected.	Herbicide methods would reduce or eliminate the use of heavy equipment, reducing soil erosion potential. No cumulative adverse effects on the geology or soils are expected, however, herbicide use should be restricted where karst features are exposed. Herbicidal suppression of woody stems allows dense herbaceous groundcover to propagate, helping hold soils in place and providing minor to moderate cumulative beneficial effects to the soils.
Hydrology and Water Quality	Mechanized equipment can contribute to soil erosion and sedimentation of streams and water bodies, as well as uncover karst features, allowing unfiltered runoff to more easily penetrate the uppermost aquifer. The resulting increase in total dissolved solid contamination would provide potential localized minor, immediate and cumulative adverse effects on water quality. However, no significant adverse effects to source waters or water quality are expected.	Herbicide use would end the cycle of disturbance, providing increased soil stability. Erosion potential and resulting sedimentation in water would be reduced, creating minor immediate and cumulative beneficial effects. Herbicides would not be applied to soils, water bodies or buffer zones. Following manufacturers and Forest Service directives, there are no significant immediate or cumulative adverse effects on source waters or water quality.
Climate	Carbon emissions from heavy equipment have been implicated as a cause of global warming, however, no observable immediate or cumulative effects on climate conditions would result from continuing ROW mechanical vegetation control.	The use of herbicides for vegetation control within ROWs would have no known or observable immediate or cumulative effects on the climate conditions. Carbon emissions from the use of heavy equipment would be reduced or eliminated.
Air Quality and Noise	Localized dust, exhaust and noise can be created in ROWs during maintenance activities. Mechanical cutting activities can disturb wildlife, especially during mating and nesting periods. Minor immediate adverse effects during the maintenance activities would continue. No beneficial or adverse cumulative effects were identified.	Air pollution from the volatization of proposed herbicides is extremely unlikely due to the application methods and low volumes. No significant or cumulative adverse effects to air quality would occur. Minor immediate and cumulative beneficial effects would be realized from heavy equipment noise reduction.

Table 7 – Continued

Resource	Alternative 1 No Action Alternative Mechanical Methods	Alternative 2 Proposed Action Alternative Approved Herbicide Treatment
Vegetation Communities	Mechanical methods are non-selective and all vegetation within the ROW is cut, putting any sensitive plant species present at risk of disturbance. Mechanical methods for ROW maintenance will continue to have moderate immediate and minor cumulative adverse effects on vegetation communities within power line ROWs by perpetuating the constant cycle of disturbance.	Herbicide application would be highly specific and pose no significant immediate or cumulative adverse effects to non-target vegetation communities in the activity or analysis areas. Continued disturbance is reduced or eliminated, allowing for the development of herbaceous ground cover and improved wildlife habitat and providing minor immediate and cumulative beneficial effects.
Riparian, Wetland and Floodplain Areas	Mechanical methods can cause problems when used in wetland, floodplain and riparian areas, and the potential for adverse effects, primarily due to erosion, does exist. However, if riparian area protection measures are followed, continuing mechanical vegetation control will have no additional significant direct, indirect, immediate or cumulative effects (adverse or beneficial) on wetland, floodplain, or riparian areas within the analysis area.	Herbicide use promotes the establishment of a permanent herbaceous/shrub vegetation community that provides increased soil stability, which reduces the potential for erosion and resulting sedimentation. No significant immediate or cumulative adverse effects to riparian areas within the project area are expected. Minor immediate and moderate beneficial cumulative effects from reducing current erosional processes and the subsequent siltation of streams and wetlands are anticipated.
Fish and Wildlife	The use of heavy equipment for vegetation maintenance may degrade fish and wildlife habitat, disturb sensitive species during mating and cause the mortality of slow moving individuals inhabiting ROWs, providing a minor immediate adverse effect. However, no significant adverse cumulative effects to wildlife and fish populations' viability within the analysis area are expected.	Herbicide treatments target biochemical pathways unique to plants, do not persist in the environment and are nontoxic to fish and wildlife at normal application rates. No direct, indirect or cumulative adverse effects are expected. Immediate and moderate cumulative direct beneficial effects are expected from reducing or eliminating wildlife exposure to mechanical equipment and by creating early successional habitat.
(PETS) Proposed, Endangered, Threatened and Sensitive Species	Heavy equipment use has the immediate minor effect of impacting wildlife and habitat within ROWs, however, the activity is not likely to cause a population viability loss that could lead to Federal listings of PETS species, therefore, no significant cumulative adverse effects are anticipated by continuing mechanical methods.	Herbicide use provides immediate and cumulative direct moderate beneficial effects by creating early successional habitat important to a variety of PETS species for food, cover and reproduction, and by indirectly reducing adverse impacts applicable to mechanical maintenance methods. No known direct, indirect or cumulative adverse effects are expected.
MIS	Rapid re-growth of woody stems necessitates frequent re-treatment, creating a constant cycle of disturbance. Minor adverse effects on water quality and aquatic species habitat from frequent use of heavy equipment are possible; however, no adverse long-term population trends of aquatic or terrestrial MIS within the analysis area are expected.	Herbicide use should develop a semi-permanent early successional community in ROWs, providing quality habitat for many MIS within the analysis area. However, it is not expected to significantly affect the long-term population trends of terrestrial MIS. Herbicides applied according to guidelines would provide no adverse effects to aquatic MIS within the analysis area.

Table 7 – Continued

Resource	Alternative 1 No Action Alternative Mechanical Methods	Alternative 2 Proposed Action Alternative Approved Herbicide Treatment
Cultural Resources	Historical or cultural sites have been identified in the ROWs. The continued use of mechanical methods would provide no significant adverse effects to identified historic or cultural properties. Unknown resources could be adversely impacted by heavy machinery. Maintaining ROWs is critical to providing reliable electric service, which is an essential community value and provides significant immediate and cumulative beneficial effects.	Historical or cultural sites have been identified in the ROWs. Unknown resources would not be adversely affected by herbicide use. The low-impact of herbicide application would protect any unidentified historic or cultural resources from impact with heavy equipment, providing an immediate and cumulative beneficial effect. Maintaining ROWs is critical to providing reliable electric service, which is an essential community value and provides significant immediate and cumulative beneficial effects.
Socioeconomic Considerations	Reliable electric service would continue to be maintained using mechanical methods. Costs of mechanical equipment use would adjust according to market conditions, affecting consumer electricity costs. The current condition of rising maintenance costs could result in higher electricity costs, providing immediate and cumulative adverse effects.	Reliable electric service would be maintained by treating only target woody stem vegetation with herbicide, which is appreciably less expensive than mechanical methods. Maintenance costs are expected to be reduced approximately 70%-93% resulting in lower costs for electricity and providing a moderate cumulative beneficial effect to the socioeconomic condition.
Recreation and Scenic Integrity	No change in current recreation options and opportunities within the analysis area would be expected. Mechanical methods. would continue to produce minor to moderate immediate and cumulative adverse effects to recreation and scenic integrity by degrading both the scenic beauty and habitat quality of power line ROWs within the activity area. However, ROWs will continue to remain open; therefore, no significant cumulative effects, adverse or beneficial, to recreation or scenic integrity to the greater National Forests are expected.	Herbicide treatment beneficially affects scenic integrity by reducing competition from woody vegetation on grasses and flowering species that enhance viewing opportunities as well as providing improved habitat for species such as quail, turkey, songbirds and butterflies. A minor immediate adverse effect to scenic integrity due to initial die-off of woody vegetation is expected. However, as non-woody vegetation reclaims the area, both the scenic beauty and habitat quality of ROWs would be improved, creating minor to moderate cumulative beneficial effects to the recreation and scenic integrity.
Human Safety	Effects to human safety include the inherent risks associated with mechanized and cutting equipment. Maintaining ROWs to provide reliable electric service to support social infrastructure, and subsequently human safety, would continue, providing immediate and cumulative beneficial effect by maintaining social infrastructure.	The proposed herbicides target biochemical pathways unique to plants, do not accumulate in human tissue and are passed through the body without significant effect. Application methods and quantities proposed present little, if any, risk to the public. A minor adverse risk to applicators from overexposure is possible; however, no significant immediate or cumulative adverse effects to workers or the general public are anticipated. Maintaining ROWs to provide reliable electric service to support social infrastructure, and subsequently human safety, provides immediate and cumulative beneficial effects.

ENVIRONMENTAL CONSEQUENCES

This Environmental Consequences section summarizes the physical, biological, social and economic environments of the affected analysis area and the potential changes to those environments due to implementation of the alternatives. This section also presents the scientific and analytical basis for comparison of alternatives presented in the table above.

The participating rural electric cooperatives maintain approximately 425 miles of transmission and distribution lines that cross National Forest properties. The majority of the lines are located in the Ozark National Forest, with smaller sections in the Ouachita National Forest. Approximate mileages of power lines were obtained by digitizing each rural electric company's truck maps and calculating mileages using ArcView GIS.

Right-of-way widths vary from as little as 20 feet to as much as 100 feet, with the average being 40-60 feet. For the purposes of this project, estimated ROW area acreages were determined by using an average width of 50 feet. The ROW areas, referred to herein as the activity area, comprise approximately 2,563 acres, all of which is currently being managed for vegetation control through mechanical means only.

The rural electric cooperatives propose to maintain the footprints of the existing power lines and to add the use of silvicultural herbicides to the vegetation management of these established ROWs. The proposed Action Alternative includes the same ROW area of approximately 2,563 acres, with selective herbicide treatment to only targeted woody stem vegetation within the established ROWs.

Analysis area acreages for scientific studies were estimated by adding a 300-foot buffer area on each side of the centerline of the power line ROW for a maximum study area of 600 feet. Vegetation and geologic studies were conducted on areas 100 feet on either side of the power line, and wildlife studies were conducted over the entire 600-foot estimated analysis area. Mileage and acreage details by forest are provided in Table 6. Where multiple power lines exist within the 600-foot analysis area, acreage figures have been calculated to include buffer areas only once (See Table 6). Studies were conducted for the larger analysis areas, however, proposed herbicides would only be applied to target vegetation within the established power line ROWs (activity area).

The analysis area investigated for this Environmental Assessment encompassed a maximum area of approximately 29,381 acres. The following information is provided as an ecological overview of the analysis area with details of the various ecoregions that encompass the two National Forests. The biological and ecological studies in this assessment pertain to the analysis area, portions of which are included in the following designated areas known as ecoregions.

North America is divided into 15 ecological regions, or ecoregions. The analysis area is located in Level I Eastern Temperate Forests Ecoregion. Level II ecoregions are intended to provide a more detailed description of the Level I regions, and are useful for national and sub-continental synopses of physiography, wildlife and land use. The project is located in Level II Ozark, Ouachita-Appalachian Forests' Ecoregion. Level III ecoregions describe distinct ecological areas within level II regions and Level IV

ecoregions are further subdivisions of level III. For the purposes of this EA, focus is centralized on level III and IV ecoregions.

Within the analysis area, there are four level III ecoregions. They are:

- Arkansas River Valley
- Boston Mountains
- Ouachita Mountains
- Ozark Highlands

The analysis area can further be broken down into eight level IV ecoregions which are: Arkansas Valley Hills, Arkansas Valley Plains; Scattered High Ridges and Mountains; Lower Boston Mountains; Upper Boston Mountains; Fourche Mountains; Springfield Plateau; and White River Hills. Extensive descriptions of each ecoregion, including predominant topography, vegetation and economic activities, are provided in Appendix 5.

The scientific evaluations presented below include the following categories:

- Geology and Soils
- Hydrology and Water Quality
- Climate
- Air Quality and Noise
- Vegetation Communities
- Riparian Areas
- Fish and Wildlife
- Threatened, Endangered, Sensitive and Species Proposed for Listing (PETS)
- Cultural Resources
- Socioeconomic Considerations
- Recreation and Scenic Integrity
- Human Safety

Each category is structured to present the current conditions of the analysis area under the heading "Affected Environment." Two sections, Alternative 1 and Alternative 2, contain the potential effects (beneficial and adverse, immediate and cumulative) of each alternative.

GEOLOGY AND SOILS

Affected Environment

The U.S. Interior Highlands is a mountainous region spanning eastern Oklahoma, western and northern Arkansas, southern Missouri, and the extreme southeast corner of Kansas. The name is designated by the United States Geological Survey to refer to the combined mountainous region of the Ozarks and Ouachita Mountains, which form a distinct physiographic division. It is the only major highland region between the Rocky Mountains and the Appalachian Mountains in the United States.

The portions of the Ozark and Ouachita National Forests within the project area are located within the Interior Highlands geologic province, which is subdivided into the varied geography of the Salem and Springfield Plateaus, the Ozark and Ouachita Mountains, and the Arkoma Basin (see Appendix 6).

In the project area, there are two predominant area categories, the Ouachita Mountains and the Ozark Plateau, which are divided by the Arkoma Basin. The specific formations for each area are detailed below.

Soils included in this report are confined to those specific soil associations to be encountered along the respective power line ROWs within the National Forests identified above. According to the US Soil Conservation Service, a soil association is made up of adjacent soil series that occur as areas large enough to be shown individually on the soil map, but which are shown as one unit because the time and effort of delineating them separately cannot be justified.

Listings of the soil associations and general descriptions of each soil series encountered within the power line ROWs in each of the counties included in this report are presented in Appendix 6. The soil descriptions were obtained from the online Official Soil Series Description provided by the Soil Survey Staff, USDA Natural Resources Conservation Service. Each description provides general information on soil depth, drainage, permeability, source, location and slope.

There is existing erosion in some of the areas proposed for treatment with herbicides. The erosion has taken place primarily in those areas characterized by steeper slopes. This erosion, in some cases, may be related to the use of mechanized equipment for vegetation control. Tracks left by this mechanized equipment may also encourage traffic by other users, which also contributes to the erosion potential.

Detailed discussions of the geologic formations and soil series found within the study area are provided in Appendix 6.

The Ouachita Mountains are an east to west trending range that were thrust upward and are highly faulted and folded. These formerly lofty peaks have been eroded since the Permian and Jurassic Geologic Periods to provide the thick sediments now comprising the Mississippi River deltaic environment of eastern Arkansas and southward. The remaining hills are heavily timbered and highly dissected by erosional features.

The Ozark Plateau consists of rugged hills and deep valleys. This highly dissected environment contains deep river-eroded gorges, with as much as 1500 feet of local relief.

The Arkansas River Valley separates the Ozark Plateau to the north and the Ouachita Mountains to the south. There are a few mountains in this province, with Magazine Mountain being the highest elevation in Arkansas.

All three of the geologic provinces within the study area were sculpted to their current state by erosional processes of streams and rivers cutting through the various formations.

The most sensitive geologic resources within the analysis area are those characterized by karst topographies. These are primarily found in the northwest and north central portions of Arkansas. Karst environments, especially where not thickly covered by top soils or residuum, are vulnerable to rapid infiltration of precipitation and any associated contaminants to underlying freshwater aquifers.

The primary concern with soils in the study area is the potential for erosion. Those soils found on steep slopes are especially vulnerable to rapid erosion where vegetation cover is removed or disturbed.

Another concern is the effects of herbicides on soil microorganisms. A single handful of soil may contain thousands of different species of bacteria (most of which have yet to be classified), hundreds of different species of fungi and protozoa, dozens of different species of nematodes plus various mites and other microarthropods. The abundance and species composition of soil microorganisms is dependent on the soil type and amount of organic matter present.

Separate evaluations for determining the Affected Environment for Geology and Soils were conducted. However, due to the symbiotic nature of topics, the effects of the alternatives are discussed collectively.

ALTERNATIVE 1: NO ACTION

Geology and Soils

The no Action Alternative is the current method of vegetation control along power line ROWs within the analysis area. This alternative would require the rural electric cooperatives to continue to manage vegetation within ROWs by mechanical means only, including, hand tools and heavy equipment. The use of only mechanical methods requires that heavy equipment access the electric utility corridors approximately every two to three years to prevent the re-establishment of trees that could affect power line integrity. This process affects all vegetation in the ROWs, both desirable and undesirable.

Whether equipped with rubber tires or metal tracks, heavy equipment affects the ground it moves across in a variety of ways. The weight of the heavy equipment may create both breaks in and compaction of the soil, and tire or track marks imprinted into the ground can destroy vegetation as well as the root structures that help hold the soil in place. Mulch created during the cutting process may provide some cushion for tires or tracks driving over the area, however, some compaction is likely to occur.

Impacts to the physical characteristics of soils from heavy equipment may affect both hydrologic function and site productivity (Neary 1996). Compaction from heavy equipment can increase the porosity and infiltration rates in some locations and decrease them elsewhere, and may also result in the compaction of clay and silt textured soils, which reduce soil macroporosity. The result is decreased rooting volumes and moisture

storage capacity for desirable ground cover vegetation. These impacts can affect the ability of plants to obtain water and nutrients necessary to sustain productivity. Vegetation control by heavy mechanical equipment may also leave areas of bare soil, which would be vulnerable to erosion, increasing the potential for precipitation run-off to expose underlying geologic features. Also in the wake of heavy mechanical use, unintentional trails are created that OHV users can exploit causing an increase in damage to ecosystems.

Because soils serve as a filter for the percolation of precipitation into the groundwater system, erosion of soils may affect the geology and hydrogeology along the ROWs. The potential erosion of the soils along the power line ROWs could expose fractures and joints in the underlying bedrock and, in some areas, karst features, if present. Carbonate geology was identified by geologic mapping in Baxter, Stone, northern Newton, Benton, Washington and Crawford Counties in Arkansas. Some of these carbonate formations, especially the Boone Formation; have the potential for karst features to be present. Any bedrock exposed by erosion of soils along the ROWs would allow the percolation of unfiltered precipitation directly into the groundwater system through exposed or partially exposed fractures, joints and karst features, such as sinkholes.

Under certain conditions, the mulch produced from mechanical cutting may be sufficient to provide some flow disruption and slow run-off, providing a potential reduction to the erosional process. More likely, however, is that precipitation falling in the equipment track marks has the potential to flow off the compacted areas, creating erosional pathways in the loosened areas that allow soils and mulch to be carried into waterways, which can increase sedimentation and adversely affect aquatic habitats. Similarly, this silt-laden flow may reach exposed fractures, faults or karst features, creating infiltration.

Mulch, particularly from cut grasses and other leafy plants, decomposes over time providing some nutrients to the soil, however, thick layers of grass and brushy mulch may compact on top of vegetation and suppress less hardy and desirable plant species as well as create fuel sources for fires during dry periods.

Managing the entire ROW by mechanical methods creates a pattern of continued regrowth and expansion of undesired woody stems and repeated suppression of less dominant desirable ROW vegetation. Many woody species re-sprout quickly from stems or stumps, providing continuing competition with the desirable grasses and other vegetation that can help hold the soils in place and reduce the potential for erosion.

The current use of mechanical methods along the ROWs is unlikely to create the potential for additional unstable slopes; however, the repeated use of heavy equipment would have a minor cumulative adverse effect on the geology and soils of the area through the increased potential for compaction, erosion and exposure of geologic features.

ALTERNATIVE 2: PROPOSED ACTION

Geology and Soils

The use of herbicides for vegetation control reduces or eliminates the use of heavy equipment, which diminishes the impacts on the porosity and infiltration rates of analysis area soils and geology. The reduction or elimination of heavy equipment impacts on silty and clay soils would, over time, lessen the compaction of these soils and the corresponding decrease in macroporosity. In areas with sandy textured soils, the

decreased use of heavy equipment would result in reduced impacts on the soils vegetative cover, therefore minimizing the effects to porosity of the soil. The Proposed Action of adding herbicides to the ROW vegetation management would provide minimal, if any, disturbance of soil, reducing the likelihood of soil erosion and the subsequent potential adverse effects on water quality and aquatic habitat from siltation.

A study of the geologic maps of the region identified carbonate geology in Baxter, Stone, northern Newton, Benton, Washington and Crawford Counties in Arkansas. Some of these carbonate formations, especially the Boone Formation; have the potential for karst features to be present. However, no karst features were observed along the ROWs during field investigations. Any bedrock exposed by erosion of soils along the ROWs would allow the percolation of unfiltered precipitation directly into the groundwater system through fractures, joints and karst features, such as sinkholes.

The proposed action would maintain or improve the existing soil precipitation filter over the fractures, joints and karst features of the underlying carbonate bedrock. The maintenance of the soil cover would lessen the impact of unfiltered precipitation entering the hydrogeologic environment.

The proposed Action Alternative would support the creation of stable slopes. The use of herbicides would decrease or eliminate the need for mechanical equipment, thereby decreasing the erosion potential of ROW soils. Slopes would become more stabilized through a reduction in erosion potential and through the persistence of low-growing non-woody vegetation and their corresponding root systems.

The effects of herbicide use on the soil depend largely on how much of the active ingredients in the herbicides reach the soil and the persistence of the chemicals used. The herbicides proposed for use within the Action Alternative are not expected to have any significant adverse effects on the soils. Little herbicide should reach the ground since it would be applied directly to the woody vegetation foliage, cut stems and sprouts and would not be ground or area broadcast. The volume of herbicide used would decrease over time, because repeat applications would consist of directed spot treatments of re-sprouts and seedlings and the size of each infestation site would diminish over time. Following the initial treatment sequence, re-application of herbicide is anticipated to be needed at approximately four to five year intervals or longer, and only on target woody stem vegetation. Since soils are not disturbed by herbicide applications, there would be no increase in the potential for the loss of site nutrients through off-site soil movement (erosion).

Glyphosate adsorbs strongly to soil and is not expected to move vertically below the upper six-inch soil layer; therefore, residues of glyphosate are expected to be immobile in soil (US Environmental Protection Agency [US EPA] 1993). Glyphosate remains bound to soil particles until it is degraded. This herbicide is primarily degraded by microbes and fungi in the soil (or in water) to aminomethylphosphoric acid (AMPA), which is also degraded by soil microflora into naturally occurring substances (carbon dioxide, water, phosphate and nitrogen) (Voth et. al. 1998).

Glyphosate has a relatively short to moderate persistence in the environment. The half-life of glyphosate in soil ranges from 2.8 to 60 days (USDA Forest Service 2003e). Dissipation depends on microbial composition and the extent of binding to the soil.

Glyphosate does not accumulate in the soil following multiple applications (Voth et. al. 1998). The accumulation of glyphosate or AMPA in the environment over time is not expected in the treated or adjacent areas (USEPA 1993, Gipsy et. al. 2000).

Relatively little information is available on the toxicity of imazapyr to terrestrial (soil) microorganisms (USDA Forest Service 2003c). In pure culture laboratory assays, imazapyr inhibited the growth of two strains of plant-associated bacteria, *Bacillus subtilis* and *Bacillus circulans*, both isolated from wheat. LC_{50} values ranged from about 10 to 100 uM (Forlani et. al. 1995). Three other species of *Bacillus* as well as several additional soil bacteria were not affected at concentrations up to 1,000 uM. Thus, effects on bacteria appear to be highly species-specific with variation in sensitivity of up to a factor of 100. Consequently, imazapyr does appear to have the potential to shift bacterial soil populations that contain sensitive species of bacteria when applied in high concentrations. Ismail and Wong (1994) speculate that "…the reduction in cellulose degradation is likely to be only a temporary effect" and that the activity of imazapyr on soil microorganisms may decline as the herbicide is adsorbed to soil and thus unavailable to microorganisms.

Soil microorganisms have an enzyme that is involved in the synthesis of branched chain amino acids, which is functionally equivalent to the target enzyme in terrestrial macrophytes (USDA Forest Service 2003b). As detailed in Appendix 3 of the USDA Risk Assessment, metsulfuron methyl at a concentration of 5 ppm in culture inhibited the growth of several strains of *Pseudomonas*. This effect was attributed to acetolactate synthase (ALS) inhibition because the bacteria grew normally with excess amounts of valine, leucine and isoleucine (Boldt and Jackson 1998). The same concentration in soil (i.e., 5 mg/kg) decreased levels of amylase, urease and protease activity in loamy sand and clay loam soil (Ismail et. al. 1998). The reduced amylase and urease levels were apparent for the 28-day observation period; protease activity was reduced on day 7 but recovered by day 14 (Ismail et. al. 1998). At surface application rates of 0.05 to 0.075 kg/ha, transient decreases in soil bacteria were apparent for 3 days but reversed completely after 9 days (Ismail et. al. 1996). Limited data are available on the toxicity of metsulfuron methyl to microorganisms. The toxicity data are expressed in units of soil concentration – i.e., mg of metsulfuron methyl per kg soil, which is equivalent to parts per million (ppm) concentrations in soil (USDA Forest Service 2003b). The GLEAMS modeling discussed in Section 3.2.3.4 of SERA TR 04-43-17-01b provides estimates of concentration in soil as well as estimates of off-site movement (runoff, sediment and percolation). Based on this modeling, concentrations in clay, loam and sand over a wide range of rainfall rates are summarized in Table 4-1 of that publication and indicate that peak soil concentrations of about 6 ppm are likely in relatively arid soils at an application rate of 1 lb a.e./acre. As rainfall rate increases, maximum soil concentrations are substantially reduced in sand and, to a lesser extent, in loam, because of losses from soil through percolation.

Triclopyr can be slightly toxic to bacteria, actinomycetes and fungi (Sapundzhieva 1987 cited in Brown et. al. 1990), but did not affect the growth of soil microorganisms at up to 500 parts per million (USDA 1984). Carbon dioxide and metabolites 3,5,6-trichloro-2-pyrindinol (TCP) and 3,5,6-trichloro-2-methoxypyridine (TMP) are produced by the breakdown of triclopyr. TCP and TMP eventually convert to carbon dioxide (Ganapathy

1997). The warm temperatures at the time of application are expected to assist in the rapid degradation of triclopyr.

In soil, picloram is degraded over time by microorganisms to carbon dioxide and to a much lesser extent water and dilute hydrochloric acid (DowAgroSciences 2002). The half-life of picloram in soil is reported to vary from one month, under favorable conditions to several years, but the average half-life of picloram in soils is 90 days (Tu et. al. 2001). The length of time necessary for picloram to degrade is dependent on a number of factors; the persistence of picloram in soil increases with increasing application rates. In soil column studies cited in the USDA Forest Service Risk Assessment for picloram (USDA Forest Service 2003d), the soil halftimes of picloram were directly related to application rates. Application rates of about 0.4, 0.86 and 1.6 lb/acre were associated with halftimes in soil of 13, 19 and 23 days respectively; the 1.6 lb/acres application rate exceeds the maximum labeled application rate per growing season for the use proposed in this alternative. In general, breakdown of picloram is more rapid under warm moist conditions in high organic matter soils. Alkaline conditions, fine textured clay soils and a low density of plant roots can increase the persistence of picloram.

The mobility of picloram in soils is determined by the adsorption capacity of the soil, soil moisture and post-application rainfall. Picloram chemically attaches to clay particles and organic matter. Picloram absorbed by treated plants, however, can be released into the soil by passive transport through the roots, and can be taken up by roots of other nearby plants (USDA Forest Service 2003d).

At high application rates, picloram may inhibit soil microbial activity (Krzyszowska et. al. 1994). At a level of 10 ppm in sandy loam soil, picloram caused a transient decrease in nitrification after two, but not three, weeks of incubation and had no effect on ammonia formation or sulfur oxidation (Tu et al. 1994). The decrease in nitrification was relatively mild and does not portend a substantial or prolonged impact on microbial activity. Bacteria and fungi can utilize picloram as a single source of carbon and nitrogen. Picloram increases the number of ammonifying bacteria (Spiridonov et al. 1981). The clay portion of many of the soils would help to bind picloram and therefore reduce its potential for transport. The warm weather at the time of application and the acidic soil conditions in many of the application areas proposed for treatment are expected to enhance the breakdown of picloram and reduce the potential for transport and accumulations of products in soils.

Picloram may only be used in the Ouachita National Forest for kudzu control and under the direction of Forest Service personnel.

In summary, the herbicide mixtures proposed for this project are combinations of water and commercial products, which are also mixtures of active and inert ingredients. Herbicide mixtures would be applied only to target woody stem vegetation using the foliage spray method and the hack and squirt method. The selective use of herbicides according to manufacturers' label directions, Forest Plan guidelines and BMPs would suppress woody stem plants while allowing low-growing vegetation to flourish, which assists in stabilizing the soils and reducing erosional processes.

The use of herbicides along ROWs within the National Forests would result in an overall decrease in the erosion of soils due to a reduction or elimination of heavy equipment currently used for vegetation maintenance. A reduction in soil erosion would further protect the underlying geologic features, especially within karst and highly fractured topographic areas. This protection would also provide a filtration of infiltrating waters to the groundwater.

The use of herbicides is not expected to have any immediate or cumulative adverse effects on the geology or soils of the treated ROWs. The selective use of herbicides according to manufacturers' label directions, Forest Plan guidelines and BMPs would suppress woody stem plants while allowing low-growing herbaceous vegetation to flourish, which assists in stabilizing the soil and reducing erosional processes. Therefore, the proposed Action Alternative would provide a minor to moderate cumulative beneficial effect to the soils within the analysis area.

HYDROLOGY AND WATER QUALITY

Hydrology Affected Environment

The Ozark and Ouachita National Forests cover four ecoregions as defined by the Arkansas Department of Environmental Quality (ADEQ) in Regulation No. 2 (Regulations Establishing Water Quality Standards for Surface Waters of the State of Arkansas). These ecoregions are:

- Ozark Highlands,
- Boston Mountains,
- Arkansas River Valley and
- Ouachita Mountains.

Two tracts of the Ozark National Forest located in Baxter and Stone, and Benton and Washington counties are entirely within the Ozark Highlands ecoregion. Tracts of the Ozark National Forest located in the Boston Mountains include portions of northern Crawford, southern Washington, northern Franklin, southern Madison, northern Johnson, southern Newton and northern Pope Counties of Arkansas. The remainder of the Ozark National Forest within the analysis area includes a section of southern Logan County and northern Yell County, which is located in the Arkansas River Valley ecoregion. Those sections of the Ouachita National Forest located in the Ouachita Mountain ecoregion and described in this study include central portions of both Scott and Yell counties.

The Ozark Highlands ecoregion is characterized by mountainous terrain with fast-flowing spring-fed streams. Many of the streams within the Arkansas portion of the ecoregion have been designated as extraordinary resource waters by the Arkansas Department of Environmental Quality (ADEQ). The limestone and dolomite formations of the Ozark Highlands are characterized by fractures, solution cavities and other karst features, which may allow a direct linkage of surface water with groundwater. As a result, water quality in the Ozark Highland ecoregion can be directly affected by land use. The ADEQ cites increased water contamination due to the rise in the human population in this area and the resulting infrastructure development as well as erosion from construction activities. The Ozark Highlands is also the site of some of the highest agricultural animal production rates in the state. The waste from these animal production activities is generally land applied, and therefore, has potential for contamination of both surface and groundwaters.

The Boston Mountains are characterized by mountainous terrain with a sparse population. The dominant land use is silviculture and much of the region is located within the Ozark National Forest. The area has exceptionally high water quality and many of the streams within this ecoregion have been designated as extraordinary resource waters by the ADEQ. The area is characterized by geology consisting predominantly of sandstone and shale. The ADEQ's concerns about potential water quality degradation include conversion of hardwoods to improved pastures, confined animal operations, even-aged timber management and localized natural gas production.

The surface waters of the Arkansas River Valley ecoregion exhibit distinct seasonal characteristics, with zero flows common during the summer. Surface water contamination within this region is from the introduction of agricultural contaminants during peak runoff events. Agricultural activities consist primarily of pasturelands and increasingly, poultry production. The current exploitation of natural gas deposits has resulted in some site-specific water quality degradation. The Arkansas River Valley has experienced a rapid expansion of confined animal activities over the past 15 years.

The Ouachita Mountains ecoregion is listed by the ADEQ as an area with exceptionally high water quality. The predominant land use is silviculture by private timber companies and the National Forest. Potential water quality problems within this ecosystem include possible acidification, erosional and siltification due to poor timber management practices and increased surface water turbidation.

The ADEQ divides Arkansas into six major river basins: the Red River Basin, Ouachita River Basin, Arkansas River Basin, White River Basin, St. Francis River Basin and the Mississippi River Basin. The major river basins for the Ozark and Ouachita National Forests covered by this study include portions of the Ouachita River Basin and Arkansas River Basins. The ADEQ divides these basins into water quality planning segments.

Analysis area ROWs are located within the counties and watersheds described in Table 8.

Table 8 – Watersheds, Segments and Basins by County

County(s)	Watershed	Segment/Basin
Benton/Washington	Illinois River	3J-Neosho
Crawford	Lake Fort Smith-Shepard Springs	3H-Arkansas
Franklin/Johnson/Madison/Newton	Mulberry River	3H-Arkansas
Johnson	Spadra Creek	3H-Arkansas
Pope	Illinois Bayou	3H-Arkansas
Logan	Paris City Lake	3H-Arkansas
Baxter/Stone	White River	4F-White
Scott and Yell	Arkansas River	3E, 3G-Arkansas

The ADEQ has designated waters within Segments 3E, 3G, 3H, 3J and 4F as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, as well as public, industrial and agricultural water supplies. The ADEQ has also designated several streams as Extraordinary Resource Waters and Natural and Scenic Riverways. The Illinois River has been designated as an ecologically sensitive water body by the ADEQ. These designations refer to high quality waters that constitute an outstanding state or national resource, and as such shall be protected by (1) water quality controls, (2)

maintenance of natural flow regime, (3) protection of instream habitat, and (4) encouragement of land management practices protective of the watershed.

Protecting water quality is a priority of the public as well as state and Federal agencies. Certain geologic features such as carbonate geology with karst characteristics are vulnerable to potential contamination by rapid infiltration of precipitation through sinkholes, fractures and solution cavities into the uppermost aquifer.

Carbonate geologies within the analysis area are located in the northwestern and northern portions of Arkansas. Carbonates, especially where not thickly covered by top soils or residuum, are vulnerable to rapid infiltration of any contaminants present to underlying freshwater aquifers. The presence of karst features such as sinkholes, solution cavities or fractures can provide direct access into an uppermost aquifer, and these areas should have designated buffer zones that will not be treated with herbicides. No obvious sinkholes or exposed karst features were identified in carbonates exposed along the ROWs during the site investigations; however, the potential for these features to occur exists in the analysis area. Applicators should be trained to identify sinkholes or other karst features. Field personnel encountering karst features should contact the supervising licensed applicator, who would direct treatment for the area according to manufacturers' recommendations, regulatory requirements and Forest Service directives.

Water Quality Affected Environment

Section 303(d) of the Clean Water Act requires States to identify waters that do not meet, or are not expected to meet, applicable water quality standards. These water bodies are compiled into a list known as the 303(d) list. The regulation (40 CFR 130.7) requires that each 303(d) list be prioritized and identify waters targeted for Total Maximum Daily Load (TMDL) development.

The Arkansas Department of Environmental Quality 2004 Water Quality Inventory Report (ADEQ 2004) divided the impaired water body segments into five tables. The waters listed in Category 5a are those waters that are considered impaired and would require the development of a TMDL, unless some other pollution control mechanism is implemented and future assessments indicate full attainment of water quality standards. The Category 5a streams within the analysis area of this EA include the Arkansas River within Segment 3H (HUC 11110104 and 11110201), Hicks Creek within Segment 4F (HUC 11010004) Reach -015 and Norfork River within Segment 4F (HUC 11010006).

The waters listed in Category 5b are currently not meeting water quality standards. However, proposed changes to the water quality standards outlined in Regulation No. 2, and/or the reclassification of some stream types, will result in the de-listing of most of these stream segments. The Category 5b streams within the analysis area of this EA include Saldo Creek within Segment 4F (HUC 11010004), Big Creek within Segment 4F (HUC 11010014), Greenbrier Creek within Segment 4F (11010014). Category 5c contains those stream segments where water quality data indicates impairment, but the data is questionable because of quality control/quality assurance issues. There are no analysis area streams listed in Category 5c. The stream segments listed in Category 5d are those that need additional field verification in order to determine the accuracy of the assessment. Numerous analysis area streams are listed in category 5d. Category 5e

stream segments routinely exceeded water quality standards, but the magnitude of the exceedance was not severe. No analysis area streams are listed in Category 5e.

Shallow fresh-water aquifer systems are found throughout Arkansas, and supply an abundance of high-quality groundwater for a wide range of uses including industrial, municipal, agricultural and domestic users. Groundwater is one of the most important sources of water supply in Arkansas and accounts for approximately 60 percent of the total water use in the State (ADEQ 2004). Most all of the surficial aquifers supply water of good to very good quality.

Water-quality concerns resulting from natural water-rock interaction range from simple hardness issues related to high concentrations of dissolved calcium and magnesium to high concentrations of iron related to the dissolution of iron-oxide coatings from the aquifer sediments. Non-point sources of contamination range from elevated nutrients and bacteria in shallow aquifers in northern Arkansas associated with increased animal production and septic systems, to low-level pesticide detections in eastern Arkansas associated with row-crop agricultural practices.

Groundwater in Arkansas occurs in two general geologic settings, which are represented by seven major physiographic regions of the state: Ozark Highlands, Arkansas Valley, Boston Mountains, Ouachita Mountains, South Central Plains, Mississippi Alluvial Plain and Mississippi Valley Loess Plains. The study area for this EA is entirely within the Interior Highlands, which is comprised of the Ozark Highlands, Arkansas Valley, Boston Mountains and Ouachita Mountains.

The Interior Highlands are underlain by thick sequences of consolidated rock of predominantly Paleozoic age. Groundwater in these consolidated rocks occurs primarily in fractures and joints in the sandstones and shales, in addition to fractures and solution openings (karst) in the limestone and dolomites. These rocks are important for both domestic and municipal water supplies. Wells throughout western Arkansas average about 150 feet in depth and normally produce less than 10 gpm. Yields greater than 25 gpm are rare in this area. The Roubidoux Formation and the Gunter Sandstone Member of the Van Buren Formation constitute the only significant aquifer system in the Ozarks, and are used extensively for municipal supply systems, where surface-water sources are unavailable. Together these units may yield up to 500 gpm to wells.

Groundwater quality within the study area of this EA (north central, northwest and west Arkansas) is good to very good. Land use in the majority of this area is silviculture and much of the area is unpopulated National Forest. Water wells used for municipal purposes constitute the primary use of groundwater in these areas. These wells consistently report high quality water supplies.

The August 1996 amendments to the Safe Drinking Water Act directed the EPA to support the protection of all public drinking water sources. EPA is now working with the States, Tribes and Communities to develop the Source Water Assessment and Protection (SWAP) program, which addresses potential contamination of both surface and subsurface water sources. In Arkansas, the Arkansas Department of Health (ADH) is developing and implementing the SWAP program. Source water is defined as untreated water from streams, rivers, lakes, springs and aquifers that is used as a supply of drinking water. Source water areas are the sources of drinking water delineated and mapped by

the ADH for each federally regulated public water system. The protection of source areas in lands managed by the Forest Service is included in the planning process for National Forest management.

ALTERNATIVE 1: NO ACTION

Hydrology and Water Quality

The No Action Alternative would continue ROW vegetation management by the use of hand tools and heavy mechanized equipment, which has the potential to contribute to soil erosion. Sediment losses from sites where competing vegetation is controlled by mechanical methods can be one to two orders of magnitude greater than natural losses from undisturbed watersheds (Neary and Michael, 1996). The sediment from the erosion of soils becomes part of the normal fluvial sediment transport and storage process and results in an increase in turbidity. Soil disturbance from the employment of mechanical vegetation control can also result in the reduction of nitrogen and phosphorus levels of 20 to 30 times the normal annual rate of undisturbed forest watersheds due to soil erosion and loss of vegetative matter from the system (Neary et al. 1984).

Mechanized vegetation control has the inherent possibility of localized contamination from oil, grease and fuels. Normal leakages as well as repairs and maintenance in the field may result in site contamination if BMPs are not strictly enforced.

Certain geologic features, such as carbonate geologies with karst characteristics, are vulnerable to potential contamination by rapid infiltration of precipitation through sinkholes, solution cavities and open fractures with direct connect to the uppermost aquifer. Mechanized vegetation control has the potential of increasing erosion due to both the clear cutting along ROWs and the tracking left by heavy equipment. This erosion potential reduces the soils and residuum that filter precipitation and its potential contaminants prior to reaching karst or other conduits to the underlying groundwaters.

As noted above, soil disturbance and erosional processes may be expedited by the use of heavy equipment during mechanical ROW maintenance and these processes contribute to the loss of nutrients in soils and the quality of the soils, and increased sediment migration will reach adjacent streams and other water bodies. This sediment increases turbidity and will be deposited in water bodies, potentially resulting in minor, immediate adverse effects following heavy equipment use. Therefore, the continued frequent use of heavy equipment in the ROWs has the potential to provide localized minor, immediate and cumulative adverse effects on water quality and aquatic species and habitat. However, the continuation of the No Action Alternative is not expected to produce significant adverse effects to source waters identified by the ADH in the Source Water Assessment and Protection Program, or to the water quality of streams assessed by the ADEQ the Section 303(d) listings in the analysis area.

ALTERNATIVE 2: PROPOSED ACTION

Hydrology and Water Quality

The proposed Action Alternative would use hand-applied herbicide mixtures to control target vegetation along ROWs in National Forests. Only woody stem vegetation would be treated, and no broadcast, aerial or ground spraying would be conducted. Herbicides would not be applied in Forest Service-designated buffer zones or buffer zones associated

with karst features and would be applied only according to manufacturers' directions and Forest Service Plans.

Because the proposed use of herbicides does not disturb the soils, herbicide usage would protect water quality and maintain site productivity by retaining nutrient-rich organic matter and soil surface horizons onsite within the analysis area. Sediments retained onsite do not contribute to additional nutrient loadings or physical deterioration of aquatic ecosystems and water resources through increased turbidity (Neary and Michael 1996).

Maxwell and Neary (1991) concluded that the impact of vegetation management techniques on erosion and sedimentation of water resources is that herbicides are less than fire, which is less than mechanical (herbicides<fire<mechanical). Neary and Michael (1996) further stated that herbicides do not increase natural erosion rates. The proposed action of hand applying herbicides to target woody stem vegetation would be conducted in the first year, followed by reapplication as needed in one to three years with further increases in time required between applications. The use of heavy equipment would be significantly reduced or eliminated. As grasses and low growing vegetation become densely established and heavy equipment is no longer routinely accessing the area, the soils would become more stable, decreasing erosion and the resulting water quality impacts from runoff. Further, because herbicides would not be used within 100 feet of the water's edge, source water would have further protection from the potential contact of herbicides (FSM 2526.03). These factors would ensure adherence to the Source Water Assessment and Protection Program developed by the ADH. The decrease in turbidity due to the implementation of the proposed Action Alternative would result in the potential for improvement of water quality in those waterbody segments listed by the ADEQ in the Section 303(d) list.

Herbicide Detection and Drinking Water Standards

Herbicides initially applied on foliage or directly onto the soil, either disappear in the soil through degradation, transport or a combination of both, and can potentially move into water bodies (environmental fate). Degradation over time reduces the amount of herbicide available for transport to off-site locations. Herbicide transport processes include atmospheric drift, foliar and stem wash-off, plant uptake, soil leaching, volatilization, surface runoff and subsurface flow (Neary et al. 1993).

Besides hydrological processes, such as hydrolysis, herbicide degradation processes include photodecomposition and microbial metabolism. The interaction of precipitation and evaporation as forces driving herbicide movement, as well as other climatic factors, degradation processes, soil-water properties and the characteristics of individual herbicides, makes site-specific prediction of the behavior of any given herbicide very difficult (Michael and Neary 1993). Specifically, "The greatest tendency for transport of herbicide occurs during the initial storms following spray application. If the intensity of the initial precipitation is not sufficient to cause movement across the soil, the danger of herbicide movement is essentially eliminated, especially for chemicals that degrade relatively quickly, but less so for herbicides that translocate readily in soil and groundwater (Evans and Duseja 1973)."

General Properties of Herbicides with Respect to Soil and Water Contamination

Herbicides that reach surface and sub-surface waters do so primarily through runoff and leaching. Runoff is the waterborne transport of compounds over the earth's surface, while leaching is the process by which compounds are carried downward through the soil by percolation of rainwater, snow melt or irrigation water.

Herbicides most likely to contaminate waters through leaching and runoff have the following properties: low adsorptivity to soil, relatively high water solubility, slow degradation rates and high application rate (Green et al. 2001, Trautmann et al. Undated). Adsorptivity to soil clay and organic matter is critical and herbicide persistence in the multi-month range elevates the likelihood of soil and water contamination. Herbicides with high adsorptive coefficients can have substantial loss in sediment (as opposed to dissolved chemical in runoff water) (Durkin 2003). These are general rules only and only generically apply to site-specific situations. Variations in temperature, soil acidity and other chemical conditions, along with physical site conditions like depth to groundwater, preclude simple generalizations about the degradation and transport of herbicides through soil to surface and groundwaters. In addition, some herbicide properties can interact to complicate prediction of leaching and movement to surface and groundwater. For instance, high degradation rates (often correlated to higher environmental temperatures) can counter low soil adsorptivity rates, so that assessing a single chemical indicator, like adsorptivity, in isolation is often inappropriate.

Most research on the effects of herbicides on the water quality of forest streams has been conducted in the southern United States; and therefore should be applicable to this EA. Precipitation in the southern United States is relatively consistent throughout the year, with the lowest levels occurring during the summer when sporadic thunderstorms constitute the majority of precipitation. Herbicide applications are proposed to occur in late spring through early fall, with most taking place during the driest portion of the year.

Hand application by backpack sprayer to only target vegetation poses little likelihood of contaminating surface waters. Broadcast aerial application poses higher risk of accidentally depositing herbicides onto surface waters or otherwise causing drift of chemicals beyond target areas. Michael and Neary (1993) noted, "…surface waters are more likely to be contaminated by aerial applications and least likely to be contaminated by stem injection."

Herbicides typically are either foliar active (intended to be taken up by the target plants through their leaves and stems) or soil active (taken up by the target plants through their root systems). Foliar-active herbicides are generally less likely than soil-applied chemicals to leach into subsurface waters, because the chemical – unless washed off the plant – remains solely in the on-plant tissue and does not immediately enter the soil to become subject to runoff or percolation into sub-surface flow paths (USDA Forest Service 1991). For this alternative, herbicides would be applied only to foliage and stems of woody vegetation using the foliar spray method and the hack and squirt method. No ground or aerial applications would be conducted within the ROWs.

Two of the five proposed herbicides, glyphosate and picloram, have established EPA drinking water standards. These Maximum Contaminant Levels (MCLs) are 700 ppb for glyphosate and 500 ppb for picloram. The other three herbicides do not have enforceable

MCLs, however, EPA has established Drinking Water Levels of Concern (DWLOCs), which are theoretical upper limits on a pesticide's concentration in drinking water in light of total aggregate exposure to a pesticide in food and from residential uses. The DWLOC and MCL numbers are the same for glyphosate and picloram, and are as indicated above. The DWLOCs for the remaining three herbicides are as follows: imazapyr 87,000 ppb; metsulfuron methyl 8,700 ppb; and triclopyr 1,700 ppb.

EPA, Forest Service and other studies document effects on aquatic species. These are addressed the Fish and Wildlife section.

Karst Geology

Karst geologies were identified by geologic mapping in Baxter, Stone, northern Newton, Benton, Washington and Crawford Counties in Arkansas. Any bedrock exposed by erosion of soils along the ROWs would allow the percolation of unfiltered precipitation directly into the groundwater system through fractures, joints and karst features, such as sinkholes or exposed solution cavities. The utilization of foliar application methods, in conjunction with restricted buffer zones, as discussed above for this alternative, would greatly reduce the potential for the proposed herbicides to reach the karst surfaces and therefore should not affect the groundwaters associated with karst topography.

Environmental Fate

The environmental fate of the five candidate herbicides proposed within the Action Alternative are discussed in this section. Some of the determinations about the environmental fate of individual herbicides are based on secondary sources of information that do not always specify potentially important details, such as type and rate of herbicide application or climatic, soil and other factors that can strongly influence herbicide persistence and concentrations in soil and water. Some of the secondary sources also do not clearly distinguish the environments in which the herbicides were applied, notably agricultural versus forestry settings. Differences in soil types and climatic regimes between forest and cropland environments make extrapolation of results from one environment to the other tenuous. Movement of chemicals to and through subsurface and surface waters is also dependent upon both the dilution and the scale of herbicide application. Some information sources do not specify the size of the herbicide treatment area in relation to watershed size.

Glyphosate is moderately persistent in soil and is unlikely to enter the aquatic environment in more than trace amounts unless it is applied directly to water or washes from overhanging foliage. The preponderance of documented half-lives for glyphosate ranged from 25 days to 4 months. A major metabolite of glyphosate, AMPA, behaves in soil and water similarly to glyphosate. Bakke (2001) concluded, after analyzing 103 samples collected between 1991 and 1999 from various National Forests in the Sierra Nevada of California, that with buffers and ground application, none of the samples had operationally detectable concentrations of glyphosate. Glyphosate dissipates rapidly in bodies of water through microbial metabolism, adsorption to suspended sediments and partitioning into bottom sediments. If erosion is controlled, and based on the methods of application for this action alternative, glyphosate should not adversely affect buffered water resources. However, glyphosate is approved for aquatic use and may be used directly in water by other users.

Imazapyr is unlikely to be detected in forest streams when streamside buffers and ground application are used. Foliar application is the primary mode of treatment for this alternative. Although imazapyr often persists in soils, it is typically described as being minimally mobile. In water, imazapyr breaks down to two dozen degradates, none of which is described as being persistent in water. In water, imazapyr dissipates rapidly through photodegradation. Reported half-lives in water range from 2 to 5 days. If erosion is controlled, and based on the methods of application for this action alternative, this chemical should not enter buffered water resources. Imazapyr is approved for aquatic use and may be used directly in water by other users.

Metsulfuron methyl is weakly adsorbed to most soils and may be mobile in a range of soil types. The compound is marginally likely to be detected in forest streams, even when streamside buffers and ground application are used. Persistence of metsulfuron methyl in soil is variable, with documented half-lives ranging from 10 days to 10 months. Field monitoring of ground-applied metsulfuron methyl in forest streams is limited. One known study in Florida showed low concentrations (<10 ppb), with over 99 percent of the samples having non-detectable concentrations. If erosion is controlled, and based on the methods of application for this action alternative, this chemical should not enter buffered water resources.

Although Triclopyr is not strongly adsorbed to soil and only variably persists in soils, leaching does not appear to be a concern and only small quantities have been detected in runoff during field studies. With the establishment of adequate streamside buffers and ground application, and absent direct application onto surface water, triclopyr concentrations in surface waters are typically not detected in forestry applications. In water, the main degradation pathway for triclopyr is photolysis. Reported half-lives in natural waters were typically less than four days and depended primarily on light intensity. If erosion is controlled, and based on the methods of application within the Action Alternative, this chemical should not enter buffered water resources. The TEA formulation of triclopyr is approved by EPA for use in aquatic and riparian environments for aquatic weed control (USDA Forest Service 2003a).

Picloram is extremely mobile, relatively persistent in soil and has the potential to contaminate groundwater. Water quality monitoring of picloram in the southern United States suggests that detectable concentrations of the chemical could occur in surface waters in some situations. The compound has been detected in the groundwater of seven states. Picloram can persist in soils for years and may be "…in some soils…nearly recalcitrant (unmanageable) to all degradation processes" (US EPA 1995). US EPA (1995) described picloram as among the most mobile of currently registered pesticides in some soil types. Picloram can leach to significant soil depths and has been found in stream water 0.6 miles or more from the point of application.

Selected properties of the five herbicides are summarized below (Table 9). Field half-life is the time in days for one-half of a volume of chemical to break down into its degradates. Soil adsorption gages the binding of chemical to soil particles. The tabulated adsorption values are for the coefficient $K_{oc,}$ which incorporates effects of organic carbon on chemical adsorption. Higher soil adsorption values indicate greater herbicide adsorption to soil and, therefore, less tendency for movement into water.

Water solubility is the amount of a chemical that would dissolve in a fixed volume of water. Higher water solubility values indicate a greater likelihood of chemical detectability in water. Leaching potential is the relative likelihood of downward translocation of the chemical in percolating groundwater, based on the Hornsby Index: the ratio of soil adsorption (K_{oc}) to filed half-life, multiplied by 10 (Seelig 1994). The leaching potential values do not incorporate operational considerations like application rate, local soil conditions and effectiveness of buffers in ameliorating herbicide concentrations in surface or groundwaters, nor do they comprehensively address interactions among these factors.

Table 9 – Selected Properties of Proposed Herbicides

Herbicide	Field Half-Life (days)	Soil Sorption (ml/g)	Water Solubility	Leaching Potential
Glyphosate	47	24,000	High	Low-Intermediate
Imazapyr	110	100	Moderate	High
Metsulfuron Methyl	30	35 (pH 7)	Moderate	High
Triclopyr	46	780	Low	Intermediate
Picloram	90	16	High	High

Field half-life, soil sorption and leaching potential are taken primarily from Wauchope et al. (1992, cited in Seelig 1994). Half-life and sorption values are variably quantified in the literature and the values cited here are central tendencies for these parameters. Monitoring results refer to ground application in forested environments with buffered streams.

There are increased risks of herbicides entering surface water through overland flow when applied to slopes greater than 30 percent. However, adherence of buffers and implementation of other BMPs would reduce the likelihood of entry into surface waters. Dyrness (1969) suggested that length and steepness of slope have less influence on pollution from forested watersheds because little or no surface runoff takes place in the forest, except where soils have been severely disturbed.

Cumulative adverse water quality effects from herbicide applications could result if multiple applications (either spatially or temporally) were to produce elevated herbicide concentrations. Cumulative effects could occur spatially when multiple treatments producing detectable chemical concentrations occur close enough together geographically, so that the effects of one treatment combine with the effects of others before dilution and degradation processes substantially reduce the concentrations. Cumulative effects could also occur temporally if degradation processes from a single treatment have not reduced concentrations before another treatment at the same location introduces new amounts of the chemical.

The potential for cumulative water quality effects from herbicide treatments depend on a variety of factors, including initial concentration of the herbicide in surface water, the frequency of treatment at each site, proximity of all treatment sites, frequency of treatments at others sites, rates of dilution and degradation processes that reduce chemical concentrations and treatment rates. As directed by Forest Plans, management and coordination of herbicide activities by Forest Service personnel would prevent excessive loading of products in any particular area.

Picloram may be detectable in low amounts, typically in the 0 – 10 ppb range, even if stream buffers and backpack methods of application are used. Soils containing sinkholes over limestone bedrock, severely fractured surfaces and substrates that would allow direct introduction into the aquifer should not be treated with picloram.

According to the Forest Plan for the Ouachita National Forest, picloram may only be used in the Ouachita National Forest to control kudzu. Due to the infestations of invasive species and the potential for the Forest Service to use picloram for vegetation control, the use of picloram in Ozark National Forest should only be used under specific authorization of the Forest Service. As noted above, National Forest Plans' and manufacturers' guidelines for herbicide application in the vicinity of surface waters or karst topographies, such as sinkholes or where fractured bedrock is exposed, should be strictly followed.

Conditions:

- As per Forest Plan, picloram may only be used for kudzu treatment in the Ouachita National Forest. Use of picloram, if any, in the Ozark National Forest would be approved by and under the direction of Forest Service personnel.
- No broadcast or area spraying would be conducted and products would not be sprayed directly on the ground.
- Herbicide mixtures would be applied only to target woody stem plants. No other vegetation would be treated.
- Field personnel would be trained in proper spraying and application techniques and would be under the supervision of a licensed applicator.
- Activities would be conducted in accordance with applicable regulations and in keeping with manufacturers' recommendations and Forest Plan guidelines.

Hydrology and Water Quality Summary:

Picloram is mobile and persistent within the environment and its use is restricted to the treatment of kudzu in Ouachita National Forest. Due to these factors and the potential for picloram to be used in Ozark National Forest, additional usage of picloram could add to the environmental loading of the chemical in that region.

If picloram is not used for ROW vegetation management and all applicable label directions and Forest Service directives are followed, there are no significant potential immediate or cumulative adverse effects on water quality from the proposed action. Herbicide use typically decreases over time and the intervals between treatments increase, as the woody vegetation is suppressed and native grasses and desirable ROW vegetation become more strongly established. These grasses provide increased soil stability, which reduces the potential for erosion and resulting sedimentation in water, creating minor immediate and moderate cumulative beneficial effects on water quality.

CLIMATE

Affected Environment

Arkansas is divided geographically into two principal divisions based on topography, soils, farming activity and to a lesser extent, on climate. The dividing line between these two sections cuts diagonally across the state, generally from northeast to southwest, and is designated as the Fall Line by geologists. The area located to the west and north of the

Fall Line is the Interior Highlands and the area to the east and south of this line is the lowlands of the delta. The project analysis area is located in north central, northwestern and western portions of Arkansas and is entirely within the Interior Highlands.

The Interior Highland area includes the varied geography of the Arkansas geologic provinces of the Salem and Springfield Plateaus, the Ozark and Ouachita Mountains and the Arkoma Basin. The Ozark Mountains and particularly that portion described as the Boston Mountains, has the most noticeable effect on Arkansas weather. There is little daily variation in the average temperatures and precipitation across the study area, although there are local differences between the mountains and valleys. The overall climate for the Arkansas area is mild throughout the year, with only short periods of temperature extremes in the winter and summer months. The winters are short, but cold periods do occur, with temperatures of zero degree Fahrenheit (F) or lower occasionally occurring in January and February. According to the National Oceanic and Atmospheric Administration (NOAA), the coldest temperature ever recorded in Arkansas was minus 29 degrees F. During the summer, the maximum temperatures exceed 100 degrees F at times, especially during July and August, particularly at valley stations. According to the NOAA, the highest temperature ever recorded in Arkansas was 120 degrees F. The growing season of the interior highlands is approximately 180 days (NOAA).

Data from the NOAA Southern Regional Climate Center (SRCC) was utilized to determine the approximate ranges of temperature and precipitation across the analysis area in Arkansas. According to the SRCC data, the average temperature across the area ranges from a low of 34 in January, to a high of 80 degrees in July. The normal daily maximum temperature across the area ranges from a low of 44 degrees in January to a high of 92 in July. The normal daily minimum temperature across the area ranges from a low of 22 degrees in January to a high of 68 in July.

Most of the precipitation falls in the form of rain. Precipitation in the form of snow occurs primarily in the highlands, with the average annual total of approximately one foot. Precipitation is predominantly of the shower type during the summer with periods of general rain during the late fall, winter and early spring. The average number of days with measurable precipitation averages approximately 100 per year. The wet period in the Interior Highlands extends from March through May. The entire state of Arkansas is subject to heavy rains, which frequently produce 24-hour totals of 5 to 10 inches. According to the SRCC data, the normal monthly precipitation across the area ranges from a low of 2.5 inches in August, to a maximum of 6 inches in May. The normal annual precipitation within the analysis area in Arkansas ranges from 46 to 50 inches.

NOAA data indicates approximately 60 thunderstorms reported each year, with the greatest frequency in June and July (National Climate Center 2002). Varying numbers of tornadoes are reported each year. Climatic wind data from the NOAA for Fort Smith, Arkansas, indicate that the average annual wind direction throughout the year is from the west at 8 miles per hour. The maximum wind speed is 10 miles per hour in March, while the minimum is 6 miles per hour in July and August (National Climate Center).

The analysis area has a subtropical climate with mild winters and hot, humid summers. Gulf air masses dominate the weather. Spring and summer have frequent thunderstorms. Winter precipitation is caused mostly by frontal systems. Annual precipitation averages

55 inches per year in the Arkansas analysis area and falls 98 – 110 days per year. Precipitation is generally well distributed throughout the year with the driest month receiving an average of over two inches. Spring and summer droughts are common with fall being the driest time of the year. Thunderstorms occur 50 – 60 days per year. Annual Average snowfall is six to eight inches per year (USDA Forest Service 1990).

ALTERNATIVE 1: NO ACTION

Climate

The No Action Alternative of continuing with mechanical vegetation control for ROWs within the National Forests would have no observable impact on climatic conditions within the study area. Neither temperature ranges nor precipitation ranges would be affected by the utilization of mechanized vegetation control of ROWs within the National Forests of north, northwest and west Arkansas. No known or observable immediate or cumulative effects on the climate conditions would result from continuing the use of mechanical vegetation control.

ALTERNATIVE 2: PROPOSED ACTION

Climate

Neither temperature ranges nor precipitation ranges would be affected by the utilization of herbicides for vegetation control of ROWs within the analysis area and no localized impacts of the use of herbicides to control vegetation along ROWs should be realized. The use of herbicides for vegetation control within the ROWs would have no known or observable immediate or cumulative effects on the climate conditions.

AIR QUALITY AND NOISE

Affected Environment

Existing air emission sources of contaminants occurring within the analysis area consist mainly of mobile sources. These include, but are not limited to, combustion engines such as those found on vehicles and farm equipment used on nearby agricultural fields, dust from unpaved surfaces and smoke from prescribed (federal, local, county) and agricultural burning. Many homes employ wood burning fireplaces and heaters for winter heating.

Some light industry, largely consisting of timber or poultry related activities, does occur on private property near National Forest properties, primarily adjacent to municipalities along state and interstate highways.

The Clean Air Act requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for six pollutants considered harmful to public health and the environment: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter and sulfur dioxide. The standards were set at the level required to provide an ample margin of safety to protect the public health.

An attainment area is a geographic area in which levels of a criteria air pollutant meet NAAQS for the pollutant. Under the Clean Air Act, any area that violates national ambient air quality standards for any of the six criteria pollutants as few as once per year and as often as four times over a three-year period is classified as a “non-attainment” area. There are no non-attainment areas for any of these six criteria pollutants for the

analysis area. All of the analysis areas lie within attainment areas (EPA AIRS web site at www.epa.gov.data/index.html) and all alternatives are in general conformity with State and/or Tribal Implementation Plans (SIPS and/or TIPS).

The analysis area is within the National Forests of northern, northwest and west Arkansas. These areas are not adjacent to, nor do they contain, any activity that would be a major continuous emitter of noise pollution. The Forest Service does undertake timber management practices that result in the periodic and localized harvesting of timber resources. Timbered properties adjacent to the National Forest, likewise, undertake the managed harvesting of timber on a periodic basis. These practices do create noise on a localized and short-term basis.

ALTERNATIVE 1: NO ACTION

Air Quality and Noise

The No Action Alternative would neither increase nor decrease the air quality or the amount of noise pollution currently experienced within the analysis area. Mechanized vegetation control does create dust, equipment emissions and noise in a localized area during ROW maintenance. Noise is a concern if ROW maintenance takes place near nesting or mating areas of sensitive wildlife species and can have minor short-term adverse effects.

The continued use of mechanical methods would provide ongoing adverse effects during the maintenance activities. No beneficial or adverse cumulative effects were identified for this alternative.

ALTERNATIVE 2: PROPOSED ACTION

Air Quality and Noise

All herbicide application would be with hand-held backpack sprayers. No aerial or broadcast spraying would be conducted. Only target vegetation would be affected by this methodology. The hack and squirt application method creates no potential for airborne mist as liquids are applied directly to the cut in the woody stem. The foliage application method directs the herbicide mixture from hand-held sprayers to the leaves of target woody stem plants only. BMPs ensure that herbicides are only applied in appropriate weather conditions, which reduces the air contact with the compounds. Unlike dry dusts generated from mechanical methods, herbicides are applied in water mixtures and settled quickly on the target foliage. As noted in numerous studies, air pollution from the volatilization of the proposed herbicides is unlikely (Ganapathy 1997, DowAgroSciences 2002, USDA Forest Service 1995, Schuette 1998).

The use of herbicide treatment instead of mechanical methods would provide an immediate minor localized and continuing cumulative benefit by eliminating the dust generated during mechanized control of vegetation in ROWs. There would be no significant or cumulative adverse effects to air quality from the proposed action.

The application of herbicides by individuals wearing backpack sprayers, applying herbicides according to manufacturers' label requirements would provide minimal adverse noise effects or disruptions and would have little or no adverse effect on the wildlife during mating and nesting. Utilizing herbicides as proposed would provide minor immediate and cumulative beneficial effects to wildlife and humans by eliminating the noise from heavy equipment currently used in maintaining ROWs in the analysis area.

VEGETATION COMMUNITIES

Affected Environment

The description of potentially affected terrestrial ecological resources, for the purpose of this EA, is divided into two major sections: flora and fauna. These sections contain listings of Threatened, Endangered, Proposed and Sensitive species that may be found within the proposed analysis area. For purposes of analysis, the Interior Highlands region ecology is divided into ecoregions and into habitats found within each ecoregion.

An ecoregion (ecological region), is a geographically distinct assemblage of natural communities and species, covering a relatively large area of land or water (Wiken 1986, Omernik 1987, Commission for Environmental Cooperation [CEC] 1997, US Environmental Protection Agency [USEPA] 1997). Ecoregion definitions were developed to separate the landscape into areas that have relatively similar characteristics of landform, land use, soil and historical natural vegetation (CEC 1997).

The Commission for Environmental Cooperation (CEC) and the scientific community has adopted a Roman numeral hierarchical system for various levels of ecological regions (CEC 1997, Griffith et al. 1994a, 1994b, 1997; Woods et al., 1996, 1998; Clarke and Bryce, 1997; Bryce et al. 1998; Pater et al. 1998). The analysis area is located entirely within the Level I Eastern Temperate Forests ecoregion and the Level II Ozark, Ouachita-Appalachian Forests Ecoregion. Level III ecoregions describe distinct ecological areas within Level II regions. Nested within Level III regions are Level IV ecoregions that are even more detailed and complex, allowing for localized monitoring, reporting and decision making to take place (CEC 1997, Griffith et al., 1994a, 1994b; Woods et al., 1996, 1998; Clarke and Bryce, 1997; Bryce et al., 1998; and Pater et al., 1998). For methods used to define the EPA's ecoregions, see Omernik (1987, 1995), Omernik et al. (2000), Gallant et al. (1989) and Wiken (1986). For the purposes of the EA, focus will be on Level III and IV ecoregions (see Table 10). These levels allow locally important ecological characteristics to be identified, consequently permitting more specific management strategies to be created.

Table 10: Ecoregion Levels III and IV within the Analysis Area

Level III Ecoregions	Level IV Ecoregions
Arkansas Valley	Arkansas Valley Hills
	Arkansas Valley Plains
	Scattered High Ridges and Mountains
Boston Mountains	Lower Boston Mountains
	Upper Boston Mountains
Ouachita Mountains	Fourche Mountains
Ozark Highlands	Dissected Springfield Plateau-Elk River Hills
	Springfield Plateau
	White River Hills

Table 11 shows the analysis area habitats and acreage located within each ecoregion.

Table 11: Level III and IV Ecoregions and Corresponding AR-GAP Landcover Types

Level III Eco-regions	Level IV Eco-regions	Gap Types	Dominant Plant Species	Acres	Level 4 Acres	Level 3 Region Acres (% of Total)
Arkansas Valley	Arkansas Valley Hills	Agriculture	(pasture and dry crops)	3.02	314.77 (6.73%)	4678.94 (15.92%)
		T.1.A.9.b.I	Pinus echinata	211.20		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	85.60		
		T.1.B.3.a.II	Quercus alba	11.58		
		Water	Water	3.37		
	Arkansas Valley Plains	Agriculture	(pasture and dry crops)	128.19	422.80 (9.04%)	
		P.1.B.3.c.VII	Quercus phellos	82.57		
		T.1.A.9.b.I	Pinus echinata	54.20		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	157.18		
		T.1.B.3.a.II	Quercus alba	0.66		
	Scattered High Ridges and Mountains	Agriculture	(pasture and dry crops)	69.75	3941.36 (84.24%)	
		P.1.B.3.c.VII	Quercus phellos	156.62		
		T.1.A.9.b.I	Pinus echinata	1036.11		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	2173.23		
		T.1.B.3.a.II	Quercus alba	455.12		
		T.1.B.3.a.V	Quercus stellata	41.28		
		Water	Water	9.25		
Boston Mountains	Lower Boston Mountains	Agriculture	(pasture and dry crops)	932.30	12705.95 (69.44%)	18296.61 (62.27%)
		T.1.A.9.b.I	Pinus echinata	1206.69		
		T.1.A.9.c.I	Juniperus virginiana	2.76		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	5021.69		
		T.1.B.2.b.IV	Juniperus virginiana	4.77		
		T.1.B.3.a.II	Quercus alba	5032.85		
		T.1.B.3.a.V	Quercus stellata	504.90		
	Upper Boston Mountains	Agriculture	(pasture and dry crops)	445.64	5590.66 (30.56%)	
		T.1.A.9.b.I	Pinus echinata	8.61		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	1990.38		
		T.1.B.2.b.IV	Juniperus virginiana	106.27		
		T.1.B.3.a.II	Quercus alba	3039.75		
Ouachita Mountains	Fourche Mountains	Agriculture	(pasture and dry crops)	375.70	2879.97 (100%)	2879.97 (9.80%)
		P.1.B.3.c.VII	Quercus phellos	10.11		
		P.1.B.3.c.VIII	Liquidambar styraciflua	85.53		
		T.1.A.9.b.I	Pinus echinata	1726.18		
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	675.05		
		T.1.B.3.a.II	Quercus alba	6.04		
		Water	Water	1.35		

Table 11--Continued

Level III Eco-regions	Level IV Eco-regions	Gap Types	Scientific Name	Acres	Level 4 Acres	Level 3 Region Acres (% of Total)
Ozark Highlands	Dissected Springfield Plateau-Elk River Hills	Agriculture	(pasture and dry crops)	54.39	824.89 (23.39%)	3526.20 (12.00%)
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	161.82		
		T.1.B.2.b.IV	Juniperus virginiana	74.43		
		T.1.B.3.a.II	Quercus alba	487.13		
		T.1.B.3.a.V	Quercus stellata	37.43		
		T.2.B.3.a.I	Pinus echinata - Quercus spp.	9.69		
	Springfield Plateau	Agriculture	(pasture and dry crops)	80.77	379.27 (10.76%)	
		T.1.B.3.a.II	Quercus alba	233.33		
		T.1.B.3.a.V	Quercus stellata	65.18		
	White River Hills	Agriculture	(pasture and dry crops)	262.99	2322.03 (65.85%)	
		T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	14.03		
		T.1.B.2.b.IV	Juniperus virginiana	1203.58		
		T.1.B.3.a.V	Quercus stellata	54.60		
		T.2.B.3.a.I	Pinus echinata - Quercus spp.	786.58		
		Water	Water	0.25		

Scale 1:100,000 **Total Ecoregion Acreage encompassing the analysis area** **29,381**

Center for Advanced Spatial Technologies (CAST). 1996 The Arkansas GAP Analysis Project Final Report. http://www.cast.uark.edu/gap/chap7.htm

Located within the analysis area are the following AR-GAP Landcover habitat communities: Ozark-Ouachita Dry-Mesic Oak Forest, Interior Highlands Glade-Barrens, Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland, and Ozark-Ouachita Riparian. Table 12 shows where the GAP types fall within these communities.

Ozark-Ouachita Dry-Mesic Oak Forest is found throughout the Ozark and Ouachita Highlands. It is comprised of dry-mesic to mesic and gentle to moderately steep slopes. Soils are typically moderately to well drained and are more fertile than those associated with oak woodlands. A closed canopy of oak species (*Quercus rubra* and *Quercus alba*) and often hickory species (*Carya* spp.) typify this system. *Acer saccharum* may occur on more mesic areas of this system (Ouachita Ecoregional Assessment Team 2003).

Interior Highlands Glade-Barrens type includes three habitats: Central Interior Highlands Dry Acidic Glade and Barrens, Central Interior Highlands Calcareous Glade and Barrens and the Ozark-Ouachita Dry Oak Woodland. The Central Interior Highlands Dry Acidic Glade and Barrens system is found in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions. It occurs along moderate to steep slopes or valley walls of rivers along most aspects. Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata*, *Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils.

The Central Interior Highlands Calcareous Glade and Barrens system is also found primarily in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions running along moderate to steep slopes and steep valleys usually on southerly to westerly facing slopes. The system is dominated by *Schizachyrium scoparium* and is commonly associated with *Andropogon gerardii, Bouteloua curtipendula* and calcium-loving plant species. Stunted woodlands are dominated by *Quercus muehlenbergii* and interspersed with *Juniperus virginiana*. Fire plays an important role in managing the Central Interior Highlands Dry Acidic Glade and Barrens and the Calcareous Glade and Barrens system by restricting woody growth and maintaining the more open glade structure (Ouachita Ecoregional Assessment Team 2003).

The Ozark-Ouachita Dry Oak Woodland system is also found primarily in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions running along gentle to steep slopes and over bluff escarpments with southerly to westerly faces. *Quercus stellata, Quercus marilandica* and *Quercus coccinea* dominate the system. The understory is comprised of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. *Quercus stellata* is the major dominant in flatwoods with fragipans. Drought stress is the major influence on this system (Ouachita Ecoregional Assessment Team 2003).

The Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland type includes pine-hardwood co-dominated sites in three habitats: Ozark-Ouachita Pine-Oak Forest habitat, Ozark-Ouachita Pine-Oak Woodland habitat and the Ozark-Ouachita Pine/Bluestem Woodland habitat. This system represents forests and woodlands found primarily in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma and southern Missouri. *Pinus echinata* is an important or dominant component. Although this system occurs throughout the region, there is local variation in the degree to which it is present. Mostly, *Pinus echinata* occurs with a variable mixture of hardwood species. Hardwood composition in these areas is much more closely related to aspect and topographic factors than is the pine component (Dale and Ware 1999, Ouachita Ecoregional Assessment Team 2003).

The Ozark-Ouachita Riparian type includes two habitats: Ozark-Ouachita Riparian habitat and the South-Central Interior Large Floodplain habitat (not found in the study area). The Ozark-Ouachita Riparian system is found along streams and small rivers within the Ozark and Ouachita regions. The system often contains cobble bars and steep banks and has little to no floodplain development. It traditionally has higher slopes than larger floodplains and experiences periodic, strong flooding. It is often characterized by a cobble bar with forest immediately adjacent and little to no marsh development. Typical tree species include *Liquidambar styraciflua, Platanus occidentalis, Betula nigra*, maples species (*Acer* spp.) and flood tolerant oaks (*Quercus* spp.). The shrub layer is typically composed of *Lindera benzoin, Alnus serrulata* and *Hamamelis vernalis*. Small seeps and fens can often be found within this system. These areas are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.) and other herbaceous species such as *Impatiens capensis*. Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers (Ouachita Ecoregional Assessment Team 2003).

For a listing of rare communities that can be found in the Interior Highlands, please refer to Appendix 8, Table 1. Although none of these rare communities were found within the analysis area, during field visits or with AR-GAP Landcover data, there is the possibility that one or more of these rare communities could exist within the analysis area. The AR-GAP Landcover data is designed for use on a large scale, therefore small, rare plant communities will not be accounted for in the data.

The list of plant communities shown in Table 12 was compiled from AR-GAP Landcover data by using the available truck map data, digitized ROWs and a 300-foot buffer on either side of the digitized ROWs and intersecting the 600-foot total buffer with the AR-GAP Landcover data. The AR-GAP Landcover data was designed to be used at a scale of 1:100,000, or smaller, for assessing the conservation status of vertebrate species and vegetation types over large geographic regions. AR-GAP Landcover data is best used for coarse-filter evaluation of potential impacts or benefits of major projects or plan initiatives on biodiversity.

Table 12—Analysis Area Plant Community Types

Community	Habitats	GAP types:	Scientific Name	Common Name	Acres	Total Acres
Ozark-Ouachita Dry-mesic Oak Forest	Ozark-Ouachita Dry-mesic Oak Forest habitat	T.1.B.3.a.II	Quercus alba	white oak - mixed hardwoods	9266.46	9266.46
		T.1.B.3.a.III	Quercus rubra	Quercus spp., northern red oak - oak	0	
		T.1.B.3.a.IV	Quercus falcata	Quercus spp., southern red oak - oak	0	
		T.2.B.4.a.I	Quercus spp. - Carya texana	oak - black hickory	0	
Interior Highlands Glade-Barrens	Central Interior Highlands Dry Acidic Glade and Barrens, Central Interior Highlands Calcareous Glade and Barrens and Ozark-Ouachita Dry Oak Woodland	T.1.A.9.c.I	Juniperus virginiana	eastern red cedar	2.76	2095.22
		T.1.B.2.b.IV	Juniperus virginiana	eastern red cedar	1389.06	
		T.1.B.3.a.V	Quercus stellata	post oak	703.40	
		T.2.A.2.b.I	Juniperus virginiana - Quercus spp.	eastern red cedar - oak	0	
		T.2.B.3.a.II	Juniperus ashei-Quercus spp.	white cedar - oak	0	
Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland ecological system	Ozark-Ouachita Pine-Oak Forest and Woodland	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	oak - shortleaf pine - hickory	10278.99	11075.26
		T.2.B.3.a.I	Pinus echinata - Quercus spp.	shortleaf pine - oak	796.27	
	Ozark-Ouachita Pine	T.1.A.9.b.I	Pinus echinata	shortleaf pine	4243	4243
Ozark-Ouachita Riparian	Ozark-Ouachita Riparian habitat and South-Central Interior Large Floodplain habitat	P.1.B.3.c.VII	Quercus phellos	willow oak	249.30	334.83
		P.1.B.3.c.VIII	Liquidambar styraciflua	sweetgum	85.53	
		R.1.B.3.c.I	Salix - Populus	willow - cottonwood	0	
		R.1.B.3.c.II	Betula - Platanus	birch- ycamore-maple	0	

ALTERNATIVE 1: NO ACTION

Vegetation Communities

The No Action Alternative would require the rural electric cooperatives to continue to manage vegetation within power line ROWs by mechanical means only. Mechanical methods are very effective for completely removing thick stands of vegetation. However, the heavy equipment techniques used along ROWs are non-selective in that they cut all vegetation within the path of the machine. Mechanical methods of ROW maintenance may also cause the compaction and or erosion of soil (Neary and Michael 1996), subsequently creating negative impacts to the vegetation community.

Successive mechanical cutting procedures may significantly increase the amount and difficulty of labor needed to complete vegetation control. When deciduous tree species are cut, the stems re-sprouts with several shoots, creating even more dense vegetation than what existed before ROW maintenance occurred. The resulting dense woody vegetation may prevent the establishment of other plant species, such as grasses and perennial plants, which do not require frequent maintenance. Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of disturbance.

Environmental impacts due to mechanical ROW maintenance are more intense when densely vegetated areas are cleared, compared to the selective removal of trees or brush. Mechanical methods for ROW maintenance are also ineffective at controlling non-native invasive plants and are known to facilitate their spread (Miller 2006). The heavy equipment techniques used along ROWs are non-selective in that they clear-cut all vegetation within the path of the machine. Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of disturbance. Selective cutting or mowing is not feasible with large machinery used in mechanical methods, therefore, sensitive plant species inhabiting the ROWs, if any, would potentially be at risk of disturbance. Therefore, use of mechanical methods for ROW vegetation maintenance will continue to have moderate immediate and minor cumulative adverse effects on the vegetation communities within power line ROWs by perpetuating the constant cycle of disturbance.

ALTERNATIVE 2: PROPOSED ACTION

Vegetation Communities

The participating rural electric cooperatives Proposed Action Alternative is to use Forest Service-approved herbicides to control specific woody stem vegetation within existing constructed utility corridors located on Forest Service lands. Application of herbicide mixtures would be by individuals walking along the ROWs, using low-pressure backpack sprayers to apply herbicide to target woody stem vegetation only.

The Action Alternative seeks to promote the establishment of low-growing plant communities, such as grasses, on the ROW to “out-compete” trees and tall-growing brush that may damage power lines. Promoting low-growing plant communities would be accomplished by protecting this vegetation from disturbance during maintenance and by eliminating tall-growing vegetation so that low-growers can establish and propagate. No mechanized area spraying would be used in the application of herbicides.

Non-native invasive species (NNIS) are not in themselves target vegetation for herbicide treatment. However any NNIS that meet the requirements of target vegetation, i.e. trees such as tree of heaven and tall-growing brush, would be treated. In this sense the Action Alternative would reduce the spread of woody NNIS. In contrast, removal of trees and tall-growing brush may provide conditions that are conducive to the growth and spread of existing low-growing NNIS.

Herbicide use within ROWs would be less likely to spread invasive species than mechanical treatment however there is some risk of spread of non-native invasive species by crews moving through the ROWs.

The potential effects of proposed herbicides on non-target vegetation communities are presented below.

Picloram (Tordon K)

Picloram is a pyridine herbicide that acts as a plant growth regulator and mimics naturally occurring plant hormones in a manner that leads to uncontrolled and abnormal growth. These effects can in turn lead to gross signs of toxicity and plant mortality (USDA Forest Service 2003d). Picloram is more toxic to broadleaf plants than grains or grasses. The use of picloram for ROW maintenance does pose environmental risks related to contamination of surface and groundwater and damage to non-target terrestrial plants adjacent to areas of application via runoff or drift (Dow 1999, EPA 1995, EPA 2003).

Picloram is extremely mobile, relatively persistent in soil and has the potential to contaminate groundwater (EXTOXNET 1996, EPA 1995, EPA 2003). Picloram may also travel in runoff after heavy rainfall. If picloram is applied in the proximity of sensitive crops or other desirable sensitive plant species, site-specific conditions and anticipated weather patterns will need to be considered if unintended damage is to be avoided. More tolerant plant species are not likely to be affected unless they are directly sprayed or subject to substantial drift. A detectable inhibition of the activity of soil microorganisms is also likely at application rates used in Forest Service Programs (USDA Forest Service 2003d). Picloram absorbed by treated plants can be released into the soil by passive transport through the roots and can be taken up by roots of nearby non-target plants (EPA 1995, USDA Forest Service 2003d). However, the warm weather at the time of application along with the acidic soil conditions in many of the application areas proposed for treatment are expected to enhance the breakdown of picloram and reduce the potential for transport and accumulations of products in soils. Natural microbial processes also assist in the chemical decomposition of herbicides, further reducing their potential to affect non-target plants. The clay content of many soils also may bind picloram and reduce its potential for transport to non-target vegetation.

Picloram will not be used within American burying beetle areas in this alternative. According to the Ouachita Forest Plan and Forest Service herbicide activities within the Ouachita National Forest, picloram may only be used to control kudzu. Due to the potential presence of invasive species in any forest and the potential for the Forest

Service to use picloram for its control, the use of picloram in the Ozark National Forest should be coordinated with the Forest Service.

Glyphosate (Roundup, Accord)

The application of glyphosate leads to a variety of toxic effects in plants, including the inhibition of photosynthesis in plants as well as inhibition of respiration and nucleic acid synthesis in plants and microorganisms (USDA Forest Service 2003e). Glyphosate residues in plant tissues tend to remain until foliage is shed or the plant dies and tissues begin to decay. The primary hazards to non-target terrestrial plants are associated with unintended direct deposition or spray drift (USDA Forest Service 2003e). The reported half-lives of glyphosate in vegetation typically are less than 24 days (WHO 1994, Giesy et al. 2000). Glyphosate is strongly adsorbed to soil and is unlikely to enter the aquatic environment in more than trace amounts unless it is applied directly to water or washes from overhanging foliage (Duke 1988, Tatum 2004). Once adsorbed to soil, glyphosate is no longer available for uptake by plants and loses its herbicidal activity (Duke 1988). There is little information suggesting that glyphosate will be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms (USDA Forest Service 2003e).

Imazapyr (Arsenal, Powerline, Stalker, Chopper)

Imazapyr is practically non-toxic to conifers, but is toxic to many other plant species. Imazapyr inhibits acetolactate synthase (ALS), an enzyme that catalyzes the biosynthesis of three branched-chain amino acids, all of which are essential for plant growth. Although post-emergence application is more effective than pre-emergence application, toxicity can be induced either through foliar or through root absorption. Imazapyr is not metabolized extensively in plants but is transported rapidly from treated leaves to root systems and may be exuded into the soil from the roots of treated plants. Imazapyr is relatively non-toxic to soil microorganisms (USDA Forest Service 2003c).

Imazapyr is not strongly adsorbed to soil and therefore has the potential to be highly mobile. When applied to areas in which runoff is favored, damage from runoff appears to pose a greater hazard than drift. Residual soil contamination with imazapyr could be prolonged in arid areas. In areas of relatively high rainfall rates, such as the analysis area, residual toxicity to sensitive plant species would be much shorter (USDA Forest Service 2003c). Field studies, however, indicate that in actual use, mobility is minimal (Mangels 1991). Degradation of imazapyr in soils occurs primarily through microbial metabolism (Weed Science Society of America [WSSA] 1994). The reported half-lives for imazapyr in soil in field studies ranged from 25–142 days (WSSA 1994). In a forestry field study, levels of imazapyr residues in vegetation peaked soon after herbicide application and dissipated rapidly, falling to 10% or less of peak concentrations by day 14 (Michael and Boyer 1986).

Metsulfuron methyl (Escort)

Metsulfuron methyl inhibits acetolactate synthase (ALS), an enzyme that catalyzes the biosynthesis of three branched-chain amino acids, all of which are essential for plant growth (USDA Forest Service 2003b). Terrestrial (soil) microorganisms also have an enzyme that is involved in the synthesis of branched chain amino acids and studies suggest that transient effects on soil bacteria are plausible. Metsulfuron is weakly

adsorbed to most soils and may thus be mobile in a range of soil types (Michael et al. 1991). Dissipation from soil is due to microbial degradation and hydrolysis, with degradation occurring at a much faster rate under acidic conditions and higher moisture and temperature levels (WSSA 1994). When used in directed foliar applications (i.e., backpack), offsite drift could be reduced substantially but the extent of this reduction cannot be quantified (USDA Forest Service 2003b). Reported soil half-lives ranged from 7–42 days (WSSA 1994).

Triclopyr (Garlon)

Triclopyr mimics indole auxin plant growth hormones and cause uncontrolled growth in plants (USDA Forest Service 2003a). Triclopyr residues tend to remain in plants until foliage is shed or the plant dies and tissues begin to decay (Tatum 2003). The primary hazards to non-target terrestrial plants are associated with unintended direct deposition or spray drift. The estimated half-life in above ground drying foliage, such as in a forest overstory, was 2–3 months (Kamrin 1997). Although triclopyr is not strongly adsorbed to soil, leaching does not appear to be a concern and only small quantities have been detected in runoff during field studies (Tatum 2003). Field studies indicate that some bryophytes and lichens may be sensitive to long-term effects after triclopyr exposure (USDA Forest Service 2003a). Triclopyr in soil is readily degraded through microbial metabolism, with reported half-lives ranging from 30–90 days (Kamrin 1997).

In summary, if all label directions and Forest Service directives are followed, the proposed action would pose no significant potential immediate or cumulative adverse effects to non-target vegetation communities in the activity or analysis areas.

With the exception of picloram, the herbicides, using proposed methods according to label direction and Forest Plan guidelines, do not pose environmental risks related to contamination of surface and groundwater, or the likelihood of damage to non-target terrestrial plants adjacent to areas of application via runoff or drift. Example mixtures use only small amounts of picloram, however, picloram's mobility and integrity in soil, as well as Forest Service usage and directives, indicate the potential for minor immediate and cumulative adverse effects to nearby non-target vegetation from its use.

Spot and localized herbicide treatments work well in treating deciduous stumps to keep them from re-sprouting because herbicides tend to kill the vegetation roots. Herbicide treatment is effective for a longer term than with mechanized control techniques; thereby reducing potential adverse effects from continued disturbance to the vegetation communities inhabiting the ROWs (activity areas). Consequently, the Proposed Action Alternative would have the minor immediate and cumulative beneficial effects of reducing the cycle of disturbance to ROW vegetation communities within the activity area, allowing the growth and expansion of desirable grasses and other non-woody vegetation.

RIPARIAN, WETLAND AND FLOODPLAIN AREAS

Affected Environment

Healthy and properly functioning riparian areas, wetlands and floodplains are physically and biologically diverse and highly productive environments. These land-water interfaces are generally very dynamic and support complex associations of plant and

animal communities. Riparian and wetland areas maintain or improve water quality, regulate impacts of flooding and provide continuous groundwater recharge areas.

The analysis area holds a diversity of wetland types; however, extensive wetland areas do not exist across the majority of the Forests within the analysis area. In most cases, when wetlands do cross the analysis area ROWs, they are associated with mountain streambeds and are ephemeral in nature. Approximately 2/3^{rds} of riparian areas are intermittent, while a much smaller percentage of wetlands and riparian areas, about 1/3rd, are perennial in nature. Occasionally, upland areas, which support small bogs or marsh features that have wetland characteristics, are present within the analysis area; however, these are very small and are not represented on habitat maps. For a detailed listing of the named streams, rivers and lakes, refer to the Hydrology and Water Quality section.

Wetlands include those areas that are inundated or saturated for a sufficient period of time to, under normal circumstances, support a prevalence of vegetation typically adapted for life in saturated soil conditions (U.S. Army Corps of Engineers 1987). A floodplain is that part of the land adjacent to the river that is subject to flooding and consists of a mosaic of aquatic and terrestrial environments that are intricately linked with the river. The extent of each floodplain is dependent on the size of the associated river, the frequency and severity of flooding, soil type, topography and water flow characteristics (Mitsch and Gosselink 2000). Floodplains within the analysis area range in size from very large to quite small. Due to the mosaic of aquatic and terrestrial habitats found within each floodplain, the exact boundaries of each floodplain within the analysis area were not delineated.

A riparian area or riparian management zone is an area of ecological transition between aquatic and terrestrial ecosystems, which is distinguished by gradients in biophysical conditions, ecological processes and biota. Riparian areas are adjacent to perennial, intermittent and ephemeral streams, lakes and estuarine-marine shorelines (Mitsch and Gosselink 2000, Tennessee Valley Authority [TVA] 2006) and are located in the floodplain. Stream and river habitats, over time, develop natural vegetation communities that are crucial in maintaining their biological integrity (USDA Forest Service 1999b). A healthy stream riparian area, one with stable stream banks and little or no erosion, sustains many important ecological functions including improving water quality, supplying detritus (energy), providing shade and terrestrial habitat for many amphibious wildlife species (Gregory et al. 1991, Mitsch and Gosselink 2000).

Riparian areas contain vegetative communities adapted to withstand seasonal flooding and contribute organic matter into the aquatic system food chain (TVA 2006). In addition, riparian areas provide essential shade and stream temperature regulation as well as cover and travel corridors for wildlife (USDA Forest Service 2007). Effective management of riparian areas not only produces direct benefits in terms of stream health, but may also lessen the effects of various sources of pollution in uplands (USDA Forest Service 1999b). Without well-maintained riparian management zones, runoff from cultivated fields and other developed areas containing sediment, pesticides and fertilizer may flow directly into waterways (USDA Forest Service 2007). Plants in streamside riparian management zones protect water quality by filtering out many of the potential contaminants, reducing the amount of pollutants entering aquatic habitats (Barling and Moore 1994, USDA Forest Service 2007).

Vegetative communities inhabiting undisturbed wetland and riparian areas are productive and diverse ecosystems providing habitats for a rich variety of organisms. Most importantly, riparian areas provide rich, moist environments, not often found in upland areas. The forested riparian area provides diverse habitat structure, as well as thermal and protective cover (e.g., undercut banks, large woody debris and rootwads) for wildlife. Snags used by birds, bats and other small animals are usually abundant. Such areas provide shelter for wildlife and serve as filters to reduce erosion and sediment inputs from upland erosion that may occur outside the riparian area (Barling and Moore 1994). Riparian terrestrial habitats may serve as corridors for wildlife movement, allowing for daily travel and seasonal migration. The riparian area may also serve to connect isolated populations, allowing gene flow to occur, thus keeping populations genetically vigorous.

Wetland areas also provide important habitat for many PETS species inhabiting the analysis area and are preferred foraging habitats for several imperiled bat species (Brack and LaVal 2006, Gardner et al. l991, Menzel et al 2001a,b). While some PETS species such as the small-headed pipewort may benefit from disturbance, the majority of PETS species likely inhabiting analysis area wetlands are highly sensitive to disturbance. *Percina nasuta* is a Sensitive aquatic species, that is adversely affected by pollution and sedimentation, which is reduced by the implementation of riparian management zones (Robison and Buchanan 1988). The imperiled Diana fritillary depends on riparian areas for breeding habitat, while several sensitive plant species, such as the Alabama snow-wreath and the southern lady's slipper, occur on undisturbed riparian areas as well. Riparian forests also support a disproportionately large number of breeding bird species, when compared to upland habitats (Inman et al. 2002).

All ROWs present within the analysis area were constructed several decades ago and riparian areas crossing these ROWs have evolved back to a relatively undisturbed condition. Forest Service standards for management around riparian habitats emphasize low levels of disturbance and maintenance of mature forests (USDA Forest Service 2005d,e). Utilization of these standards will minimize any potential adverse effects of ROW maintenance to riparian management zones.

Riparian, wetland, open water areas within the analysis area were identified by studying 1:24,000 Arkansas digital USGS quadrangle maps and then intersected with the ROW shape files created from the rural electric companies' truck maps. USGS quadrangle maps indicate that approximately 130 stream crossing are present within the analysis area. A 100-foot buffer around all stream/power line intersections was cross-referenced with AR_GAP Landcover data indicating that there are approximately 251.27 acres of riparian, wetland, open water areas within the analysis area. Approximately 77.7 percent of the riparian acres are located in forested areas (195.30 acres), 10.7 percent (26.90 acres) are located in Glade-Barrens, 2.3 percent (5.66 acres) are located within areas classified as Riparian or Water and 9.3 percent (23.41 acres) are located in agricultural areas, For the purpose of this EA, water is defined as open water (lakes or ponds).

Table 13 details and summarizes the forest community types occurring within a 100-foot buffer of all stream/power line intersections. Area figures and percentages are rounded for illustration purposes.

Table 13 - Forest Community Types

(Occurring within a 100-foot buffer of all stream/power line intersections)

Ecological System	Class	Scientific Name	Area (Acres)
Ozark-Ouachita Pine-Oak Forest and Woodland	T.1.B.2.b.II	*Quercus spp. - Pinus echinata - Carya spp.*	97.73
	T.2.B.3.a.I	*Pinus echinata - Quercus spp.*	8.47
Ozark-Ouachita Dry-mesic Oak Forest Habitat	T.1.B.3.a.II	*Quercus alba*	52.50
Ozark-Ouachita Pine	T.1.A.9.b.I	*Pinus echinata*	36.60
Total Forested		***77.7%***	***195.30***
Interior Highlands Glade-Barrens	T.1.B.2.b.IV	*Juniperus virginiana*	22.08
	T.1.B.3.a.V	*Quercus stellata*	4.82
Total Glade		***10.7%***	***26.90***
Ozark-Ouachita Riparian	P.1.B.3.c.VII	*Quercus phellos*	4.61
	P.1.B.3.c.VIII	*Liquidambar styraciflua*	0.90
Water	Water	Water	0.15
Total Riparian and Water		***2.3%***	***5.66***
Agriculture	***Agriculture***	***(Pasture & dry crops) 9.3%***	***23.41***
TOTAL ACRES		***100%***	***251.27***

ALTERNATIVE 1: NO ACTION

Riparian, Wetland and Floodplain Areas

The No Action Alternative would continue the management of ROWs in the activity area by only mechanical means, including, hand tools and heavy equipment.

In general, mechanical methods that disturb soil (heavy equipment or scraping actions) are not appropriate for use near riparian areas, floodplains, water bodies or wetlands, or on steep slopes, or in areas of soft soils. Wetland, riparian and floodplain areas may also be subjected to indirect minor adverse effects by impacts from heavy machinery use in upland habitats. The erosion of disturbed and loosened soil can wash important nutrients away from the system and deposit sediments in wetlands or riparian areas, thus, filling in wetlands and creating increased turbidity and decreased O_2 (oxygen) concentrations in the water (Mitsch and Gosselink 2000). However, mitigation measures developed by the USDA Forest Service, such as buffers of 100 feet to protect wetland, riparian areas/springs, if implemented, should protect riparian management zones within the analysis area (FSM 2526.03).

In summary, mechanical methods for ROW maintenance can cause problems when used in wetland, floodplain and riparian areas and the potential for adverse effects, primarily due to erosion, do exist. However, if Forest Service measures developed to protect riparian areas are adhered to, the No Action Alternative of continuing with mechanical vegetation control for ROWs within the National Forests will have no additional

significant direct, indirect, immediate or cumulative effects (adverse or beneficial) on wetland, floodplain, or riparian areas within the analysis area.

ALTERNATIVE 2: PROPOSED ACTION

Riparian, Wetland and Floodplain Areas

Risk characterizations of herbicides conducted by the EPA and other independent agencies, confirm that the proper use of herbicides most commonly used in modern silviculture are not likely to present a risk to fish and wildlife (Giesy et al. 2000). Further, according to manufacturers' labeling, glyphosate and imazapyr are approved for aquatic use.

Due to the selective nature of spot applications, vegetation in environmentally sensitive areas can be treated with herbicides with less impact than other application methods. In all instances, herbicide application for ROW maintenance will comply with manufacturers' label directions, Forest Plan standards and Best Management Practices (BMPs), which are designed to protect streams from siltation and contamination by herbicides.

Mitigation measures developed by the USDA Forest Service, such as buffers of 100 feet around all riparian and wetland zones, should protect riparian and wetland areas within the analysis area (FSM 2526.03). Because the use of hand tools and herbicide application do not disturb the soils, herbicide usage will help protect water quality and maintain site productivity by preventing siltation and erosion. Neary and Michael (1996) declare that herbicides do not increase natural erosion rates. Sediments retained on-site do not contribute to additional nutrient loadings or physical deterioration of aquatic ecosystems and water resources through increased turbidity (Neary and Michael 1996). Maxwell and Neary (1991) concluded that the impact of vegetation management techniques on erosion and sedimentation of water resources is herbicides<fire<mechanical. The study also concluded that sediment losses during inter-rotation vegetation management could be sharply reduced by using herbicides and moderate burning instead of mechanical methods and heavy burning.

The proposed action involves the specific direct application of herbicide mixtures to woody species stems and spot spraying of individual target plant foliage. The selective herbicide treatment process suppresses woody stems that can out-compete sensitive non-target plant species critical to the areas. The use of hand-applied herbicides also reduces or eliminates the potential for heavy equipment to impact non-target vegetation.

In summary, if all label directions and Forest Service directives are followed, there are no foreseen significant potential immediate or cumulative adverse effects to riparian areas within the analysis area from the proposed action. Herbicide use for ROW maintenance promotes the establishment of a permanent herbaceous/shrub vegetation community that provides increased soil stability, which reduces the potential for erosion and resulting sedimentation. This would create minor immediate and moderate beneficial cumulative effects by reducing current erosional processes and the subsequent siltation into streams and wetlands. Consequently, there would be no adverse direct, indirect, immediate or cumulative effects to riparian areas, aquatic habitats or wildlife and fisheries communities from implementation of the Proposed Action Alternative.

FISH AND WILDLIFE

Affected Environment

Wildlife and Fisheries management across the analysis area is a cooperative effort between numerous state and federal agencies including the Ozark and Ouachita National Forests, Arkansas Game and Fish Commission and the US Fish and Wildlife Service. The analysis area contains a wide variety of habitats within the Arkansas Valley, Boston Mountains, Ouachita Mountains and the Ozark Highlands Level III ecoregions and can be further broken down into nine Level IV ecoregions. Within each ecoregion is a variety of ecological communities supporting an abundance of wildlife and fish species. The occurrence and distribution of fish and wildlife species within the analysis area is dependent upon the regional and local terrestrial and aquatic habitats available. See Appendix 5 for a detailed description of the ecoregions found within the analysis area and a list of the common flora and fauna associated with each ecoregion.

The large relatively unfragmented blocks of natural habitats found on the Ozark and Ouachita National Forests represent some of the last and best examples of native ecosystems in their respective regions. For this reason, they are havens for native flora and fauna including many species that are rare and declining. These lands are especially important to species requiring large areas of undeveloped habitat (such as black bear), species requiring large blocks of mature forest (such as some forest songbirds) and species dependent on appropriate kinds of ecological disturbance (such as periodic fire) (USDA Forest Service 2005b,c,d,e).

ALTERNATIVE 1: NO ACTION

Fish and Wildlife

The No Action Alternative provides for the continuing maintenance of ROWs on National Forest lands by means of mechanical methods only. These mechanical methods consist of the use of hand tools and heavy equipment with extendable booms, cutters and trimmers as well as skidder type units. Mechanical methods, especially heavy equipment, have the potential to adversely affect the physical characteristics of soils and in turn affect both the hydrologic function and site productivity of wildlife habitat by creating erosion pathways and compaction of the soil.

Many wildlife and fish species are highly susceptible to the disturbance and siltation of their aquatic habitat. Along with degrading critical habitat, mechanical methods produce high levels of noise, which can have adverse effects on breeding birds and other sensitive species of wildlife. The use of heavy equipment for vegetation maintenance has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests (Hall et al. 1999, Johnson et al. 2000, Kingsbury 2002, Nazdrowicz 2003, Wilsmann and Sellers 1988). Wildlife species inhabiting the area during cutting activities are at risk of disturbance, injury or death from impact with the equipment.

Generalized cutting with heavy equipment immediately controls the potentially damaging woody vegetation, but does not stop the re-growth of woody stems. Since many woody stem plant species remain viable and re-sprout, there is continuing and increasing

competition with grasses and other herbaceous groundcovers that provide habitat for quail, turkey and other game species.

Some wildlife may flee the area due to noise and vibrations from the machinery, lessening the potential risk for injury or death to those species from cutting activities. However, active nests, along with slow moving and fossorial species, would remain at risk from impacts with machinery. Mechanically cleared ROWs may provide benefits for some wildlife, such as improving habitat for disturbance dependent species. However, cutting or mowing the entire ROW corridor may destroy desirable plant species and existing habitat and the use of heavy equipment during nesting or mating may inhibit species propagation.

The use of heavy equipment for vegetation maintenance produces high levels of noise for a short period of time, which can temporarily disturb breeding birds and other species of wildlife. The No Action Alternative has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests, providing a minor immediate adverse effect. Further, since many woody stem plants remain viable and re-sprout after mechanical treatment, there is continuing and increasing competition with grasses and herbaceous groundcover that provide habitat for quail, turkey, deer and many non-game species. The regrowth can provide needed cover for quail and other wildlife species and future nesting habitat for shrub nesting birds.

Although the use of heavy equipment for vegetation maintenance may temporarily degrade wildlife habitat in ROWs and directly affect individuals or nests, no significant adverse cumulative effects to wildlife and fish populations' viability within the analysis area are expected.

ALTERNATIVE 2: PROPOSED ACTION

Fish and Wildlife

The Forest Service is legislatively mandated to manage National Forests for multiple use and sustained yield of the products and services. With vegetation, this includes management for timber, wildlife habitat or aesthetic purposes. The desired species to be promoted in an area will depend upon the management goals and objectives (USDA 2007). Herbicides have become an attractive alternative to other forms of vegetation management (e.g., mechanical mowing) because of cost-effectiveness, selectivity and ease of application (Hunter 1990, Wigley et al. 2002). However, there is significant public concern with herbicide use due to fears of potential toxicity to fish and wildlife (Tatum 2004) and herbicides are viewed by many as a factor affecting environmental sustainability (Wagner 1993, Lautenschlager and Sullivan 2002, Layton et al. 2003). Concerns over possible direct toxic effects of herbicides on wildlife and indirect effects resulting from alteration of wildlife habitats have, in some instances, led to constraints on the use of forest herbicides (Guynn 2004).

By US Congressional direction, EPA administrators have the responsibility of assessing the effects of herbicide use on the environment and public health (SAF 1978). For terrestrial animals, the primary route of exposure to herbicides used in forestry is through the consumption of treated vegetation or other affected food items. For aquatic

organisms, the primary route of exposure is direct contact with herbicide residues in the water (Tatum 2004). Amphibians, in particular, are often identified as species that might be especially sensitive to silvicultural chemical use. Recent publications by Relyea (2005a, 2005b) implicate the use of glyphosate-containing herbicides to the global decline of amphibians. However, assumptions of Relyea's experimental design exaggerate the potential impact of glyphosate-containing products to aquatic species. There are no other data that suggest the use of glyphosate-containing herbicide products is responsible for global declines in amphibian populations (Langeland 2006). Furthermore, the preponderance of scientific research suggests that amphibians do not exhibit a general pattern of greater sensitivity than other aquatic organisms to herbicides (Giesy et al. 2000, Langeland 2006, Tatum 2004).

Several scientific papers have concluded that herbicide use has no appreciable effect on the wildlife species or communities under study (Savidge 1978, Gruver and Guthery 1986, Freedman et al. 1988, Sullivan 1990, Hood et al. 2002). However, if used indiscriminately herbicides may potentially affect ecosystems by direct toxicity to non-target organisms, compromising water quality or altering plant communities and habitat structure (Miller and Miller 2004). When applied according to label directions, however, concentrations of silvicultural herbicides are typically much lower than the concentrations associated with adverse effects on both fish and wildlife (Tatum 2004). Risk characterizations on herbicides conducted by the EPA and other independent agencies confirm that proper use of herbicides most commonly used in modern silviculture are not likely to present a risk to fish and wildlife in the analysis area (Giesy et al. 2000).

The proposed action involves the direct application of herbicide mixtures to woody species stems or spot spraying of individual plant foliage. Herbicide mixtures would be applied to targeted woody stem vegetation only, including brush and trees, within the utility ROWs, reducing or eliminating the need for mechanical methods. Grasses and other types of non-woody vegetation are not treated, nor are any products or mixtures broadcast, sprayed aerially, applied on the ground or on surface waters. The mixtures are applied by individuals using low-pressure backpack sprayers, walking the utility corridor ROWs. Mixtures are combinations of water and commercial herbicide formulations, which are themselves mixtures of active chemicals and inert properties.

In many cases the use of herbicide is the least ecologically invasive vegetation control technique available (Tatum 2004). Scientific evaluations and professional practice have demonstrated that herbicides are a safe and effective method of managing forest vegetation (Neary and Michael 1996). Although, as with any forest management tool, herbicides must be used judiciously in order to minimize adverse effects to the environment (Miller and Miller 2004, SAF 1978). The use of herbicides carries less overall risk than alternative vegetation control methods and often requires less energy to implement (Walstad et al. 1987). The modes of action (targeted to plant processes), short persistence, lack of accumulation in food chains and the rapid excretion by animals of forest herbicides minimizes chronic exposure. Therefore, chronic toxicity is not significant for herbicides currently registered for forest use (SAF 1978, USDA Forest

Service 1989a, 1989b, 1990). However, training in the properties and appropriate use of herbicides for all staff involved is necessary before planning, prescribing, applying, evaluating and monitoring herbicide programs (SAF 1978).

Utilization of herbicides for ROW maintenance would minimize soil erosion and compaction, lower carbon emissions and extend the time between required vegetation management activities; thus reducing the adverse anthropogenic (human) effects of ROW maintenance to fish and wildlife species. The Proposed Action Alternative would further minimize adverse effects on wildlife species inhabiting the analysis area by reducing noise and vehicle disturbance during the treatment periods. Due to the fact that many bird and reptile species use ROW habitats for reproduction (Congdon et al.1993, Dodd 2001, Fink et al. 2006, Yahner 2004), the application of herbicides on foot should increase the reproductive success of these species within the analysis area. The Proposed Action Alternative would also minimize the inadvertent crushing or chopping of wildlife by heavy equipment during ROW maintenance.

Herbicide use within ROWs may in fact be beneficial to many wildlife species by maintaining high quality early successional habitat important to a variety of wildlife species for food, cover and reproduction. A number of game and non-game species forage heavily on herbaceous and woody vine species and also use these areas for cover. Herbicide use for ROW maintenance would be beneficial to many insect species by releasing nectaring flowers that are their primary forage. A greater abundance of insects should be beneficial to species, such as insectivorous birds, occupying the analysis area by increasing the number of available prey. Furthermore, because the Proposed Action Alternative utilizes foot access for treatment activities, herbicide application for ROW maintenance should create less disturbance of and sediment problems to aquatic species of fish and wildlife.

Because forest herbicides target biochemical pathways unique to plants, do not persist in the environment, are nontoxic at normal application rates and do not bioaccumulate, adverse effects to wildlife due to toxicity and decreased water quality generally are not a concern among informed resource professionals (Borrecco et al. 1972, McComb and Hurst 1987, Freedman 1991, Tatum 2004). The adherence to US Forest Service regulations for herbicide use would facilitate the maintenance of ecological conditions that now support a diverse range of sensitive terrestrial, aquatic, semi-aquatic and amphibious flora and fauna inhabiting the analysis area (USDA Forest Service 2005b).

In summary, the strict adherence to Forest Service guidelines, manufacturers' label directions and BMPs during the use of herbicides for ROW management would have minimal direct, indirect or cumulative adverse effects upon aquatic ecosystems or fish and wildlife populations inhabiting the Ozark and Ouachita National Forests. The use of herbicides for ROW management would provide both immediate and moderate cumulative direct beneficial effects by maintaining high quality early successional habitat important to a variety of wildlife species for food, cover and reproduction and by indirectly reducing the adverse effects to wildlife applicable to mechanical maintenance methods.

PROPOSED ENDANGERED, THREATENED, OR SENSITIVE SPECIES (PETS)

Affected Environment

As documented in the Endangered Species Act of 1973, the United States has pledged itself to protect all species of flora and fauna that are in danger of or threatened with extinction (ESA 1973). Therefore, when proposing any Action Alternative it is crucial to ensure the protection of Threatened, Endangered, Sensitive and Species Proposed for Listing (PETS) possibly inhabiting the Ozark and Ouachita National Forests. The Proposed Action Alternative analyzed in this document will adhere to the Plan Direction for Threatened and Endangered Species measures found in Biological Assessment for the Ozark-St. Francis National Forests Land Resource Management Plan (USDA Forest Service 2005a). These project mandatory protective measures are consistent and compatible with the Ouachita National Forest Land and Resource Management Plan (USDA Forest Service 2005d). In addition, current risk assessments prepared for the USDA Forest Service by Syracuse Environmental Research Associates, Inc. for each proposed herbicide to be used in implementation of this project were consulted and are incorporated by reference (USDA Forest Service 1999 and 2003).

Mitigation measures and BMPs developed by the USDA, such as buffer strips around sensitive areas, should be strictly adhered to in order to ensure minimum impact to sensitive non-target species and environments. Herbicides should not be applied within 60 feet of any Threatened, Endangered, Proposed or Sensitive plant. To minimize the disturbance of imperiled bat species possibly inhabiting the analysis area, herbicides should not be applied within 60 feet of any known bat population or possible habitat (caves and selected talus areas). Herbicide mixing, loading or cleaning areas in the field should not be located within 300 feet of any wetlands, open water or wells, or other sensitive areas (USDA Forest Service 2005e). Buffer zone limits for herbicide application near sensitive areas would be under the direction of the Forest Service.

A Biological Evaluation, also called a Biological Assessment (BE/BA), documenting the possible effects of the Proposed Action Alternative to known and potential populations and habitat of PETS plant and animal species within the analysis area was prepared. All federally listed (Threatened or Endangered) species and all Regional Forester's (Region 8) Sensitive listed species known to occur or with the potential to occur on the Ozark and/or Ouachita National Forests within or near ROWs were considered in the BA/E for this analysis. A list of PETS species requiring special consideration was compiled (Tables 14a and 14b).

Table 14a – Federally Threatened and Endangered Species for the Ozark and Ouachita NFs Given Special Consideration in this EA.

Species	Common	Status	Comments
Nicrophorus americanus	American Burying Beetle	E	Potential habitat does exist. Treatments may have slight effects on prey base.
Inflectarius magazinensis	Magazine Mountain Shagreen	T	Occurs in restricted habitat on Mt. Magazine. Talus areas will not be treated.
Myotis grisescens	Gray Bat	E	Potential habitat does exist. Treatments will not affect this species.
Myotis sodalis	Indiana Bat	E	Potential habitat does exist. Treatments will not affect this species.
Corynorhinus townsendii ingens	Ozark Big-eared Bat	E	Potential habitat does exist. Treatments will not affect this species.
Picoides borealis	Red-cockaded woodpecker or RCW	E	Potential habitat does exist. Treatments will not affect this species.

Table 14b – Regional Forester's Sensitive Species for the Ozark and Ouachita NF Given Special Consideration in this EA.

Species	Common	Comments
Myotis leibii	Eastern small-footed bat	Potential habitat does exist. Treatments will not affect this species.
Aimophila aestivalis	Bachman's sparrow	Uses early seral herbaceous vegetation
Percina nasuta	Longnose darter	Potential habitat does exist. Mechanical equipment could crush eggs at stream crossings
Amorpha ouachitensis	Ouachita false indigo	Potential habitat does exist. Treatments may affect individuals
Callirhoe bushii	Bush's poppymallow	Potential habitat does exist. Treatments may affect individuals
Castanea pumila var. ozarkensis	Ozark chinquapin	Potential habitat does exist. Treatments may affect individuals
Eriocaulon koernickianum	Gulf pipewort	Potential habitat does exist. Treatments should not affect individuals
Tradescantia ozarkana	Ozark spiderwort	Potential habitat does exist. Treatments may affect individuals
Trillium pusillum var. ozarkanum	Ozark least trillium	Potential habitat does exist. Treatments may affect individuals
Speyeria diana	Diana fritillary	Potential habitat does exist. Treatments may enhance nector producing plants used by this species.
Lanius ludovicianus migrans	Migrant loggerhead shrike	Potential habitat does exist. Treatments may enhance habitat for this species.
Amorpha paniculata	Panicled false indigo	Potential habitat does not exist. Treatments will not affect this species
Vernonia lettermannii	Narrowleaf ironweed	Potential habitat does exist. Treatments may affect individuals.

Field Surveys

ATOKA Environmental Biologists and support staff conducted extensive field surveys within the analysis area from April 2 to April 19 and June 11 to June 20, 2007. Forest Service Biologists were contacted by the investigators before the start of field surveys to gather the most current inventory data and known species locations. These key contacts are listed, along with all other Forest Service contacts, in the section titled Consultation and Coordination.

The analysis survey area included 300 feet on either side of the centerline of all ROWs, for a total width of 600 feet, occurring on National Forest lands permitted for the rural electric cooperative on portions of the Ozark and Ouachita National Forests. The Region 8 Sensitive Species list was reviewed for species possibly occurring in the Ozark and Ouachita National Forests. The need to conduct site-specific PETS species surveys for this project was then assessed after consultation with Forest Service biologists, a review of the scientific literature, known PETS occurrence and ARC GIS were used to determine specific habitats within the analysis area most likely to support populations of PETS species. Within the analysis area habitats deemed suitable, as well as any documented locations, for PETS species were surveyed. A review of known occurrences and a thorough literature review were conducted for the 19 species listed in Table 14a and Table 14b (see Appendix 8).

Some of the reasons for excluding PETS species from site-specific inventories include the following:

1. The species is unlikely to occur because habitat is not present or the analysis area is outside the species' range;
2. A current and adequate site-specific inventory for the specific species is already available;
3. Survey methods are not feasible or effective;
4. Although adverse effects to habitat or impacts to individuals may occur, knowing numbers and location of individuals would not improve application of mitigation.

PETS Species

Field surveys were scheduled to coincide with the regional flowering periods of the flora and active season for fauna on the Forest Service PETS list of concern for the analysis area. Plant surveys were conducted along ROWs and extended approximately 100 feet on either side of the centerline. Field surveys were conducted in two sessions to maximize the likelihood of encountering flora on the PETS species list during the flowering season for each plant species. Floristic site examination procedures described in Goff et al. (1982) were implemented, focusing on US Forest Service PETS list of concern and non-native invasive plants as requested by Forest Service biologists.

Field surveys were also conducted within the analysis area for the presence of fauna on the US Forest Service PETS list during this time period. Geologic maps were used to determine areas likely to hold bat hibernacula and active season roosting areas (sandstone overhangs, limestone caves, large trees with exfoliating bark) and those areas were surveyed for the presence of bat sign (guano and insect wings). A majority of the

ROWs within the analysis area were visited to verify the parent material shown on geological maps. All possible active season roosting areas encountered within the analysis area were also searched for bat sign. ARC GIS was used to identify bodies of water within 1 mile of the analysis area large enough to support bald eagle nesting activity (Peterson 1986). All bodies of water meeting these criteria were surveyed on foot, with binoculars, for sign of nesting bald eagles.

ALTERNATIVE 1: NO ACTION

PETS Species

The No Action Alternative provides for the continuing maintenance of ROWs on National Forest lands by mechanical methods only. These mechanical methods consist of the use of heavy equipment with extendable booms and cutters as well as skidder type units. Mechanical methods have the potential to affect the physical characteristics of soils, and in turn affect both the hydrologic function and site productivity of wildlife habitat by creating erosion pathways and compaction of the soil. Many aquatic PETS species, such as *Percina nasut* are highly susceptible to disturbance and siltation of their aquatic habitats.

Generalized cutting with heavy equipment immediately controls the woody vegetation, which is potentially damaging to power lines, but does not stop the re-growth of many woody plant species. Since the woody stem plants remain viable and re-sprout, there is continuing and increasing competition with grasses and other herbaceous groundcovers that could provide nesting and foraging habitat for many PETS species inhabiting the analysis area (see Appendix 8). Along with degrading wildlife habitat, mechanical methods produce high levels of noise, although localized and short term, which can have temporary effects on sensitive PETS species. The use of heavy equipment for vegetation maintenance has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests. Mechanical methods for ROW maintenance are also ineffective at controlling non-native invasive plants, which may invade sensitive habitats, and are known to facilitate their spread, further degrading wildlife habitat (Miller 2006).

In summary, the use of heavy equipment for vegetation maintenance maintains wildlife habitat and produces high levels of noise for a short period of time, approximately once every three years. The No Action Alternative has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests. This event will happen once in a three year period. Since many woody stem plants remain viable and re-sprout after mechanical treatment, there is continuing and increasing competition with grasses and herbaceous groundcover that provide habitat for early successional PETS species such as Bachman's Sparrow and Diana fritillary. Although the use of heavy equipment for vegetation maintenance has the immediate minor adverse effect of degrading wildlife habitat within power line ROWs, the activity is not likely to cause a loss of population viability that could lead to federal listings of PETS species. Therefore, no significant cumulative adverse effects are anticipated by continuing the use of mechanical methods in the No Action Alternative.

A detailed account, including an Environmental Baseline, Survey Information for each of the PETS species listed in Table 14a and Table 14b as well as a table defining the types of effects identified is provided in Appendix 8.

Since the possible disturbance of active season roosts by machinery would be a rare event and the degradation of foraging habitat is not expected, there should be no effect on the Ozark Big-eared bat *(Corynorhinus townsendii ingens)*, Gray bat (*Myotis grisescens*), or Indiana bat *(Myotis sodalis)* by the No Action Alternative.

Mechanical means of ROW maintenance has been shown to cause the incidental mortality of many species inhabiting the ROW. Because carrion is such an important part of the *N. americanus* diet and necessary for reproduction, mechanical means may be benefited once in a beetle's lifetime. Since this would only happen once in a 3-year period there should be no effect on the American burying beetle (*Nicrophorus americanus*).

Since the possible disturbance of active season roosts by machinery is unlikely and at most would be limited to once every three years, there should be no impact on Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) or the Eastern small-footed myotis (*Myotis leibii*). There could be impacts to nests of Bachman's sparrow (*Aimophila aestivalis*) due to mowing. However, mowing maintains habitat conditions needed for nesting in the following years.

The potential of increased turbidity is rare and insignificant and the possibility of incidental mortality to individuals during mechanical equipment creek crossings is extremely remote but there is a possibility that Longnose darter eggs could be crushed when equipment crosses streams. Mowing maintains early seral habitat that provides nectar plants for the Diana fritillary (*Speyeria Diana*). Continuing the No Action Alternative should continue to provide limited habitat for this species.

Due to the indiscriminant removal of all plant species during ROW maintenance, many plants present within a ROW have the potential to be adversely affected by mechanical ROW maintenance. Therefore, effects of the No Action Alternative on Small-headed pipewort (*Eriocaulon koernickianum*), Ozark chinquapin *(Castanea pumila var. ozarkensis)*, Ouachita leadplant (*Amorpha Ouachitensis*), Ozark spiderwort (*Tradescantia ozarkana*), Bush's poppymallow *(Callirhoe bushii)*, Nuttall's cornsalad (*Valerianella nuttallii*), Ozark least trillium (*Trillium pusillum* var. *ozarkanum*) and Ozark cornsalad (*Valerianella ozarkana*) is limited to individuals and will not cause a trend to federal listing or a loss of viability.

ALTERNATIVE 2: PROPOSED ACTION

PETS Species

The Proposed Action Alternative involves the direct application of herbicide mixtures to target woody species stems or spot spraying of individual target plant foliage. Herbicides would be applied to target woody stem vegetation only, including brush and trees, within the utility ROWs, reducing or eliminating the need for mechanical methods. Grasses and other types of non-woody vegetation would not be treated, nor are any products or mixtures broadcast, sprayed aerially, applied on the ground or on surface waters. The mixtures are applied by trained individuals using low-pressure backpack sprayers, walking the utility corridor ROWs. Mixtures are combinations of water and commercial herbicide formulations, which are themselves mixtures of active chemicals and inert properties. All applications are under direct supervision of a certified, trained supervisor. This method of maintenance will be used approximately once every three years.

The scientific community has demonstrated that herbicides are a safe and effective method of managing forest vegetation. Risk characterizations on herbicides conducted by the EPA and other independent agencies confirm that the proper use of herbicides most commonly used in modern silviculture, including those proposed in this EA and are not likely to present a risk to fish and wildlife. Herbicides have also been documented as an effective method of controlling non-native invasive plants and these methods are currently in use by the Forest Service.

The Proposed Action Alternative will also minimize any potential adverse effects to PETS species inhabiting the analysis area. Bald eagles and many bat species are sensitive to human disturbance during mating and nesting periods and herbicide application on foot will create far less disturbance than heavy equipment with noisy mechanical cutters. Furthermore, the application of herbicides by foot access should create less disturbance of and sediment problems to, sensitive aquatic PETS species such as *Percina nasuta* (among several others). Herbicide use for ROW maintenance may also be beneficial to many species by releasing nectaring flowers that are the primary forage of insects such as *Speyeria Diana.*

In summary, the Proposed Action of using approved herbicides for ROW vegetation management, strictly following the Forest Service guidelines and applicable BMPs, would have minimal direct, indirect or cumulative adverse effects on PETS species populations inhabiting the Ozark and Ouachita National Forests. Use of herbicides for ROW management would maintain early successional habitat important to a variety of PETS species for food, cover, and reproduction. Herbicide use would indirectly reduce adverse impacts to PETS species applicable to mechanical maintenance methods. This will be little change from brush hogged ROWs however the quality of herbaceous vegetation will improve over time.

A review of known occurrences, habitat specific analyses of the National Forests, and a thorough literature review were conducted for all PETS species deemed necessary to be given a complete biological evaluation within the scope of the Action Alternatives (Table 14). A detailed account, including an Environmental Baseline, Survey Information, Potential Effects and Determination of Effects of the Proposed Action for each of the PETS species listed in Table 14 and a table defining the types of effects identified, is provided in Appendix 8.

Because the Proposed Action Alternative utilizes foot access for treatment activities, ROW with the use of herbicides should minimize the disturbance of sensitive species possibly inhabiting the project area. Therefore, the Proposed Action will not affect Ozark big-eared bat *(Corynorhinus townsendii ingens),* gray bat (*Myotis grisescens*) or Indiana bat *(Myotis sodalis).*

The maintenance of ROWs using herbicides should eventually increase the habitat quality in the project area for the American Burying Beetle by increasing the habitat quality for rodents and many bird species, which are the animal's primary prey. In addition, since adult ABB are active only at night, it is highly unlikely that ABB will be disturbed during herbicide applications. Therefore, the Proposed Action Alternative should not adversely affect the American Burying Beetle (*Nicrophorus americanus*).

The selective treatment of woody vegetation should increase the habitat quality of the ROWs within the analysis area for bird species that require early successional breeding habitat. Therefore, effects of the Proposed Action Alternative to the Bachman's Sparrow (*Aimophila aestivalis*) could be beneficial.

Because the Proposed Action Alternative utilizes foot access for treatment activities and a 100-foot buffer around all wetland areas, herbicide application for ROW maintenance should create minimal disturbance to wetland habitats. The Proposed Action Alternative should have no impact on the Longnose darter (*Percina nasuta*), and Gulf pipewort (*Eriocaulon koernickianum*).

Herbicide use for ROW maintenance may improve the habitat for various insect species including Diana Fritillary (*Speyeria Diana*) by releasing nectaring flowers that are their primary forage.

The proposed action involves the direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. However, the possibility does exist for incidental exposure of non-target species. Therefore, individual Ozark chinquapin *(Castanea pumila var. ozarkensis),* Ouachita leadplant (*Amorpha Ouachitensis*), Ozark spiderwort (*Tradescantia ozarkana*), Bush's poppymallow *(Callirhoe bushii),* Nuttall's cornsalad (*Valerianella nuttallii*), Ozark least trillium (*Trillium pusillum* var. *ozarkanum*) and Ozark cornsalad (*Valerianella ozarkana*) "may be impacted but this should not cause a trend to federal listing or loss of viability."

MANAGEMENT INDICATOR SPECIES (MIS)

As requested by the Forest Service, ATOKA biologists developed a list of Management Indicator Species (MIS) applicable to the Proposed Action Alternative. The National Forest Management Act (NFMA) regulations require the selection of MIS during the development of forest plans (36 CFR 219.19 [a] in effect prior to 2000 and, due to various court rulings, still followed in the development of the 2005 Revised Forest Plans).

Management Indicator Species are selected "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.19 [a] [1]). Limits to the usefulness and application of the MIS concept have been reflected in the scientific literature since the regulation requiring a MIS list for each Forest Service management plan was adopted in 1982 (Barry et al. 2006, Landres et al. 1988, Lindenmeyer 2000, Noss 1990, Simberloff 1998, Weaver 1995). New planning regulations for the National Forest Management Act, which eliminate the use of MIS, are not yet in effect. The "1982 regulations" remain in effect until a transition to the new regulations is completed.

After combining the Ozark and Ouachita National Forests' MIS lists from the 2005 Revised Plans (USDA Forest Service 2000d, e), the process of elimination was used to screen out species that would not be affected by the Proposed Action Alternative. The process procedure used for this EA is as follows:

(1) Elimination of those species not dependent on early successional habitat or not affected by management activities. This included species found in various habitat types and considered to be habitat generalists. During the species selection process, it was taken into account that the utility corridors were pre-existing and no additional ROWs would be constructed.

(2) Elimination of species that have a limited distribution across the analysis area as well as transient species and non-residents, which are not significantly dependent on national forest lands.

(3) Eliminated species that could not be suitably evaluated due to the lack of information or the need of a usable monitoring procedure.

(4) The resulting list was then examined to identify species with the most limiting requirements on forest seral stages and special habitat components present within the analysis area.

(5) Major habitat components were examined to determine adequate species representation.

(6) High demand species were added to represent public interest and address issues and concerns.

Management Indicator species (MIS) reviewed for the Utility Corridor Vegetation Management Assessment are displayed in Table 15.

Table 15: MIS For Ozark and Ouachita National Forests

Common Name	Scientific Name	Selected for USF Project?
Black Bear	*Ursus americanus*	No. Habitat Generalists.
White-tailed Deer	*Odocoileus virginianus*	Yes
Northern Bobwhite	*Colinus virginianus*	Yes
Eastern Wild Turkey	*Meleagris gallapavo*	Yes
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Yes
Red-cockaded Woodpecker	*Picoides borealis*	Coverd in Threatened and Endancered Species section
Pileated Woodpecker	*Dryocopus pileatus*	Snag depedent species.
Scarlet Tanager	*Piranga olivacea*	Yes
Prairie Warbler	*Dendroica discolor*	Yes
Rufous-crowned Sparrow	*Aimophila ruficeps*	No. Limited distribution across analysis area.
Acadian Flycatcher	*Empidonax virescens*	No. Interior Forest Species.
Cerulean Warbler	*Dendroica cerulea*	No. Interior Forest Species.
Northern Parula	*Parula americana*	No. Lack of habitat in the analysis area.
Brown-headed Nuthatch	*Sitta pusilla*	No. Limited distribution across analysis area.
Ovenbird	*Seiurus aurocapilla*	No. Interior Forest Species.
Largemouth Bass	*Micropterus salmoides*	Yes
Smallmouth Bass	*Micropterus dolomieu*	Yes
Bluegill Sunfish	*Lepomis macrochirus*	Yes
Redear Sunfish	*Lepomis microlophus*	Yes
Yellow Bullhead	*Ameiurus natalis*	Yes
Central Stoneroller	*Campostoma anomalum*	Yes
Redfin Darter	*Etheostoma whipplei*	No. Limited distribution across analysis area.
Green Sunfish	*Lepomis cyanellus*	Yes
Longear Sunfish	*Lepomis megalotis*	Yes
Johnny Darter	*Etheostoma nigrum*	No. Does not occur in the analysis area.
Orangebelly Darter	*Etheostoma radiosum*	No. Does not occur in the analysis area.
Northern Studfish	*Fundulus catenatus*	No. Limited distribution across analysis area.
Northern Hog Sucker	*Hypentelium nigricans*	Yes
Striped Shiner	*Luxilus chrysocephalus*	Yes
Channel Darter	*Percina copelandi*	No. Does not occur in the analysis area.
Pirate Perch	*Aphredoderus sayanus*	No. A Coastal Plain species.
Creek Chubsucker	*Erimzon oblongus*	No. Limited distribution across analysis area.

TERRESTRIAL MIS

The analysis area contains a wide variety of terrestrial habitats within the Arkansas Valley, Boston Mountains, Ouachita Mountains and the Ozark Highlands ecoregions, formerly referred to collectively as the Ozark-Ouachita Plateau. The predominant habitats found in the analysis area are: Mixed Pine-Oak Forest (38%), Dry-mesic Oak Forest (32%), Shortleaf Pine (14%), Agriculture (8%) and Glade Barrens (7%). Wetland, riparian and floodplain areas encompass only 1% of the analysis area. There would be no change in the percentage of each habitat by the implementation of either alternative. Appendix 5 provides detailed descriptions of the ecoregions within the analysis area and a list of the common flora and fauna associated with each.

Terrestrial MIS potentially affected by the proposed Alternatives are shown in the following Table 16. Each MIS is addressed in detail in the following sections.

Table 16: Potentially Affected Terrestrial Management Indicator Species

Common Name	Scientific Name	Habitat Type
White-tailed Deer	*Odocoileus virginianus*	Generalist; often uses forest edges and early successional habitats
Northern Bobwhite	*Colinus virginianus*	Patchy habitat with abundant early successional communities
Eastern Wild Turkey	*Meleagris gallopavo silvestris*	Mature forest with abundant early successional communities
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Mature forests with an open understory and abundant snags
Scarlet Tanager	*Piranga olivacea*	Mature forest communities

ALTERNATIVE 1: NO ACTION

Terrestrial MIS

The No Action Alternative temporarily degrades wildlife habitat and produces high levels of noise for a short period of time, approximately once every two to three years which can have temporary immediate adverse effects on breeding birds and other sensitive species of wildlife. Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of vegetation disturbance. The use of heavy equipment for vegetation maintenance has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests. Since many woody stem plants remain viable and re-sprout after mechanical treatment, there is continuing and increasing competition with grasses and herbaceous groundcover that provide habitat for quail, turkey and non-game MIS species. MIS that rely on mature successional habitat components, such as the scarlet tanager, would not suffer any additional adverse edge effects due to implementation of the No Action Alternative due to the fact that analysis area ROWs are pre-existing.

ALTERNATIVE 2: ACTION

Terrestrial MIS

The proposed action involves the direct application of herbicide mixtures to woody species stems or spot spraying of individual plant foliage, subsequently reducing or eliminating mechanical methods. Herbicide mixtures would be applied to targeted woody stem vegetation only, including brush and trees, within the utility ROWs. Grasses and other types of non-woody vegetation are not treated, nor are any products or mixtures broadcast, sprayed aerially, applied on the ground or on surface waters. The mixtures are applied by individuals using low-pressure backpack sprayers, walking the utility corridor ROWs.

Over time, the proposed use of herbicides for ROW maintenance should convert much of the activity area into an early successional community suitable for many wildlife species. Early successional habitat is important to a variety of both game and non-game wildlife species by providing food, cover and habitat suitable for reproduction. MIS that rely on

mature successional habitat components, such as the scarlet tanager, would not suffer any additional adverse edge effects due to implementation of the Proposed Action Alternative due to the fact that analysis area ROWs are pre-existing.

A number of game and non-game species forage heavily on herbaceous and early successional vegetative species, and also use these areas for cover. Herbicide use for ROW maintenance would be beneficial to many insect species by releasing nectaring flowers that are their primary forage. A greater abundance of insects should be beneficial to insectivorous species, such as insectivorous birds, occupying the analysis area by increasing the number of available prey. Furthermore, because the Proposed Action Alternative utilizes foot access for treatment activities, herbicide application for ROW maintenance should create less disturbance of and sediment problems to aquatic species of fish and wildlife.

The following terrestrial MIS are addressed individually.

WHITE-TAILED DEER ***Odocoileus virginianus***

The white-tailed deer was selected as an MIS for this project because of its game status, economic importance and its use of early successional openings and associated edges for foraging habitat and cover.

The whitetail deer is one of the most sought after and economically important big game species in the United States. In many U.S. states and Canadian provinces, hunting for white-tailed deer is deeply ingrained in local cultures and is central to the economy of many rural areas. White-tailed deer are generalists and can adapt to a wide variety of habitats, including most forest types, forest edges and brushy areas (Smith 1991). The species benefits from a mosaic of habitats including second-growth forest, openings and farmlands created by anthropogenic activities such as timber harvest and agriculture. These activities have seemingly mimicked many natural disturbances (i.e., fire, blowdowns) that retard succession and create forest openings and early successional habitats important in providing forage preferred by the white-tailed deer (McCabe and McCabe 1984, Segelquist et al 1972).

White-tailed deer range from southern Canada throughout most of the coterminous United States (absent in Utah, rare in Nevada and California), southward to northern South America (NatureServe, 2007, Smith 1991). However, the species is absent from much of southwestern U.S, where a lack of cover and precipitation may be limiting factors (Smith 1991). Southernmost populations in the neotropics may represent other species (Molina and Molinari 1999). The white-tailed deer is widespread and common in suitable habitat throughout the project area.

ALTERNATIVE 1: NO ACTION

White-tailed Deer

Direct Effects

There would be no direct effects on adult deer and mobile young, but newborn fawns bedded down in ROWs during maintenance could be killed or injured.

Indirect Effects

Manual maintenance of ROWs would maintain a preferred foraging habitat for white-tailed deer. Hunting conditions in ROWs should be maintained. No change in huntable deer populations due to ROW maintenance is likely.

Cumulative Effects

Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of vegetation disturbance. The No Action Alternative is not expected to affect the long-term population trends of the white-tailed deer.

ALTERNATIVE 2: ACTION

White-tailed Deer

Direct Effects

Deer bedded down in or adjacent to ROWs may be temporarily displaced during ROW management activities.

Indirect Effects

The reduction in the density of hardwood stems would allow a flush of forbs, legumes (herbaceous) and grass species that produce fruits, seeds and forage used by deer. Hunting conditions in ROWs may improve but a dramatic increase in huntable deer populations is unlikely.

Cumulative Effects

Over time, the proposed use of herbicides for ROW maintenance should convert much of the ROWs within the project area into early successional community, providing cover and foraging habitat and increase the time between maintenance activities. However, the Proposed Action Alternative is not expected to affect the long-term population trends of the white-tailed deer.

NORTHERN BOBWHITE *Colinus virginianus*

The Northern Bobwhite was selected as an MIS for this project because of its small game status, economic importance and to help indicate the effects of management of ROWs as early successional herbaceous communities.

The Northern Bobwhite is economically one of North America's most important game birds, especially in the southern and Midwestern United States (Brennan 1999). Bobwhites require a diverse, patchy habitat that includes open areas of herbaceous vegetation, a rich source of associated invertebrates, grassy areas for nesting, heavy brush or woody cover and bare ground with little litter cover (Roseberry and Sudkamp 1998, Rosene 1984). Bobwhites tend to be associated with early successional plant communities. Abundant herbaceous plants, seed crops, fruits and insect prey items found in this cover condition are important in the life history of this upland game species

(Rosene 1984, Dimmick et al. 2004). Within the analysis area, the Northern Bobwhite usually occurs in oak savanna and woodland, restored glades, native fields, early seral forest (0-5), and thinned and burned forest areas.

The Northern Bobwhite is a non-migratory species that is widely distributed throughout the eastern United States and Mexico, and has been documented in suitable habitat across much of the analysis area. However, the once abundant game bird appears to be in decline over much of its range. Broad-scale data derived from Christmas Bird Count, U.S. Fish and Wildlife Service Breeding Bird Survey and state game agencies point to strong evidence of widespread decline throughout U.S. (Brennan 1999, NatureServe 2007).

ALTERNATIVE 1: NO ACTION

Northern Bobwhite

Direct Effects

There would be no direct effects on adult birds and mobile chicks, but existing nests with eggs may be damaged or destroyed if maintenance operations occur during the nesting season. Bobwhites may be temporarily displaced during ROW management activities and females may abandon nests adjacent to analysis area ROWs.

Indirect Effects

Manual maintenance within the ROWs would temporarily eliminate nesting habitat after each maintenance cycle; however, the cycle provides for needed bare ground and brushy habitats.

Cumulative Effects

Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of disturbance. The No Action Alternative is not expected to affect the long-term population trends of the Northern Bobwhite.

ALTERNATIVE 2: ACTION

Northern Bobwhite

Direct Effects

There would be no direct effects on adult birds or mobile chicks, but existing nests within ROWs may be disturbed if herbicide applications occur during the nesting season. Individuals nesting in or adjacent to ROWs may be temporarily displaced during ROW management activities and females may abandon nests.

Indirect Effects

The Proposed Action Alternative should result in improved quality of suitable nesting and brood habitat within the ROWs. Hunting conditions within ROWs would be improved, but a dramatic increase in huntable bobwhite populations is unlikely.

Cumulative Effects

Over time, the proposed use of herbicides for ROW maintenance should convert much of the ROWs within the project area into a semi-permanent early successional community

providing quality brooding and nesting habitat. However, the Proposed Action Alternative is not expected to affect the long-term population trends of the Northern Bobwhite.

EASTERN WILD TURKEY ***Meleagris gallopavo silvestris***

The Eastern Wild Turkey was selected as an MIS for this project because of its game status, economic importance and its use of early successional openings for breeding and brooding habitat.

The Eastern Wild Turkey is a highly prized game animal of economic importance that uses a wide range of habitat types. However, the species is dependent on forage from grass and forb openings (seeds, fruits, berries, insects), interspersed with older timber stands capable of producing hard (acorns) and soft (fruits/berries) mast. Breeding and nesting habitat consists of small openings in forest patches, along the edge of timber stands bordering fields, roadside vegetation and along ROWs. Throughout the wild turkey's range, brood-rearing habitat is characterized by herbaceous vegetation interspersed with forest. Herbaceous vegetation is important because it provides an ideal foraging environment with abundant insect and spider populations that meet the protein requirements of poults (young birds) through the age of eight weeks (Dickson 2001, Porter 1992).

The Eastern Wild Turkey's is a non-migratory species with a native range that includes New England and southern Canada, extending south to northern Florida and west to Texas, Missouri, Iowa and Minnesota. Eastern Wild Turkey populations appear to be wide spread and stable across the analysis area.

ALTERNATIVE 1: NO ACTION

Eastern Wild Turkey

Direct Effects

There would be no direct effects on adult birds and mobile chicks, but existing nests with eggs within ROWs would be damaged or destroyed if maintenance operations occur during the nesting season. Turkeys nesting adjacent to ROWs may be temporarily displaced during ROW cutting activities and females may abandon nests.

Indirect Effects

Manual maintenance within the ROWs would temporarily eliminate nesting habitat. A dramatic decrease in huntable turkey populations is unlikely.

Cumulative Effects

Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of disturbance. However, the No Action Alternative is not expected to affect the long-term population trends of the Eastern Wild Turkey.

ALTERNATIVE 2: ACTION

Eastern Wild Turkey

Direct Effects

There would be no direct effects on adult birds or mobile chicks, but existing nests with eggs within ROWs may be disturbed if herbicide applications occur during the nesting

season. Turkeys nesting adjacent to ROWs may be temporarily displaced during ROW management activities and females may abandon nests.

Indirect Effects
Alternative will result in improved quality of suitable nesting and brood habitat within the ROWs. Hunting conditions in ROWs would improve but a dramatic increase in huntable turkey populations is unlikely.

Cumulative Effects
Over time, the proposed use of herbicides for ROW maintenance should maintain a quality early successional community, providing suitable nesting and brood habitat and increase the time between maintenance activities. However, the Proposed Action Alternative is not expected to affect the long-term population trends of the Eastern Wild Turkey.

RED-HEADED WOODPECKER *Melanerpes erythrocephalus*

The Red-headed Woodpecker was selected as an MIS for this project to serve as an ecological management indicator species. ROWs within the project area may serve as foraging habitat and travel corridors between other suitable habitats.

The Red-headed Woodpecker usually occurs in areas with large hard mast trees, low tree density and an open understory with abundant dead limbs or snags (Rodewald 2005). The species was formerly a common species inhabiting the central and eastern United States, but there is evidence of decreasing numbers throughout North America dating back to at least the 1930s (Roy et al 2001). The Red-headed Woodpecker occurs in open deciduous woodlands (especially with oak and other hard mast trees) in both upland and riparian areas, groves of dead trees (including those associated with beaver ponds, forest edges, orchards, parks, open agricultural areas with tree rows, oak savanna and residential areas) (Smith et al 2000). During the start of breeding season, the species moves from forest interior to forest edge (Twomey 1945) and prefers open areas with snags and lush herbaceous ground cover; open, upland meadow or short-grass areas, such as pastures or golf courses (Rodewald 2005). Within suitable habitat, Red-headed Woodpeckers will nest in dead trees, dead portions of live trees, a variety of naturally occurring cavities, telephone poles and occasionally in nest boxes (Smith et al. 2000).

The Red-headed Woodpecker is widespread, but patchily distributed across the eastern United States, west to the edge of the Great Plains in New Mexico, Colorado, Wyoming and Montana. The species is also found in extreme southern Canada from Saskatchewan to New Brunswick, but is most common in the mid-western and Gulf Coast United States (NatureServe 2007). The Red-headed Woodpecker often migrates from the northern and western portions of range in fall, but yearly dynamics greatly influenced by abundance of hard mast (Zimmerman 1993). Several studies indicate that the species displays a mainly diurnal migration in fall and nocturnal migration in spring (NatureServe 2007, Smith et al 2000), a pattern consistent with observations over many years in Arkansas Ozarks. The Red-headed Woodpecker is declining over much of breeding range. North American Breeding Bird Survey (BBS) data indicate the most serious declines in the Ozark-Ouachita Plateau.

ALTERNATIVE 1: NO ACTION

Red-headed Woodpecker

Direct Effects

There are no direct effects to this species.

Indirect Effects

There are no indirect effects to this species.

Cumulative Effects

Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of disturbance. However, the No Action alternative is not expected to affect the long-term population trends of the Red-headed Woodpecker.

ALTERNATIVE 2: ACTION

Red-headed Woodpecker

Direct Effects

There would be no direct effects to adult birds. However, individuals nesting adjacent to ROWs may be temporarily displaced during ROW management activities.

Indirect Effects

The Proposed Action Alternative would not affect the quality of insect foraging habitat within ROWs.

Cumulative Effects

Over time, the proposed use of herbicides for ROW maintenance should convert much of the ROWs within the project area into an early successional community, providing suitable foraging habitat and increasing the time between maintenance activities. However, the Proposed Action Alternative is not expected to affect the long-term population trends of the Red-headed Woodpecker.

SCARLET TANAGER *Piranga olivacea*

The Scarlet Tanager was selected as an MIS for this project to serve as an ecological management indicator species. It prefers dense, mature hardwood and hardwood-pine forest types, which are abundant habits within the analysis area adjacent to ROWs.

The preferred habitat of the Scarlet Tanager includes mature hardwood and mixed hardwood-pine habitat types (NatureServe 2007). Eastern populations favor open forests often occurring near gaps and edges. The Scarlet Tanager is most common in areas with a relatively closed canopy, a dense understory with a high diversity of shrubs and scanty ground cover and is able to breed successfully in relatively small patches of forest (Bushman and Therres 1988). This tanager species sometimes nests in wooded parks, orchards and large shade trees of suburbs (Isler and Isler 1987, Senesac 1993).

The Scarlet Tanager is a neotropical migrant with a breeding range that includes eastern North Dakota and southeastern Manitoba across southern Canada and northern U.S. to New Brunswick and central Maine, south to central Nebraska, Kansas, Oklahoma, Arkansas, northern Alabama, northern Georgia, northwestern South Carolina, western North Carolina, central Virginia and Maryland (NatureServe 2007). A complete migrant,

virtually all individuals depart breeding grounds in Sep and Oct and migrate to their wintering grounds in Central America and northern South America. The Scarlet Tanager population is slightly increasing in suitable habitats within the Ozark-Ouachita Plateau.

ALTERNATIVE 1: NO ACTION

Scarlet Tanager

Direct Effects

There would be no direct effects to adult birds. However, individuals nesting adjacent to ROWs may be temporarily displaced during ROW management activities and females may temporarily abandon nests.

Indirect Effects

The No Action Alternative would not affect foraging habitat for Scarlet tanagers.

Cumulative Effects

Rapid re-growth of woody vegetation necessitates re-treating the same area approximately every two to three years, creating a constant cycle of vegetation disturbance within the ROW. The No Action Alternative is not expected to affect the long-term population trends of the Scarlet Tanager.

ALTERNATIVE 2: ACTION

Scarlet Tanager

Direct Effects

There would be no direct effects to adult birds. However, individuals nesting adjacent to ROWs may be temporarily displaced during ROW management activities.

Indirect Effects

The Proposed Action Alternative would have no effect on insect foraging habitat for Scarlet tanagers.

Cumulative Effects

Over time, the proposed use of herbicides for ROW maintenance should convert much of the ROWs within the project area into a quality early successional community, increasing the time between possible disturbances from maintenance activities. The Proposed Action Alternative is not expected to affect the long-term population trends of the Scarlet Tanager.

PRAIRIE WARBLER *Dendroica discolor*

Prairie warbler was chosen as a MIS due to its status as a neotropical migratory bird of concern that has specialized habitat needs. Optimal habitat conditions for this species are even-aged regenerating forests of stand size or larger. Monitoring in the Ozark-Ouachita physiographic province shows a declining trend for this species.

Potential populations on ROWs would be associated with adjacent stands if they in stand-sized early seral habitat, pine-bluestem habitat or oak savanna/woodland habitats.

ALTERNATIVE 1: NO ACTION

Prairie Warbler

Direct Effects

There could be direct effects to nests and eggs of this species by mowing of Rows. ROW habitat becomes suitable for nesting about the time they are scheduled for maintenance.

Indirect Effects

Manual maintenance does provide for nesting habitat late in the maintenance cycle. Mowing sets it back and it is not suitable the first couple of years after mowing. Prairie warblers use ROWs for foraging when suitable habitat is adjacent to the ROW.

Cumulative Effects

Cumulative effects of manual maintenance on national Forests and private lands do not cause significant cumulative effects to Prairie warblers.

ALTERNATIVE 2: ACTION

Prairie Warbler

Direct Effects

There should be no direct effects to prairie warblers due to herbicide use.

Indirect Effects

Indirect effects occur since habitat for prairie warblers would be diminished from the habitat that occurs in the latter stages of manual maintenance.

Cumulative Effects

Cumulative effects of herbicide maintenance in National Forest and private lands will have minimal effects on Prairie warbler populations.

AQUATIC MIS

Distinct fish species assemblages have been shown to coincide with distinct ecosystems and monitoring species occurrence and abundance data of some fish species can serve as indicators of aquatic ecosystem health (Dauwalter 2003, Keith 1987, Rohm et al. 1987). A total of 11 fish, eight lotic and three lentic species, have been selected as aquatic MIS for the analysis area representing a mixture of game and non-game species (see Table 17). Aquatic MIS were selected to help indicate effects of management activities on aquatic habitats and water quality within the analysis area. Aquatic species selected as MIS were determined to have a population distributed throughout the majority of the analysis area.

Each aquatic species is addressed individually, but grouped as lotic or lentic for effects analysis. Natural history information for the aquatic MIS was taken primarily from Robison and Buchanan (1988).

LOTIC SPECIES

Eight species have been selected as lotic MIS to monitor the health of stream and river communities within the analysis area, with an emphasis on recreational fishing (see Table 17). These particular lotic MIS species were selected because they occur throughout the majority of the analysis area and many are sensitive to siltation and habitat alteration.

Life history information and habitat requirements for lotic MIS were taken primarily from Robison and Buchanan (1988).

Table 17: Potentially Affected Lotic (Stream and River) Management Indicator Species

Common Name	Scientific Name	Habitat Type
Smallmouth Bass	*Micropterus dolomieu*	Cool, clear mountain streams with permanent flow and rocky bottoms
Yellow Bullhead	*Ameiurus natalis*	Clear, gravel/rocky-bottomed streams, avoids strong current and is common in reservoirs
Central Stoneroller	*Campostoma anomalum*	Small to medium streams with cool, clear water and gravel, cobble or exposed bedrock substrates
Green Sunfish	*Lepomis cyanellus*	Wide range of ecological conditions; in degraded streams there may be an increase in relative abundance
Longear Sunfish	*Lepomis megalotis*	In small, clear, upland streams with rocky bottoms; avoids strong current, turbid water and silt substrate
Northern Hog Sucker	*Hypentelium nigricans*	Clear, permanent streams with gravel or rocky substrate
Redfin Darter	*Etheostoma whipplei*	Largest populations are in small clear rocky streams
Striped Shiner	*Luxilus chrysocephalus*	Small to moderate-sized streams with permanent flow, clear water and rocky/gravel substrate

SMALLMOUTH BASS ***Micropterus dolomieu***

The smallmouth bass was selected as an MIS for this project due to its status as a gamefish species. It will also serve as an ecological management indicator for lotic ecosystems within the analysis area.

Smallmouth bass occur in the northeastern U.S. from the Great Lakes and southeastern Canada west to South Dakota and Iowa, and south to eastern Oklahoma, Arkansas and northern Alabama. The species is found in all major drainages of the Ozark and Ouachita uplands within the analysis area and is mainly an inhabitant of cool, clear mountain streams with permanent flow and rocky bottoms. It is more intolerant of habitat alteration than any of the other black basses, and is especially intolerant of high turbidity and siltation. The conservation of this species is not in question and the smallmouth bass are commonly distributed in suitable habitats throughout the analysis area. The smallmouth bass is considered a key species by the Arkansas Department of Environmental Quality of the Ozark Highlands, Boston Mountains and Ouachita Mountain Ecoregion. However, sharp declines in percent occurrence as demonstrated in the 1996 BASS inventories and other more empirical observations of smallmouth populations indicate there is some level of concern.

YELLOW BULLHEAD ***Ictalurus natalis***

The yellow bullhead was selected as an MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The yellow bullhead is native throughout most of the eastern and central U.S. as well as southern Canada, It is found in a variety of habitats, but seems to prefer clear, gravel- and rocky-bottomed permanent streams. The yellow bullhead avoids strong current and is common in analysis area reservoirs, occurring primarily in pools with structure (root wads, undercut banks, boulders, etc.). Feeding habits may be somewhat more specialized than in the other bullhead species, with insect larvae, mollusks, crustaceans and small fish preferred. The yellow bullhead is considered a key species by the Arkansas Department of Environmental Quality for the Arkansas River Valley Ecoregion.

CENTRAL STONEROLLER ***Campostoma anomalum***

The central stoneroller was selected as an MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The central stoneroller is a small non-game fish that generally inhabits small to medium streams with cool, clear water and gravel, cobble or exposed bedrock substrates. The species is also sometimes found in upland impoundments and in slow-moving, turbid water (Robison and Buchanan 1998, NatureServe 2001). The cartilaginous lip of the lower jaw is used to scrape algae from rocks, thus this species can have a conspicuous effect on the distribution of algae in small streams (Matthews et al. 1987). Central stonerollers usually occur in large schools, especially in areas with few or no predators where it is often the most abundant species. Stream alterations that result in shallow homogenous habitats are conducive to increased central stoneroller populations (Ebert and Filipek 1988) because of both increased algal growth and decreased predation.

The central stoneroller occurs throughout much of the eastern and central U.S. from New York west to North Dakota and Wyoming, and south to South Carolina and Texas. Isolated populations occur in southwestern Mississippi and eastern Louisiana. The central stoneroller is a found throughout the Ozark and Ouachita Mountains, into upper Arkansas River Valley streams, and is common to abundant throughout much of its range. However, populations may fluctuate from year-to-year (NatureServe 2007). Many factors, biotic and abiotic, natural and anthropogenic, contribute to these fluctuations.

GREEN SUNFISH ***Lepomis cyanellus***

The green sunfish was selected as a MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The green sunfish is an adaptable game species that occurs in a variety of aquatic habitats. It is tolerant of a wide range of ecological conditions, particularly to extremes of turbidity, dissolved oxygen, temperature and flow (Robison and Buchanan, 1988). In the Midwest, the relative abundance of green sunfish increases in degraded streams (Karr et al. 1986). Data from the Ouachita Mountain ecoregions support that premise (Hlass et al. 1998). Population increases of the green sunfish in forest streams could be an indicator of negative impacts from forest management activities.

This green sunfish is native to most of the central and eastern U.S. west of the Appalachians and east of the Continental Divide, from the Great Lakes region south to the Gulf Coast states and northeastern Mexico. It has been introduced widely elsewhere in the United States and is generally common to abundant (NatureServe 2001). It appears that populations of green sunfish fluctuate from year to year. Many factors, biotic and abiotic, natural and anthropogenic, contribute to these fluctuations. Populations of green sunfish appear to be stable over time. The conservation of the species is not in question.

LONGEAR SUNFISH ***Lepomis megalotis***

The longear sunfish was selected as an MIS for this project because of its status as a gamefish species and because to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The longear sunfish is a game species native to much of the central and eastern U.S., including Texas northeast to New York, west to Minnesota and south to Louisiana, Mississippi and Alabama. In Oklahoma and Arkansas, it occurs in a variety of habitats but is most abundant in small, clear, upland streams with rocky bottoms and permanent or semi-permanent flow (Miller and Robison 1973, Robison and Buchanan 1988). It avoids strong current, turbid water and silt substrate. Populations of longear sunfish fluctuate from year-to-year, but are considered to be stable over time. Population densities in managed and unmanaged streams are similar and the conservation of the species is not in question**.** The longear sunfish is considered a key species by the Arkansas Department of Environmental Quality for the Arkansas River Valley, Boston Mountains and Ouachita Mountain ecoregions.

NORTHERN HOG SUCKER ***Hypentelium nigricans***

The northern hog sucker was selected as an MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The northern hog sucker occurs in much of the eastern U.S., excluding southern Georgia, Florida and Alabama. In Oklahoma, it is found only in the Ozark Region. It lives in clear, permanent streams with gravel or rocky substrate and generally prefers deep riffles, runs or pools having a current. It is intolerant of pollution, silt and stream channel modification (Smith 1979). The northern hog sucker is considered a key species within the Ouachita Mountain Ecoregion. The species has the potential to be found in streams that intersect the analysis area in both the Ouachita and Ozark National Forests (Robison and Buchanan 1988). There is no information to suggest that the northern hog sucker has conservation concerns on National Forest Lands. The northern hog sucker is considered a key species by the Arkansas Department of Environmental Quality for the Ozark Mountains and the Ouachita Mountains Ecoregion.

REDFIN DARTER ***Etheostoma whipplei***

The redfin darter was selected as an MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

The redfin darter occurs in several tributaries within the Arkansas and White River drainages above the Fall Line in Missouri, Arkansas, Kansas and Oklahoma. In the

Ouachita National Forest, the redfin darter occurs in the upper Ouachita Mountains and Arkansas River Valley ecosystems, north of the range of the orangebelly darter, which is also an MIS species. They are often found in sandy or rocky pools and are sometimes found in shallow gravel to rubble riffles of headwaters, creeks and small rivers. Largest populations are in small clear rocky streams. Very little is known about the life history of the redfin darter but they likely forage on aquatic insects. Darters, especially of the genus *Etheostoma*, are sensitive to degradation because of their specificity for reproduction and feeding in benthic habitats (Karr et al. 1986, Robison and Buchanan 1988). Such habitats are degraded by activities that result in siltation and habitat alteration. Populations of this species fluctuate from year-to-year, but are considered stable. The redfin darter is considered a key species by the Arkansas Department of Environmental Quality for the Arkansas River Valley Ecoregion.

STRIPED SHINER ***Luxilus chrysocephalus***

The striped shiner was selected as an MIS for this project to serve as an ecological management indicator for lotic ecosystems within the analysis area.

This striped shiner occurs from New Brunswick to Saskatchewan in the northern portion of its range, through the Great Lakes and Mississippi Valley to Oklahoma, Louisiana and Alabama. The species is abundant in the Ozark and Ouachita Mountains where it seems to prefer small to moderate-sized perennial streams with permanent flow, clear water and rocky or gravel substrate. The striped shiner is found in low to moderate currents but avoids strong currents. The striped shiner is considered an indicator species by the Arkansas Department of Environmental Quality for the Ouachita Mountain Ecoregion. The conservation of this species is not in question.

ALTERNATIVE 1: NO ACTION

LOTIC SPECIES

The No Action Alternative would require the rural electric cooperatives to continue to manage vegetation within ROWs by only mechanical means, including, hand tools and heavy equipment.

In general, mechanical methods that disturb the soil can cause problems when used in wetlands, on steep slopes or in areas of soft soils susceptible to erosion. Soil disturbance and erosional processes may be expedited by heavy equipment use during mechanical ROW maintenance. These processes contribute to increased sediment migration, which may contaminate adjacent streams and other water bodies, add fill to wetlands, and create increased turbidity and decreased O_2 (oxygen) concentrations in the water. These conditions could adversely affect aquatic habitats and sensitive aquatic species.

Direct Effects

The primary potential threat to the aquatic species in lotic systems from continued mechanical methods is erosion of top soil, which has the potential to affect aquatic habitats adjacent to analysis area ROWs. This would happen once every two to three years if heavy rains occur directly after treatments. Species such as the redfin darter, northern hog sucker and smallmouth bass are intolerant of siltation and increased turbidity, which can cause individuals to temporarily abandon previously suitable habitat.

Indirect Effects
Increased turbidity may decrease foraging and spawning opportunities for lotic MIS within the analysis area.

Cumulative Effects
Minor cumulative adverse effects on water quality, aquatic species and habitat are possible from the continued frequent use of heavy equipment in the ROW areas. However, the No Action Alternative is not expected to affect the long-term population trends of the lotic MIS within the analysis area.

ALTERNATIVE 2: ACTION

LOTIC SPECIES

The Action Alternative would utilize approved herbicides to treat woody vegetation in utility ROWs, subsequently reducing or eliminating mechanical methods. Herbicides would be applied to target vegetation only and would follow Forest Plan directives, manufacturers' recommendations and BMPs. Risk assessment data indicates the herbicide treatments proposed within the Action Alternative do not persist in the environment and are nontoxic to fish at normal application rates. Herbicides would be applied at the lowest rate effective in meeting project objectives and according to guidelines for protecting human (National Research Council 1983) and wildlife health and the environment (United States Environmental Protection Agency 1986). In all instances, herbicide application for ROW maintenance will comply with manufacturers' label directions, Forest Plan standards and Best Management Practices, which are designed to protect streams from contamination by herbicides. Even for long-term exposures, risks to aquatic plants from the application of this herbicide are substantially below the level of concern even at high application rates.

Because herbicide application methods do not disturb the soil, the Proposed Action Alternative would protect waters from increased turbidity and maintain site productivity by retaining nutrient-rich organic matter and soil surface horizons on-site within the activity area. Maxwell and Neary (1991) concluded that the impact of vegetation management techniques on erosion and sedimentation of water resources is that herbicides are less than fire, which is less than mechanical (herbicides<fire<mechanical). Mitigation measures developed by the USDA, such as buffers of 100 feet around all wetlands zones, should further protect lotic systems from any potential effects of herbicide within the activity area.

Direct Effects
The use of herbicides for ROW maintenance, applied adhering to Forest Service standards, manufacturers' label directions and BMPs, would provide no direct effects to aquatic MIS inhabiting lotic habitat adjacent to ROWs.

Indirect Effects
The application of herbicides in accordance with manufacturers' directions and Forest Plan guidelines would provide no indirect effects to aquatic MIS inhabiting lotic habitat adjacent to project ROWs.

Cumulative Effects
There would be no cumulative effects from the Action Alternative to aquatic MIS inhabiting lotic habitat adjacent to ROWs. Therefore, the Proposed Action Alternative is

not expected to affect the long-term population trends of the lotic MIS within the analysis area.

LENTIC SPECIES

Lentic fish species are those found in standing water such as lakes, ponds and reservoirs. Three species of fish have been selected as MIS to track the health of lake and pond communities, particularly as they relate to their ability to support a recreational fishery (see Table 18). Lentic species were selected because they are sought-after demand species and represent recreational fishing opportunities. Detailed life history information and habitat requirements are documented in Robison and Buchanan (1988) and the MIS summary and analysis of data document (USDA-Forest Service 2003a).

Table 18: Potentially Affected Lentic (Lake and Pond) Management Indicator Species

Common Name	Scientific Name	Habitat Type
Largemouth Bass	*Micropterus salmoides*	Clear, waters in natural and manmade lakes and ponds and pools of streams and rivers and intolerant of high turbidity and siltation
Bluegill	*Lepomis macrochirus*	Clear, warm waters having at least some aquatic vegetation and other cover, sometimes found in turbid waters, but intolerant of continuous high turbidity and siltation
Redear Sunfish	*Lepomis microlophus*	Warm, clear waters without current and with an abundance of structural components such as logs, stumps and brush

LARGEMOUTH BASS *Micropterus salmoides*

The largemouth bass was selected as an MIS for this project because of its status as a gamefish species. It will also serve as an ecological management indicator for lentic ecosystems within the analysis area.

The largemouth bass is an abundant game fish in analysis area lakes and streams. It is a top end predator species in many aquatic ecosystems and is important in helping keep populations of prey species in balance. The largemouth bass is most commonly found in clear, quiet waters in natural and manmade lakes and ponds and pools of streams and rivers and is intolerant of high turbidity and siltation. This species is regularly stocked in ponds and lakes by the Forest Service as a valuable component of the forest sport fishery.

The largemouth bass is native to St. Lawrence-Great Lakes, Hudson Bay (Red River) and Mississippi River basins from southern Quebec to Minnesota and south to the Gulf; Atlantic drainages from North Carolina to Florida; Gulf drainages from southern Florida to northern Mexico. The species has been introduced throughout the U.S., southern Canada and much of world (NatureServe 2007). Largemouth bass are among the most widespread and numerous species within analysis area waters and is found in all drainages. The viability of largemouth bass is not in question within the analysis area.

BLUEGILL ***Lepomis macrochirus***

The bluegill was selected as an MIS for this project due to its status as a gamefish species. It will serve as an ecological management indicator for lentic ecosystems within the analysis area.

The bluegill is found in all drainages within the analysis area. A very popular game fish, the bluegill has been widely stocked in farm ponds and reservoirs across the United States, as well as many other parts of the world. Its largest populations are found in clear, quiet, warm waters having at least some aquatic vegetation and other cover. Although sometimes found in turbid waters, bluegill are intolerant of continuous high turbidity and siltation.

The bluegill is native to St. Lawrence-Great Lakes and Mississippi River basins from Quebec and New York to Minnesota and south to the Gulf; Atlantic and Gulf Slope drainages from Cape Fear River, Virginia, to Rio Grande, Texas and New Mexico; also northern Mexico (NatureServe 2007). Bluegill is among the most widespread and numerous species within analysis area waters and its viability is not in question.

REDEAR SUNFISH ***Lepomis microlophus***

The redear sunfish was selected as a MIS for this project due to its status as a gamefish species. It will also serve as an ecological management indicator for lentic ecosystems within the analysis area.

The redear sunfish prefers warm, clear waters without current and with an abundance of structural components such as logs, stumps and brush. It is a highly desirable sports fish because it is one of the larger panfish species. A bottom feeder, the redear is reported to be more tolerant of silt than most other sunfishes. This species is regularly stocked in ponds and lakes by the Forest Service as a valuable component of the forest sport fishery.

The redear is native to Atlantic and Gulf Slope drainages from about Savannah River, South Carolina, to Nueces River, Texas; north in the Mississippi River basin to southern Indiana and Illinois (NatureServe 2007). The redear sunfish is native to all major drainages within the analysis area, and its viability is not in question. The species is naturally reproducing in the lakes and ponds where it has been stocked.

ALTERNATIVE 1: NO ACTION

LENTIC SPECIES

The No Action Alternative would require the rural electric cooperatives to continue to manage vegetation within ROWs by only mechanical means, including, cutters and booms attached to heavy equipment.

In general, mechanical methods that disturb the soil can cause problems when used near wetlands, on steep slopes, or in areas of soft soils susceptible to erosion. Soil disturbance and erosional processes may be expedited through the use of heavy equipment during mechanical ROW maintenance. These processes can contribute to increased sediment migration that may contaminate adjacent streams and other water bodies, fill in wetlands, and create increased turbidity and decreased O_2 (oxygen) concentrations in the water that adversely affects aquatic habitats and sensitive aquatic species.

Direct Effects
The primary threat from continuing the use of mechanical methods in the No Action Alternative would be erosion and siltation into lentic systems. Largemouth bass and bluegill are intolerant of turbidity and siltation, and resulting soil disturbances from the use of heavy machinery, may adversely affect these species by causing individuals to temporarily abandon previously suitable habitat. Redear sunfish are more tolerant of silt and may incur little to no adverse effects from the No Action Alternative.

Indirect Effects
Increased turbidity may decrease foraging and spawning opportunities for sensitive lentic MIS within the analysis area for a short duration every two to three years.

Cumulative Effects
Minor cumulative adverse effects on water quality and aquatic species and habitat are possible due to soil disturbances and erosional processes from the continued frequent use of heavy equipment in the ROW areas. However, the No Action Alternative is not expected to affect the long-term population trends of the lentic MIS within the analysis area.

ALTERNATIVE 2: ACTION

LENTIC SPECIES

The Action Alternative would utilize approved herbicides to treat woody vegetation in utility ROWs, subsequently reducing or eliminating mechanical methods. Herbicides would be applied at the lowest rate effective in meeting project objectives and according to guidelines for protecting human (National Research Council 1983) and wildlife health and the environment (United States Environmental Protection Agency 1986). In all instances, herbicide application for ROW maintenance will comply with manufacturers' label directions, Forest Plan standards and Best Management Practices, which are designed to protect streams from contamination by herbicides. Even for long-term exposures, risks to aquatic plants from the application of this herbicide are substantially below the level of concern even at high application rates.

Because herbicide use does not disturb the soil, the Action Alternative would protect waters from increased turbidity and maintain site productivity by retaining nutrient-rich organic matter and soil surface horizons on-site within the analysis area. Maxwell and Neary (1991) concluded that the impact of vegetation management techniques on erosion and sedimentation of water resources is that herbicides are less than fire, which is less than mechanical (herbicides<fire<mechanical). Mitigation measures developed by the USDA, such as buffers of 100 feet around all wetlands zones, should further protect lotic systems form any minimal effects of herbicide within the analysis area.

Direct effects
If herbicides proposed in the Action Alternative are applied for ROW maintenance adhering to Forest Plan guidelines, manufacturers' label directions and BMPs, there would be no direct effects to aquatic, there would be no direct effects to aquatic MIS inhabiting lentic habitat adjacent to project ROWs.

Indirect effects
When herbicides are properly administered, there would be no indirect effects to aquatic MIS inhabiting lentic habitat adjacent to the project ROWs.

Cumulative effects
There would be no cumulative effects to aquatic MIS inhabiting lotic habitat adjacent to project ROWs. Therefore, the Proposed Action Alternative is not expected to affect long-term population trends of the lentic MIS within the analysis area.

CULTURAL RESOURCES

Affected Environment
The term 'Cultural Resources' can apply to "those parts of the physical environment–natural and built–that have cultural value of some kind to some sociocultural group." This can include, spiritual places, historic resources, archaeological resources, Native American cultural items, historical objects, religious practices, cultural uses of the natural environment, community values, or historical documents (from *Cultural Resource Laws & Practice: An Introductory Guide*, King 1998:7,9).

The USDA, Forest Service Programmatic Agreement 03-MU-11080901A, which was revised December 23, 2005, outlines exempt undertakings in Section B. Categorical Exemption citations are made to work conducted "clearly within a disturbed context (Regional PA:V.B.5) and where no ground-disturbing actions will take place. Specifically, Item 14 excludes "Permits, easements, rights-of-way…" (Regional PA:V.B.3). The agreement also notes that herbicide site prep may be handled as a non-documented categorical exclusion. This project was Categorically Exempted from inventory for heritage resources under this Programmatic Agreement because it meets the requirements of the Agreement; being within a rights-of-way and not having any ground disturbing activities. The CE is included as Appendix 9.

However, previous inventories which were near or included some of these existing powerlines on the Ozark-St. Francis National Forests did find sites within close proximity to these Rights-of-Ways. Twelve historical or cultural sites are known to be within the ROWs.

ALTERNATIVE 1: NO ACTION

Cultural Resources
ROWs were initially cleared by mechanical means for the placement of utility poles and line maintenance. The ROWs have historically been maintained using heavy machinery, and the No Action Alternative would continue this practice. The use of heavy machinery and mechanical equipment has the potential to adversely affect any unidentified historical or cultural artifacts or other resources that may be present in the ROWs. The potential for accidental contact of heavy equipment with unknown resources would continue under the No Action Alternative.

The No Action Alternative will have no significant adverse effects on the twelve known sites or any unknown sites since they are existing ROWs and new mechanical maintenance is not likely to add to additional effects to those sites.

ALTERNATIVE 2: PROPOSED ACTION

Cultural Resources
The Action Alternative of allowing individuals with backpack sprayers to hand-apply herbicides to select vegetation only, would significantly reduce or eliminate potential

impacts to any unidentified cultural or historic resources that might be present. The presence of foot traffic, which is far less invasive to the environment and its resources than heavy machinery and mechanical equipment, will protect any unknown cultural artifacts or other resources in the ROWs. Additionally, the interval required between herbicide applications increases over time, further reducing the need to access the ROWs and any subsequent potential impacts from presence in the area.

The use of herbicides for ROW maintenance would provide no significant adverse effects to identified or unidentified historic or cultural resources.

ALTERNATIVE 2: PROPOSED ACTION

Cultural Resources

The Action Alternative of allowing individuals with backpack sprayers to hand-apply herbicides to select vegetation only, would significantly reduce or eliminate potential impacts to any unidentified cultural or historic resources that might be present. The presence of foot traffic, which is far less invasive to the environment and its resources than heavy machinery and mechanical equipment, will protect any unknown cultural artifacts or other resources in the ROWs. Additionally, the interval required between herbicide applications increases over time, further reducing the need to access the ROWs and any subsequent potential impacts from presence in the area.

Since no historical or cultural sites have been identified in the ROWs, the use of herbicides for ROW maintenance would provide no significant adverse effects to identified historic or cultural resources. Considering the providing and maintaining of reliable electric service as an essential "community value," the Action Alternative would provide significant immediate and cumulative beneficial effects. Additionally, the Action Alternative uses low-impact foot traffic to apply herbicides in the ROWs, and any unidentified historic or cultural resources, as well as natural resources, would be protected from impact with heavy equipment, providing an immediate and cumulative beneficial effect.

SOCIOECONOMIC CONSIDERATIONS

Affected Environment

The analysis area is located in north central, northwest and western Arkansas. Eight of the 14 affected counties in Arkansas have a higher percentage of their populations below the poverty level than the States' average. Ten of the affected counties in are below the States' averages for median household incomes (see Tables 16 and 17). For the years 2001-2003, Arkansas ranks 48th in the nation in respect to the three-year average median household income (US Census Bureau).

Table 19 – Arkansas Counties Socioeconomic Data

County	Total Population (2000)	% White Non-Hispanic (2005)	% Black, African American (2005)	% Hispanic/ Latino (2005)	% Bachelor's Degree or Higher (2000)	Median House Value (2000)	Median House-hold Income (2004)	Per Capita Income (1999)	Persons Below Poverty Level (2004)
Baxter	38,386	97	0.3	1	12.8	84,500	31,300	16,859	13.4
Benton	153,406	81.7	1.1	12.8	20.3	94,800	47,431	19,377	9.5
Crawford	53,247	89.1	1.1	4.6	9.7	71,600	36,527	15,015	14.3
Franklin	17,771	94.8	0.7	2	11	58,500	33,400	14,616	15.6
Johnson	22,781	86.8	1.8	9.3	13.1	59,300	30,192	15,097	16.4
Logan	22,486	94.2	1.3	1.6	9.4	54,000	30,878	14,527	16.4
Madison	14.243	93.6	0.2	4	10.1	62,300	31.215	14,736	16
Newton	8,608	97	0.2	1.2	11.8	50,100	26,925	13,788	19.4
Pope	54,469	90.9	3	3.8	19	71,100	34,109	15,918	15.8
Sebastian	115,071	76.6	6.3	9.8	16.6	73,300	36,863	18,424	15.2
Scott	10,996	88.4	0.5	7	8.4	48,000	27,384	13,609	18.4
Stone	11,499	96.6	0.3	1.2	9.8	64,200	24,731	14,134	17.8
Yell	21,139	78.7	1.5	17.2	10.9	60,600	30,076	15,383	15.1
Washington	157,715	79.6	2.7	12.4	24.5	90,100	38,385	17,347	12.8
State	2,673,400	77	15.7	4.7	16.7	72,800	35,295	16,904	15.6

Ten of the affected Arkansas counties have average value of homes less than the States' averages. Eleven of the affected Arkansas counties have percentage of populations with bachelor degrees or higher below the states' average percentage.

Educational-health-social services, manufacturing and retail trade are the industries that provide the majority of employment opportunities in the area. Agriculture and construction are important parts of these counties and provide employment for many.

A reliable source of electricity is essential to the social infrastructure of urban and rural areas alike. The cost of the electricity is an important economic concern to residents and businesses, and opportunities to lower electric costs or slow rising prices are of obvious economic benefit.

ALTERNATIVE 1: NO ACTION

Socioeconomic Considerations

There would be no change in the current socioeconomic condition. Employment for mechanical control of undesired vegetation along power line ROWs within the National Forest would continue.

Reliable electric service would continue to be maintained using only mechanical methods only in Forest Service ROWs. The costs associated with using mechanical equipment would continue as currently incurred with ongoing fluctuations according to market conditions. Subsequent consumer costs would adjust according to equipment, fuel and labor considerations. Current conditions of rising fuel and equipment costs could result in higher electricity costs, providing immediate and cumulative adverse effects. The No Action Alternative would provide immediate and cumulative beneficial effects by the continuation of ROW maintenance to ensure reliable electric service. Employment associated with mechanical equipment maintenance would continue.

ALTERNATIVE 2: PROPOSED ACTION

Socioeconomic Considerations

There would be little change in the overall current socioeconomic condition due to the labor and sales aspects of the methodology selected. Employment for herbicide

application to control undesired vegetation along power line ROWs would replace employment for mechanical control within the National Forests.

According to the most recent National Survey of Fishing, Hunting and Wildlife-Associated Recreation Survey (USDI 2007), over 87 million US residents 16 years old and older fished, hunted, or wildlife watched in 2006 and spent over $120 billion. The suppression of woody stems with herbicides allows for the development of grasses and other low growing vegetation for wildlife habitat and forage, which may provide a limited increase in wildlife recreation opportunities on Forest Service lands, and subsequently more visitors to the area who would make local purchases. This could provide a potential minor cumulative financial benefit to local economies.

Reliable ROW maintenance would be maintained by treating only target woody stem vegetation with herbicide in Forest Service ROWs, which is appreciably less expensive than mechanical methods. Actual cost comparisons provided by the rural electric cooperatives of mechanical versus herbicide treatment on non-Forest Service properties indicate that the average cost of herbicide treatment is approximately seven to 30 percent of the cost of mechanical treatment. Actual costs for ROW maintenance vary by company, however, utilization of herbicides represents an estimated 70 to 93 percent cost reduction for ROW maintenance over mechanical methods, which continue to be exacerbated by rising fuel costs. This lowered maintenance cost provides a benefit to customers by lowering the cost of providing electricity, which would be a financial benefit to local businesses and residents, many of whom are below the national average in per capita income.

In summary, the Proposed Action Alternative would enable the rural electric cooperatives to significantly reduce ROW maintenance costs and consequently reduce the cost of electricity, providing a moderate immediate and cumulative beneficial effect to the socioeconomic condition. The immediate and cumulative beneficial effect of providing and maintaining reliable electric service would continue.

RECREATION AND SCENIC INTEGRITY

Affected Environment

The current landscape within the vast majority of the Ouachita and Ozark National Forests consists of woody vegetation, in most cases mature growth mixed hardwood and pine communities. Scenic integrity is intimately related to the landscape vegetation within the National Forests. Additional information on elements of the recreation and scenic integrity affected environment, such as wildlife species or habitats, may be found in the Fish and Wildlife section.

Within the National Forests there exist power lines constructed under permit to provide electrical power to adjacent private properties. In addition to these power lines, there are larger main trunk electrical distributor lines and natural gas pipelines that traverse the National Forests. Utility companies must undertake vegetation control in order to maintain the integrity of the lines and permit access whenever repair is required. Currently this vegetation control within National Forest properties is with mechanized equipment, such as mowing and larger limb trimmers.

National Forests in north, northwest and western Arkansas provide a wide variety of outdoor recreational opportunities for primitive and developed camping, hunting, fishing, hiking, backpacking, horseback and off-highway vehicle (OHV) riding, rock hounding, canoeing/kayaking and whitewater rafting, as well as picnicking, sightseeing, nature watching, hiking, driving for pleasure and photographing wildlife and scenery.

Features of the forests include wild and scenic rivers, scenic byways, wilderness areas and special interest areas. Recreation participation activities and services contribute to visitors' physical and mental well-being and represent a variety of skill levels, needs and desires, in partnership with permit holders, private entities, nonprofit/volunteer groups, and state, federal and tribal partners. Forest access points are plentiful and quality habitat for hunting and fishing are also plentiful and available to the public.

Not all recreational activities are considered beneficial to the National Forests. ROW corridors provide wildlife viewing, photographing, hunting and other opportunities, but the cleared areas also have the potential to attract uses that negatively affect the National Forests. Activities that impair the soil holding conditions and foster erosion are considered detrimental to the scenic integrity and health of the forest environment. Forest Service Chief Dale Bosworth has noted that unmanaged recreation, including OHV use, is one of the top four threats to the health of national forests (Cordell et al 2005). Cleared ROWs also have been known to be used for the illegal private cultivation of *Cannabis sativa.*

Utility ROWs must be kept clear of woody vegetation in order to ensure reliable electric service, and recreational uses of these cleared areas is under the management of the Forest Service.

ALTERNATIVE 1: NO ACTION

Recreation and Scenic Integrity

Current recreation options and opportunities within the analysis area would not be expected to vary from the current conditions. As noted in the Forest Plans, developed and dispersed recreation opportunities, including associated scenery management, would continue to be provided by the Forest Service. No changes to existing recreation management would be made. Public access (travel ways, use corridors, waterways and trails) would be managed at current levels for recreational opportunities. Open ROW corridors may attract uses that are not beneficial to forest health. Some uses may result in reduced ground cover and increased erosion while others may be illegal activities that do not meet the goals and intent of the National Forests.

In this alternative, mechanized vegetation management would still be required to control undesired vegetation along power lines and within ROWs. Selective cutting of target vegetation is not feasible with mechanical methods, requiring that the entire ROWs continue to be cleared. Maintaining these open corridors does provide some opportunities for increased wildlife viewing. However, woody debris left behind from ROW clearing and the rapid re-sprouting of the woody stem vegetation suppresses desirable species that provide habitat and forage for wildlife. Mechanical methods have the potential to adversely impact the physical characteristics of soils, and in turn affect both the hydrologic function and site productivity of mechanically treated areas by creating erosion pathways and compaction of the soil. These conditions would be

considered minor to moderate cumulative adverse effects to the environment and would result in a reduction in the esthetic value of Forest Service lands.

Mechanically cleared ROWs do provide some opportunities for wildlife, such as improving habitat for disturbance dependent species. However, cutting or mowing the entire ROW corridor may destroy desirable plant species and existing habitat, and the use of heavy equipment during nesting or mating may inhibit species propagation. Mechanical methods have also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests. Further, since many woody stem plants remain viable and re-sprout after mechanical treatment, woody stem species would continue and may increase competition with grasses and herbaceous groundcover that provide habitat for wildlife such as quail, turkey, deer and many non-game species such as songbirds.

In summary, the No Action Alternative has the potential to create localized erosional pathways and compaction of the soil along power line ROWs, as well as having direct and indirect negative effects on many wildlife species in close proximity to the ROWs. Therefore, the No Action Alternative will continue to produce minor to moderate immediate and cumulative adverse effects to recreation and scenic integrity of Forest Service property by degrading both the scenic beauty and habitat quality of power line ROWs within the activity area. However, ROWs will continue to remain open for wildlife viewing purposes; therefore, no significant cumulative effects, adverse or beneficial, to recreation or scenic integrity to the greater National Forests are anticipated from continuing the current method of vegetation control.

ALTERNATIVE 2: PROPOSED ACTION

Recreation and Scenic Integrity

The use of herbicides rather than mechanical methods to control target vegetation would eventually result in a change in the makeup of the vegetation communities within the ROWs. The ultimate result in the power line ROWs would be a greater amount of herbaceous ground cover instead of cut and cleared areas or areas with taller woody/brushy vegetation in various stages of growth. This change would be only within the existing ROWs and would not affect the remaining National Forest properties.

Forest Plans would continue to guide developed and dispersed recreation opportunities, including associated scenery management. No changes to existing recreation management would be made. Public access (travel ways, use corridors, waterways and trails) would be managed at current levels for recreational opportunities. Open ROW corridors would be maintained and would continue to potentially attract uses that are not beneficial to forest health. Some uses may result in reduced ground cover and increased erosion while others may be illegal activities that do not meet the goals and intent of the National Forests.

An increase in early successional ROW vegetation would improve the habitat quality for many game and non-game wildlife species inhabiting the ROWs. Improved habitat for non-game species, such as some songbirds and butterflies, would increase the recreational value of National Forest Service properties to the public by providing additional opportunities to watch and photograph wildlife. Higher quality habitat for game animals, such as bobwhite quail, wild turkey and white-tailed deer, will increase the

recreational value of Forest Service properties for members of the public who wish to harvest game.

Both hunting and wildlife watching are multibillion dollar a year industries. According to the most recent National Survey of Fishing, Hunting and Wildlife-Associated Recreation Survey (USDI 2007) over 87 million US residents, 16 years old and older, fished, hunted, or wildlife watched in 2006 and spent over $120 billion. Adding game forage and habitat may provide additional wildlife recreation opportunities on Forest Service lands, and subsequently more visitors to the area who would make local purchases. This could provide a potential minor financial benefit to local economies, many of which are below the national average in per capita income (see Socioeconomic Considerations Section).

In summary, both the recreational opportunities and scenic integrity of Forest Service property within the activity area would be preserved, and could be improved, by the implementation of the Proposed Action Alternative. Understanding that ROW maintenance must occur and ROW corridors maintained, the Action Alternative encourages the growth of desirable native herbaceous plant species, which in turn improves wildlife habitat and the viewing and recreational activities associated with them. Therefore, the Action Alternative would provide an immediate, minor, adverse effect to scenic integrity as the woody stem vegetation dies following initial treatment. However, as non-woody vegetation reclaims the area, both the scenic beauty and habitat quality of ROWs would be improved, creating minor to moderate cumulative beneficial effects to recreation and scenic integrity of Forest Service property.

HUMAN HEALTH AND SAFETY

Affected Environment

The human environment is supported by, and highly dependent upon, a continuous, reliable supply of electrical power. Rural electric cooperatives must maintain their ROWs to ensure line integrity for an uninterrupted supply of power. The cooperatives provide electricity to private and public entities over a wide range of areas from cities to remote locations, and many of these lines cross portions of National Forest lands.

The terrain found in and around the ROWs of the subject National Forests is varied and includes primarily forested areas on mild to steep slopes. Some inherent (though not always overt) potential risks to human safety on National Forest properties include, but are not limited to: slips and falls; becoming lost; being struck by lightning; falling trees or limbs; bites from venomous snakes; contracting blood borne pathogens from ticks and mosquitoes; poison ivy and poison oak exposures; being stung by insects; and encountering wildfire.

The existing risks to human safety from woody vegetation along ROWs within the National Forest properties are due primarily to potential hidden hazards for individuals traversing through the vegetation and encountering limbs and stumps. Taller woody vegetation growing near power lines are a threat to the integrity of the lines, particularly during severe weather events. Humans in the vicinity during a power line break could be at risk of electric shock or exposure to uncontrolled wildfires.

Herbicides and other chemicals are routinely used on surrounding private land for ROW maintenance, agricultural use and other purposes; and notification to the public or to the Forest Service regarding these uses of herbicides is not required. Ongoing water quality monitoring is conducted by the Arkansas Department of Environmental Quality and the State's most recent data is available by request. Issues related to water quality are addressed in the Hydrology and Water Quality sections of this EA.

Human health and safety concerns for the general public and ROW maintenance workers are assessed for each vegetation management alternative.

ALTERNATIVE 1: NO ACTION

Human Safety

There would be no changes in the current condition from the continuation of the No Action Alternative. Members of the general public traversing the area during mechanical methods activities would be at risk from impacts with machinery or debris. Potential injuries to unprotected workers or members of the public would include lacerations, contusions and puncture wounds from flying debris such as wood chips, limbs or rocks. Falling timber from cutting with heavy equipment has the potential to inflict serious injury or death. Operators of the equipment and other workers assisting in the cutting operations would be at risk as well; however, these risks are inherent with the intended use of the equipment in any environment. Therefore, there is a potential for moderate localized adverse effects to humans (both operators and the general public) present in the area during mechanical cutting activities. The proliferation of stumps and the accumulation of limbs and debris in the ROWs would create trip hazards for hikers, which could be considered a minor adverse cumulative effect. The continued maintenance of ROWs in order to provide reliable electric service is an immediate and cumulative beneficial effect to human safety by maintaining social infrastructure.

ALTERNATIVE 2: PROPOSED ACTION

Human Safety

In spite of the extensive published studies, there remains a lingering public perception of herbicides as highly toxic chemicals, and their use remains controversial. All substances, however, have the potential to be toxic, as it is the dose level and the conditions of exposure that cause a substance to be toxic or harmful.

Toxicology studies of the active ingredients in the proposed herbicides have been conducted to evaluate their potential adverse effects in humans and other organisms. These studies measured the effects of direct and indirect exposure to the active ingredients. The determined toxicity of a substance is divided into four categories: acute, sub-acute, sub-chronic and chronic. Acute toxicity results from a single dose of a substance through ingestion, inhalation and skin or eye exposure.

An overview of herbicide toxicity is excerpted from an article by Ken McNabb, Alabama Cooperative Extension Forester and Associate Professor at Auburn University (ANR-846, McNabb 1997). Lethal Dose (LD) 50 rates are used to provide an overview of silvicultural herbicide toxicity relative to common household products. LD50 is an index of toxicity that indicates the amount of the substance that kills 50 percent of the animal test populations when administered as a single dose.

"Many people have the misconception that all compounds whose name end in "cide," such as insecticide, rodenticide or fungicide, can be lumped together as dangerous, highly toxic chemicals and unsafe at any application level. This is simply not the case for the vast majority of agricultural pesticides and is certainly not true of forestry herbicides. Table 1 provides the acute toxicity of the active ingredient in several forestry herbicides for comparison to some other common chemicals. The table lists the LD50, which is a rating system for chemical toxicity. A low LD50 indicates that a small amount of chemical is toxic and is a more dangerous substance. Likewise, the larger the LD50, the less toxic the chemical. All of the forestry herbicides have active ingredients that are less toxic than caffeine. In addition, the active ingredient is diluted to make the herbicide product sold on the market. All over-the-counter formulations of the products listed in Table 1 have LD50s above 1,700 mg/kg (milligrams of chemical per kilogram of body weight) and so are therefore less toxic than aspirin!"

McNabb Table 1- The Relative Toxicity of Commonly Used Silvicultural Herbicides

Trade Name	Active Ingredient	LD50* of the Active Ingredient mg/kg
Arsenal	**Imazapyr**	**5,000**
Garlon	**triclopyr**	**630**
Oust *(Escort)*	**sulfometuron methyl** (metsulfuron methyl)	**5,000**
Roundup *(Accord)*	**glyphosate**	**4,320**
Tordon	**picloram**	**8,200**
Velpar	hexazinone	1,690
Weedone	2,4-D	375
For Comparison:	**Table Salt**	**3,750**
	Aspirin	**1,700**
	Malathion (insecticide)	370
	Caffeine	200

*LD50 is the dose that is lethal to 50 percent of a test animal population, expressed as milligrams (mg) of chemical per kilogram (kg) of body weight.

"How can this be so? How can a chemical with such low toxicity be so effective at killing plants? Imazapyr, for example, has an LD50 above 5,000 mg/kg, making it practically non-toxic. Yet this compound is a very effective herbicide and can control many of the largest trees. The secret to understanding this apparent contradiction comes from realizing that herbicides work on biochemical pathways that are specific to plants. For example, only plants photosynthesize (produce food from carbon dioxide and water), so, if a compound inhibits one or several of the steps in the long biochemical pathway that is photosynthesis, that compound is then toxic to plants. At the same time, this compound may have no effect on animal systems because the biochemical pathway for photosynthesis does not exist in animals. As another example, some herbicides work on amino acid pathways that are specific to plants and not found in animals. All of these types of compounds can be very effective herbicides yet are safe for animals because the biochemical basis for toxicity does not exist" (ANR-846, McNabb 1997).

Published LD50 rates for chemicals can vary among published animal studies. Common table salt acute toxicity rates, for example, vary from 3,000 to 4,000 mg/kg (McNabb 1997, USDA 2003a). Toxicity rates for the active ingredients of the proposed commercial herbicides vary slightly by study as well, and multiple studies are cited throughout this EA.

Table 20 lists LD50 rates for each of the active ingredients in the commercial herbicide formulations as studied in the USDA Forest Service Risk Assessments. These rates indicate chronic and acute toxicity, which are comparable to those cited above. Table 20 also notes the application rates referenced in the risk assessment. All proposed products would be applied per manufacturers' recommendations and in accordance with Forest Service guidelines under the direction of a licensed herbicide applicator.

Table 20 – USDA Forest Service Risk Assessment Data, LD50 Rates

Chemical Name	EPA Chronic RfD	Acute Toxicity LD50	FS Risk Assessment Application Rate (range)	FS Risk Assessment Application Rate (typical)
	mg/kg/day	mg/kg	pounds/acre	pounds/acre
Glyphosate	2	2000-6000	0.5-7	2
Imazapyr	2.5	>5000	0.3-1.25	0.45
Metsulfuron Methyl	0.25	>5000	0.0125-0.15	0.03
Picloram	0.2	5000	0.1-1	0.35
Triclopyr	0.05	600-1000	0.05-10	1

The exposure routes of herbicides to humans are inhalation, skin contact and ingestion. Since no broadcast or aerial applications would be conducted, overexposure through inhalation would not be a potential risk for the public. The greatest potential risk to the public is the unlikely possibility that individuals could or would walk through areas immediately after herbicide application where still-wet treated vegetation was present and incur dermal contact. This worst-case scenario would still have minimal adverse effects even with prolonged dermal exposure.

As indicated in animal studies referenced throughout this document, forest herbicides target biochemical pathways unique to plants, do not bioaccumulate in animal tissues and pass through the body without significant effect (Borrecco et al. 1972, McComb and Hurst 1987, Freedman 1991, Tatum 2004). For additional information, see Appendix 7, Biological Evaluation of Herbicides.

> "One of the most discussed aspects of forestry herbicides is whether or not they pose a long-term health risk to the public. Some feel that exposures to even infinitesimal amounts of these chemicals will eventually result in adverse health effects, particularly cancer. This is a complicated and often emotional issue. Even though we are living longer and healthier lives than at any period in our country's history, much of the public has come to believe that the use of agricultural pesticides has introduced hazardous chemicals into the environment at unacceptable levels. Forestry herbicides have been caught up in this debate and are viewed by some segments of the public as posing a hazard.

> …calculations of cancer risk to the public have shown forestry herbicides to be an extremely low risk. The Forest Service calculated cancer risk to the public from herbicide use on Forest Service lands in the Southeast to be 1 in 10 million. These estimates are based on an extremely conservative approach, which assumed that the herbicides were carcinogenic (cancer causing) and exposure levels were high over long periods of time--70 years. The fundamental assumption of carcinogenicity is subject to much debate and to date no forestry herbicide has been conclusively shown to be carcinogenic" (ANR-846, McNabb 1997).

As noted in the Hydrology and Water Quality section, the EPA has established drinking water levels of concern (DWLOC) for all five proposed herbicides. National Primary Drinking Water Regulations (NPDSWRs or Primary Standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. All five of the proposed herbicides have either Maximum Contaminant Levels (MCLs) or Drinking Water Level of Concern (DWLOC), or both. These are as follows:

- Glyphosate (MCL = 0.7 ppm, DWLOC = 0.7 ppm);
- Imazapyr (DWLOC = 87 ppm),
- Metsulfuron methyl (DWLOC = 8.7 ppm),
- Triclopyr (DWLOC = 1.7 ppm),
- Picloram (MCL= 0.5 ppm, DWLOC = 0.5 ppm).

USDA Risk Assessment Summaries

The USDA Forest Service has developed extensive risk assessments for all herbicides proposed for use within the Action Alternative (USDA Forest Service 2003 a,b,c,d,e). The risk assessments for each of the herbicides consider two types of exposure for workers: general and accidental/incidental. The term "general" exposure is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application.

The types of exposure scenarios developed for the public are further broken down into acute exposure and longer-term or chronic exposure. The risk assessments assume that acute exposure to the public is accidental, with the exposure occurring during or shortly after application of the herbicide. The specific acute exposure scenarios include direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated vegetation, water and fish.

The chronic exposures addressed in the risk assessments parallel the acute exposure scenarios for consumption, but are based on continuous exposure for longer periods. This is the standard scenario used in all Forest Service risk assessments and is extremely conservative, by assuming that fruit that has been directly sprayed is harvested and consumed for a prolonged period of time and that the contaminated fruit accounts for 100 percent of the individual's consumption of fruit, which is an almost impossible scenario within the analysis area due to the limited method of herbicide application.

The following summaries for each of the proposed herbicides were primarily compiled from the Forest Service Risk Assessment documents (USDA Forest Service 2003

a,b,c,d,e), which may be downloaded from the USDA Forest Service website for further review (http://www.fs.fed.us/). This section also includes potential human health effects from possible impurities or metabolites (breakdown products) for each herbicide.

Glyphosate

The total annual use of glyphosate by the Forest Service is only about 0.275 percent of the agricultural use. Thus, there is no basis for asserting that Forest Service programs will substantially contribute to general concentrations of glyphosate nationally.

Like all chemicals, glyphosate as well as commercial formulations of glyphosate may be toxic at sufficiently high exposure levels. In rats and mice, acute oral LD50 values of glyphosate range from approximately 2,000 to 6,000 mg/kg.

Glyphosate contains N-nitroglyphosphate (NNG) as an impurity and some members of the nitrosamine group may pose a carcinogenic risk. However, the EPA concluded that the NNG content in glyphosate was less than one part per million (<1 mg/L) and not toxicologically significant (USDA Forest Service 2003e). Furthermore, none of the recent scientific reviews of glyphosate toxicity cites NNG as a concern (Cox 2002, WHO 1994, Williams 2000).

The primary metabolite of glyphosate in mammals and other organisms, as well as the environment, is aminomethylphosphonate (AMPA). AMPA is not of toxicological concern, regardless of its levels in food (US EPA/OPP 2002, USDA Forest Service. 2003e). In mammals, only very small amounts of AMPA, less than 1% of the absorbed dose, are formed (US EPA/ODW 1992, Brewster et al. 1991). While this is a common environmental metabolite formed in the degradation of glyphosate, only trace amounts of AMPA are found in mammals (Macpherson1996; US EPA/ODW 1992; WHO 1994) and most of the administered dose of glyphosate (>97%) is excreted in an unchanged form (Williams et al. 2000).

The metabolic pathway in plants affected by the herbicide activity of glyphosate, however, does not occur in humans or other animals and thus this mechanism of action is not directly relevant to the human health risk assessment.

The available experimental studies indicate that glyphosate is not completely absorbed after oral administration and is poorly absorbed after dermal applications. In numerous epidemiological studies, no adverse reproductive effects from glyphosate have been noted. EPA's Re-registration Eligibility Decision indicates that glyphosate is classified as Group E: Evidence of non-carcinogenicity for humans, and is classified as either non-irritating or only slightly irritating to the skin and eyes.

Based on a total of 1513 calls to a poison control center reporting ocular effects associated with the use of Roundup, 21 percent were associated with no injury, 70 percent with transient minor injury, and 2 percent with some temporary injury. The most frequently noted symptoms included blurred vision, a stinging or burning sensation and weeping of the eyes. No cases of permanent damage were reported. Human cases of glyphosate/surfactant exposures have noted gastrointestinal effects.

The risk characterization for both workers and members of the general public are reasonably consistent and unambiguous. For both groups, there is very little indication of any potential risk at the typical application rate of 2 lbs a.e./acre. For workers, the

highest hazard quotient – i.e., 0.2, the upper range for workers involved in broadcast ground spray – is below the level of concern by a factor of about five. The highest hazard quotient for any accidental exposure scenario for workers - i.e., 0.006 for the upper range of the hazard quotient for spill over the lower legs for one hour - is lower than the level of concern by a factor of over 150.

From a practical perspective, the most likely accidental exposure for workers that might require medical attention involves accidental contamination of the eyes. Glyphosate and glyphosate formulations are skin and eye irritants. Glyphosate with the POEA surfactant (typical of the commercial formulation, Rodeo) is about as irritating as standard dishwashing detergents, all purpose cleaners and baby shampoos. As with the handling of any chemical, including a variety of common household products, reasonable care should be taken to avoid contact of skin and eyes and strict adherence to manufacturers' directions and BMPs is necessary.

Under normal circumstances, the general public would not be exposed to substantial levels of glyphosate as a result of Forest Service activities. Studies conducted to assess the potential risks of glyphosate found that none of the longer-term exposure scenarios exceeded or even approached a level of concern. The risk characterization is thus relatively unambiguous, and based on the available information and under the foreseeable conditions of application and exposure, there is no route of exposure or exposure scenario suggesting that the general public will be at risk from longer-term exposure to glyphosate.

Imazapyr

Adverse effects to workers or members of the general public do not appear to be likely from exposure to imazapyr. The weight of evidence suggests that no adverse effects are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.45 lb/acre or the maximum application rate of 1.25 lb/acre.

The toxicity of imazapyr has been relatively well characterized in experimental mammals. Some clinical case reports of intentional (attempted suicide) or accidental ingestion of large amounts of Arsenal have been reported. Resulting symptoms include vomiting, impaired consciousness and respiratory distress. No fatal cases of imazapyr ingestion have been documented.

All of the accidental exposure scenarios for workers involve dermal exposures and all of these accidental exposures lead to estimates of doses that are either in the range of or substantially below the general exposure estimates for workers.

Mild irritation to the eyes can result from exposure to relatively high levels of imazapyr. From a practical perspective, eye irritation is likely to be the only overt effect as a consequence of mishandling imazapyr. This effect can be minimized or avoided by prudent industrial hygiene practices, such as exercising care to reduce splashing and wearing goggles, during the handling and strict adherence to applicable BMPs.

While no information has been encountered in published literature on the manufacturing impurities in imazapyr (USDA Forest Service 2003c), technical grade imazapyr, as with other technical grade products, contains some impurities, which were disclosed to the EPA and were reviewed as part of the current risk assessment (i.e., American Cyanamid

1983a,b; Arthur 2000; Beardmore 1987a; Cortes and Chiarello 1994; Danishevsky and Cortes 1994; Garber 1984; Stellar 1998a,b).

Quinolinic acid is a photolytic (not metabolic) breakdown product of imazapyr that may cause neurotoxic effects at very low doses when injected directly into the brains of rats (Schwarcz et al. 1983). However, it is possible these neurotoxic effects are a result of contamination by a photolytic breakdown product rather than the administration of imazapyr. Quinolinic acid levels in the mammalian brain are regulated by an active transport system and the compound is not present in imazapyr in large enough quantities to cause direct signs of toxicity (USDA Forest Service 2003c).

Exposures to imazapyr do not lead to estimated doses that exceed a level of concern for either workers or members of the general public at either the typical or highest application rates. Based on the available information and under the foreseeable conditions of application within the Proposed Action Alternative, there is no route of exposure or scenario suggesting that the workers or members of the general public will be subjected to any substantial risk from longer-term exposure to imazapyr even at the upper range of the application rate.

Metsulfuron Methyl

The Forest Service used a total of approximately 235 lbs of metsulfuron methyl in 2002, the most recent year for which use statistics are available. Much greater amounts of metsulfuron methyl are used in agriculture (e.g., about 35,543 lbs in 1992).

In experimental mammals, the acute oral LD50 for metsulfuron methyl is greater than 5000 mg/kg, which indicates a low order of toxicity. Appropriate tests have provided no evidence that metsulfuron methyl presents any reproductive risks or causes malformations or cancer. In all species, metsulfuron methyl is eliminated rapidly from the body with a half-life of one day or less. Most of the material is excreted as the unchanged compound.

Skin absorption is the primary route of exposure for workers during the application of metsulfuron methyl. Forest Service risk assessment dermal absorption rates are used to estimate the amounts of metsulfuron methyl that might be absorbed by workers, which then are used with the available dose-response data to characterize risk. Uncertainties in the rates of dermal absorption, although they are substantial, can be estimated quantitatively and are incorporated in the human health exposure assessment.

Studies indicate that metsulfuron methyl is irritating to the skin and eyes at high doses, but does not produce sensitizing effects following repeated dermal exposure. From a practical perspective, irritation is likely to be the only overt consequence of mishandling metsulfuron methyl. The potential inhalation toxicity of metsulfuron methyl is not of substantial concern because of the implausibility of inhalation exposure involving high concentrations of this compound.

Although information on the toxicity of each metabolite is not available, a single study evaluated the effects of a plant and animal metabolite of metsulfuron methyl, triazine amine (1,3,5-triazine-2-amine, 4-methoxy-6-methyl-), following acute and 10-day oral exposures, acute dermal and inhalation exposures and in the Ames test for point mutations (O'Neal 1987). The clinical signs of toxicity resulting from acute oral, dermal

and inhalation exposures to triazine amine do not appear to differ from those for metsulfuron methyl. Following subacute oral exposure to triazine amine, cardiotoxicity was observed; this effect was not reported in subacute oral exposure studies of metsulfuron methyl. Regarding the toxicity of the other metabolites of metsulfuron methyl, US EPA (1998b) concluded that toxicity testing of other degradation products of metsulfuron methyl was not needed.

Typical exposures to metsulfuron methyl do not lead to doses that exceed a level of concern. For workers, no exposure scenarios, acute or chronic, exceed the RfD even at the upper ranges of estimated dose. For members of the general public, all upper limits for hazard quotients are below a level of concern. Thus, based on the available information and under the foreseeable conditions of application within the Proposed Action Alternative, there is no route of exposure or scenario suggesting that workers or members of the general public would be at any substantial risk from longer-term exposure to metsulfuron methyl.

Triclopyr

Like any chemical, triclopyr at sufficiently high exposure levels can cause toxic effects. Nonetheless, triclopyr has a low order of acute lethal potency. Large numbers of sub-chronic and chronic toxicity studies are available on triclopyr, and there is no information suggesting that triclopyr causes direct adverse effects on the nervous system, endocrine system or immune function.

There is no indication that workers would be subject to hazardous levels of triclopyr at the typical application rate of 1 lb/acre and under typical exposure conditions. For workers who may apply triclopyr repeatedly over a period of several weeks or longer, it is important to ensure that work practices involve reasonably protective procedures to avoid the upper extremes of potential exposure. At higher application rates, particularly rates that approach the maximum application rate of 10 lbs/acre, measures should be taken to limit exposure.

Two human dermal exposures to triclopyr BEE – i.e., accidental spray over the lower legs as well as dermal contact with contaminated vegetation – exceed the level of concern at the central estimate of exposure. The use of the highest application under consideration – i.e., 10 lbs/acre – alters the risk characterization for acute exposure terms of dermal exposures and the spill into a pond. At an application rate of 10 lbs/acre, both triclopyr BEE and triclopyr TEA formulations would exceed the level of concern for all dermal exposure scenarios at the upper range of exposure as well as some central estimates of exposure. All dermal exposure assessments are extremely conservative and designed to identify possible types of exposure would be most hazardous, and are far greater than amounts proposed for use within the Action Alternative. For triclopyr, such scenarios include prolonged dermal contact and accidental spills into water.

Garlon 3A contains triethylamine salt of triclopyr (TEA) which dissociates extremely rapidly to triclopyr acid and triethanolamine. Garlon 4 contains butoxyethyl ester (BEE) of triclopyr, which hydrolyzes to triclopyr acid and 2- butoxyethanol, as well as inert ingredients (38.4%) that include deodorized kerosene. In terms of a practical impact on the herbicide risk assessments, the most relevant factor is that both TEA and BEE will mineralize very rapidly in the environment – i.e., be completely degraded to CO2. Thus,

the uncertainties associated with the toxicity of triethanolamine and the comparable toxicity of 2- butoxyethanol to triclopyr have relatively little impact on the risk assessment (USDA Forest Service 2003a).

Deodorized kerosene is classified by US EPA as a List 3 Inert and is found in commercial formulations of Garlon 4. The acute lethal dose of kerosene for humans ranges from approximately 2,000 to 12,000 mg/kg; the acute oral LD50 values in experimental mammals range from approximately 16,000 to 23,000 mg/kg. In experimental mammals, acute oral LD50 values for triclopyr range from approximately 600 to 1000 mg/kg. Thus, the acute lethal potency of kerosene is approximately 16 times less than the acute lethal potency of triclopyr. Given the relative potency of kerosene, the acute effects associated with exposure to Garlon 4 are probably attributable to triclopyr and not to kerosene, and as mentioned previously, are negligible (USDA Forest Service 2003a).

The major metabolite of triclopyr in both mammals and the environment is 3,5,6-trichloro-2-pyridinol (TCP). Although TCP does not have the phytotoxic (poisonous to plants) potency of triclopyr, this compound can be toxic to mammals as well as other species. TCP is of concern because it is a metabolite of triclopyr and because the aggregate risks of exposure to TCP from the breakdown of both triclopyr and chlorpyrifos must be considered. However, there is no indication that the general exposures to TCP from the use of triclopyr and chlorpyrifos will result in harmful levels of exposure. As reviewed by US EPA/OPP (1998a), the chronic toxicity value for TCP is 0.03 mg/kg/day, about the same as the 0.05 mg/kg/day for triclopyr. For acute exposures, the corresponding values are 30 mg/kg/day for triclopyr and 25 mg/kg/day for TCP.

Based on their assessment, the US EPA/OPP (1998a) concluded that: “the existing uses of triclopyr are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr are unlikely to result in acute or chronic drinking water risks from TCP.”

Concentrations of TCP in surface water after the application of triclopyr at 1 lb a.e./acre are well below a level of concern (USDA Forest Service 2003a). Under normal circumstances where Forest Service Plans and manufacturers’ directions are followed and where BMPs are employed, members of the public would not be exposed to substantial levels of triclopyr as a result of Forest Service activities. For members of the general public, the risk characterization is relatively unambiguous at the typical application rate of 1 lb/acre: based on the available information and under the foreseeable conditions of exposure, there is no route of exposure or exposure scenario suggesting that the general public will be at risk from longer-term exposure to triclopyr.

Picloram

The toxicity of picloram to experimental mammals has been very well characterized. Picloram has a low order of acute toxicity, with acute oral LD50 values in the range of 3000 to 5000 mg/kg body weight. Picloram can cause irritation to the eyes. Although picloram is not a strong skin irritant, repeated dermal exposures may lead to skin sensitization. Technical grade picloram has been subject to several chronic bioassays for carcinogenicity and none of the bioassays has shown that picloram has carcinogenic potential. However, technical grade picloram does contain hexachlorobenzene (HCB), a

compound that has shown carcinogenic activity in three mammalian species and has been classified as a potential human carcinogen by the US EPA (US EPA 1995, USDA Forest Service 2003d). Hexachlorobenzene is ubiquitous and persistent in the environment, with the major sources of general exposure for the public involving industrial emissions, proximity to hazardous waste sites and the consumption of contaminated food. Virtually all individuals are, and have been, exposed to HCB and have detectable concentrations of HCB in their bodies (USDA Forest Service 2003d).

Based on current concentrations of HCB in environmental media and food, daily doses of HCB (i.e., background levels of exposure) are in the range of 0.000001 (1E10-6) mg/kg/day. Given an average concentration of 8 ppm HCB in technical grade picloram, the amount of HCB released to the environment as a result of Forest Service programs using picloram is estimated to be about 0.05 kg per year. Given the amount of HCB in picloram and the amount of picloram used in Forest Service programs, the use of picloram by the Forest Service will not substantially contribute to a widespread increase of ambient levels of hexachlorobenzene (USDA Forest Service 2003d). Further, based on the levels of contamination of technical grade picloram with these compounds and the relative potencies of these compounds to picloram, this contamination is not significant in terms of potential systemic toxic effects.

Typical exposures to picloram do not lead to doses that exceed a level of concern. For workers, no exposure scenarios, acute or chronic, exceed the RfD even at the upper ranges of estimated dose. For members of the general public, the upper limits for hazard quotients are below a level of concern except for the accidental spill of a large amount of picloram into a very small pond. Even this extreme exposure scenario results in only a small excursion above the chronic RfD and is not likely to be toxicologically significant, because of the short duration of exposure relative to those considered in the derivation of the RfD. Thus, based on the available information and under the foreseeable conditions of application, where applicable directions and BMPs are employed, there is no route of exposure or scenario suggesting that workers or members of the general public would be at any substantial risk from longer-term exposure to picloram.

Irritation and damage to the eyes can result from exposure to relatively high levels of picloram (i.e., placement of picloram directly onto the eye) and repeated exposures to picloram can lead to skin sensitization. From a practical perspective, eye irritation and skin sensitization are likely to be the only overt effects as a consequence of mishandling picloram. These effects can be minimized or avoided by prudent industrial hygiene practices and adherence to BMPs during the handling and application of picloram.

Based on the standard assumptions used in this and other Forest Service risk assessments, the contamination of picloram with hexachlorobenzene does not appear to present any substantial cancer risk even at the upper ranges of plausible exposure.

Herbicides and Human Safety Summary

In summary, the herbicides proposed in the Action Alternative present a risk to the applicators from overexposure due to an accidental release or contact, or repeated exposure to and contact with high concentrations of some products. However, the potential for these occurrences are minimized by implementation of BMPs such as training workers on proper mixing and use techniques, the proper use of personal

protective equipment, supervision by a licensed pesticide applicator and strict adherence to manufacturers' label directions.

The routes of exposure to herbicides in humans are inhalation, skin contact and ingestion. Since no broadcast or aerial applications are used, overexposure through inhalation would not be a potential risk for the public. The highest potential risk to human safety in the public is from the unlikely possibility that an individual would walk through areas immediately after herbicide application where still wet treated vegetation was present; which as a worst-case scenario, would still have no adverse effects to the individual.

Because forest herbicides target biochemical pathways unique to plants, do not persist in the environment, are nontoxic at normal application rates and do not bioaccumulate, adverse effects to wildlife due to toxicity and decreased water quality generally are not a concern among informed resource professionals (Borrecco et al. 1972, McComb and Hurst 1987, Freedman 1991, Tatum 2004). Further, as indicated in animal studies referenced throughout this document, the proposed herbicides target biochemical pathways unique to plants, do not bioaccumulate in animal tissues and pass through the body without significant effect (see Appendix 7, Biological Evaluation of Herbicides). Also, as noted elsewhere, the LD50 rates for the active ingredient of the proposed products (products are a mixture of the active ingredient and inert ingredients, which are further diluted with water) indicate a toxicity level less than caffeine.

Four of the active ingredients in the proposed commercial formulations (imazapyr, metsulfuron methyl, glyphosate and picloram) have LD50 rates less than common table salt, which is referenced in this study as 3,750 mg/kg. The fifth proposed active ingredient, triclopyr, has an LD50 of 630 mg/kg, which has less than one third the toxicity of caffeine (200 mg/kg) (McNabb 1997).

The proposed products are commercial formulations that include the active herbicide ingredients studied in the risk assessments, as well as inert ingredients; therefore, direct ingestion of only the active ingredient is not possible. The proposed commercial formulations are combined with water to make the foliage spray and the hack and squirt mixtures, further diluting the products and significantly increasing the amount required to reach an LD50 rate. As noted above, the proposed active ingredient with the lowest LD50 rate (highest toxicity) is triclopyr, with an LD50 rate of 630 mg/kg (McNabb). Garlon 3A, a commercial formulation that contains triclopyr, has an LD50 rate of 2574 mg/kg for male rats. The proposed herbicides would be mixed and applied under the supervision of a licensed applicator and would not be accessible to the public, making direct ingestion from a project container unlikely. The other potential risk of ingestion is from eating large unquantifiable amounts of freshly treated vegetation by an individual in a manner that constituted a dosage that would approach levels of concern.

Skin contact with still-wet foliage would be the other potential source of human risk to the public. Immediate, direct, extensive and prolonged skin contact could potentially occur if an improperly attired member of the public followed behind an applicator and repeatedly and extensively touched bare skin to wet target vegetation. Even in this unlikely and extreme case, the risk assessment studies and product Material Safety Data Sheets indicate the most likely effect is a skin reaction in sensitive individuals.

As with all the chemicals, strict adherence to manufacturers' label, application and safety guidelines as well as BMPs will mitigate the potential risk of overexposure to workers. Long-sleeved shirts, long pants, shoes and socks are required by applicators when applying all proposed herbicides products. Some products and mixtures may require protective eyewear or impervious gloves in some types of applications.

In summary, the herbicides proposed in the Action Alternative present the potential for minor immediate and cumulative adverse effects to the applicators from overexposure due to an accidental release or contact, or repeated exposure to and contact with high concentrations of some products, if manufacturers' directions and BMPs are not employed. If all Forest Plans, BMPs and product label directions are followed, no significant immediate or cumulative adverse effects to workers or the general public are anticipated. Further, the continued maintenance of ROWs in order to provide reliable electric service is an immediate and cumulative beneficial effect to human safety by maintaining social infrastructure.

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APPENDIX 1 – REFERENCES

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APPENDIX 2 – GLOSSARY

Absorb	To soak in or to soak up.
Absorption	The movement of a substance (e.g. a chemical) through a membrane into the body after exposure Has occurred.
Acid Equivalent	The part of a formulation that can be converted to the biologically active acid form.
Actinomycetes	Filamentous bacteria that produce several antibiotics and give soil its earthy smell.
Action Level	Analyzed sample level above which a report to the National Forest Service including a mitigation plan will be generated.
Active Ingredient	The functioning chemical in a commercial herbicide formulation.
Acute Effects	The adverse effects caused by a toxic agent that occur within a short period of time after exposure.
Adsorption	The attachment of one substance to the surface of another.
Affected Environment	The relationship of the physical environment to the changes that will or may take place as a result of human activity.
Alkaline	Term that describes a certain pH factor; any pH over 7 is considered alkaline.
Amphibious	A plant or animal with the dependence or ability to live both on land and in water.
Annual Plant	A species of plant that completes its life cycle within a one-year period.
Aquatic	Living in or on the water.
Best Management Practice (BMP):	Management practices that limit adverse impacts to the environment. In forestry BMPs are voluntary guidelines that limit soil erosion and water quality problems while conducting environmental management.
Bioaccumulation	The retention and concentration of a substance by an organism.
Biochemical	Refers to those chemical processes involving the biological function of living organisms.
Biodegradation	The series of processes by which living systems, particularly microorganisms, degrade chemical compounds and the breakdown products may be either more or less toxic than the parent compound.
Biological Diversity	The variety of life and its processes, including all life forms from one-celled organisms to complex organisms such as insects, plants, birds, reptiles, fish, other animals and the processes, pathways and cycles that link such organisms into natural communities.
Biological Evaluation or Biological Assessment (BE/BA)	A specific process required within an environmental assessment that evaluates the potential effects of a proposed project on Proposed, Endangered, Threatened and Sensitive animal and plant species and their habitats.
Buffer	A strip of vegetation that is left undisturbed or is managed to reduce the impact that a treatment or action on one area would have on an adjacent area, especially for streams or other water sources.
Brooding Habitat	Habitat (usually early successional) used by a variety of bird species to raise newly hatched offspring. These areas are important to many species of birds early in the life cycle due to the abundance of insects, soft mast and cover.

Carcinogen	A substance that causes or induces cancer.
CAS #	A unique numeric identifier that designates only one chemical substance.
Chronic Exposure	Adverse effects occurring after exposure to a toxic agent for a long period (with animal testing, this is considered to be the majority of the animal's life). These effects are considered to be permanent or irreversible.
Community	An assemblage of species constituting an organized system through which energy, nutrients and water are cycled.
Corridor	Important pathways that serve as conduits for wildlife to move from one patch of habitat to another, includes areas as small as fencerows and as large as riparian zones.
Cultural Resources	The remains of sites, structures, or objects used by people in the past; this can be historic or prehistoric.
Cumulative Effects	Effects on the environment that result from separate, individual actions that collectively become significant over time.
Degradation	Physical or biological breakdown of a complex compound into simpler compounds.
Diversity	The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.
Drainage Basin	Land area where precipitation runs off into streams, rivers, lakes and reservoirs.
Ecoregion	(Ecological Region) A geographically distinct assemblage of natural communities and species of vegetation, covering a relatively large area of land and/or water.
Ecosystem	An interacting system of organisms and their environment.
Effects	Results expected to be achieved, or actually achieved, relative to physical, biological and social (cultural and economic) factors resulting from the achievement of outputs. There are direct effects, indirect effects and cumulative effects.
Endangered Species	Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.
Endemic	A species (plant or animal) that is exclusively native to a particular place or biota.
Erosion	The wearing away of the land surface by the action of wind, water, or gravity.
Exotic Plant	A non-native plant.
Fall Line	Division in Arkansas between the mountainous west and the Mississippi delta in the eastern portion of the state.
Fauna	A collective term for animal life.
Fecundity	The potential reproductive capacity of an organism, measured by the number of gametes produced.
Flora	A collective term for plant life.
Fisheries Habitat	Streams, lakes and reservoirs that support fish, or have the potential to support fish.

Foliage Mixture Spray	Herbicide application technology where a mixture of two or more components is applied to the foliage of selected woody stem vegetation.
Forest Service	USDA Forest Service. USDA agency that administers the lands and resources of the National Forest system.
Formulation	The form in which a herbicide is packaged or prepared for use. A chemical mixture that includes a certain percentage of active ingredient (technical chemical) with an inert carrier.
Fossorial	Refers to animals that live predominantly underground.
Frilling and Injection	Another name for Hack and Squirt herbicide application.
Game	Wildlife species regularly hunted for food or sport.
Genetic Homogeneity	The extent to which members of a species share similar genetic characteristics.
Geologic Map	A special-purpose map made for showing subsurface geological features.
Glade	A clearing with few or no trees within a forested area.
Guano	The solid wastes of bats.
Glyphosate	Active herbicide in the commercial formulation, Accord, manufactured by Dow AgroSciences .
Geographic Information System (GIS)	A computer program designed to allow users to collect, manage and analyze large volumes of spatially referenced information and associated attribute data.
Gravid	A female of any species which is pregnant with eggs or young.
Habitat	An area in which a specific plant or animal naturally lives, grows and reproduces; the area that provides a plant or animal with adequate food, water, shelter and living space.
Hack and Squirt	Herbicide application technology where the mixture is applied as a selective treatment for larger woody stem vegetation unsuitable for Foliage Mixture Spray treatment. The applicator cuts or hacks a ring around the stem into the cambrium layer and applies herbicide to the cut area.
Half Life	The time required for half the amount of a substance to be reduced by natural processes.
Hardwood	A botanical group of usually deciduous trees that are characterized by broad leaves (as opposed to needles).
Herbaceous	A plant with a non-woody stem.
Herbicide	A chemical that regulates the growth of or kills specific plants.
Hydric Soils	Soils developed in conditions where soil oxygen is limited by the presence of saturated soil for long periods during the growing season.
Hydrolysis	A chemical reaction or process in which a chemical compound is broken down by reaction with water.
Hibernacula	A secure area, usually a cave or den of some sort, used by hibernating animals while in a state of torpor.
Imazapyr	Active herbicide in commercial formulations Arsenal and Stalker, manufactured by BASF.

Imperiled	A general term used to identify populations of animals and plants that are in decline and may be in danger of extinction.
Impoundment	General term for any confined water body, usually due to artificial structures, but may be natural.
Insectivorous	An organism that feeds primarily on insects, such as bats and many bird species.
Indigenous	Species native to a given land or water area by natural occurrence.
Inert Ingredients	All ingredients in a formulated pesticide product that are not classified as active ingredients.
Integrated Pest Management (IPM)	The maintenance of destructive agents, including insects at tolerable levels, by the planned use of a variety of preventive, suppressive, or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable.
Interdisciplinary Team	A team of individuals with skills from different disciplines that focuses on the same task or project.
Interior Highlands	Physiographic province incorporating the Ozark Mountains, the Ouachita Mountains and the Arkansas River Valley.
Invasive Plant	A plant species that grows and spreads rapidly, replacing desirable native plants.
Invasive Species	A species that can move into an area and become dominant either numerically or in terms of cover, resource use, or other ecological impacts. An invasive species may be native or non-native.
Jurassic Geologic Period	A geologic period that extends from about 200 to 146 million years before present. The middle period of the Mesozoic era, also known as the Age of Dinosaurs. The Jurassic follows the Triassic and is followed by the Cretageous.
Karst	A type of topography that is formed over limestone, dolomite or gypsum by dissolving or solution and that is characterized by closed depressions or sinkholes, caves and underground drainage.
Kilogram	A kilogram is 2.205 pounds.
Lactating	The production of milk from the mammary glands of species within the class Mammalia.
Lentic	Characterizes aquatic communities found in slow moving water such as such as ponds, lakes, or swamps.
Lepidoptera	An order of insects, made up of the moths, skippers and butterflies, characterized by scale-covered wings, coiled siphoning mouthparts and complete metamorphosis.
Lotic	Characterizes aquatic communities found in flowing water such as rivers, streams and springs.
LD50	(Median Lethal Dose) A measure of acute toxicity. The single dose level that kills 50 percent of the test animals exposed.
Low Growing Plant Communities	Plant communities, such as grasses that do not reach heights that would require maintenance of power line right of ways.
Macroporosity	Refers to pores greater than 50 mm in diameter.
Management Indicator	Species that may be affected by changes in habitat due to increases in levels

Species (MIS)	of activity as a result of a proposed activity or alternative.
Material Safety Data Sheet (MSDS)	A document providing proper procedures for handling or working with a particular substance that includes physical data, health effects, first aid, reactivity, storage, disposal and spill/leak procedures.
Mechanical Vegetation Management	The use of mechanized equipment for vegetation control and management.
Mesic	Refers to a habitat that is well-drained but usually moist through most of the growing season.
Metabolite	A chemical product derived from the breakdown (metabolism) of another chemical.
Metsulfuron Methyl	Herbicide manufactured by DuPont. Common name is Escort.
Mitigation	Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.
Mitigation Measures	Refers to actions implemented to reduce environmental impacts of specific human activities.
Monitoring	The evaluation on a sample basis of Forest Plan management practices to determine how well objectives have been met, as well as the effects of those management practices on the land and environment.
Monitoring and Analysis Plan	National Forest Service approved plan to monitor streams and water bodies following the application of herbicides.
NAAQS	National Ambient Air Quality Standards
National Environmental Policy Act of 1969 (NEPA)	Requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. Established Council on Environmental Quality.
National Forest Land	National Forest lands for which the Forest Service is assigned administrative responsibility.
National Forest Land and Resource Management Plan (Forest Plan)	A plan developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, that guides all natural resource management activities and establishes management standards and guidelines for the National Forest System lands of a given National Forest.
Native Plants	All indigenous terrestrial and aquatic plant species that evolved naturally in a defined native ecosystem.
NOAA	National Oceanic and Atmospheric Administration.
Non-game	Wildlife species that are not commonly hunted, or consumed by humans, such as songbirds, amphibians and all listed species.
Non-target	A species of flora or fauna affected unintentionally by a pesticide.
OHV	Off Highway Vehicle.
Obligate	An organism restricted to a particular set of environmental conditions, without which the organism cannot survive.
Occurrence	A documented point where a species has been located.
Old-growth	Forest that has reached a late stage of development after a long period without major natural or human disturbance.

Perennial Plant	A species of plant that produces flowers and seeds more than one time in its lifecycle and lives for more than one year.
Permian Geologic Period	Geologic period that extends from about 280 to 248 million years before present. The Permian follows Pennsylvanian, which is followed by Triassic.
Pesticide	Any substance used to control, prevent, destroy, repel, or mitigate insects, rodents, fungi, weeds, or other forms of plant or animal life that are considered to be pests.
PETS Species	Endangered, Threatened and Sensitive Species Proposed for Listing.
Photolytic	Chemical decomposition induced by light or other radiant energy.
Physiography	Description of the surface features of the Earth, with an emphasis on the origin of landforms.
Phytotoxic	Poisonous to plants.
Picloram	Active herbicide in the commercial formulation Tordon K, manufactured by Dow AgroSciences.
Plant Community	An association of plants of various species found growing together in different areas with similar site characteristics.
Population	A group of organisms of the same species populating a given area.
Predation	The act of hunting and killing another animal for food.
Propagation	The act of reproduction by a plant or animal through any natural process.
Pseudomonas	A genus of gram negative bacteria. Many pseudomonads are capable of degrading a variety of compounds.
Registered Herbicide	All pesticides sold or distributed in the United States must be registered by the US Environmental Protection Agency, based on scientific studies, showing that they can be used without posing unreasonable risks to people or the environment.
Residuum	Materials resulting from the disintegration, decomposition and weathering of bedrock.
RfD	Reference Dose. An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.
Right-of-Way (ROW)	A right of use across the lands of others. The land provided for a public service such as a highway or utility corridor, usually including the roadway or utility line/pipe itself and designated land on either side.
Riparian	Land areas directly influenced by water, usually having visible vegetative or physical characteristics indicating this water influence. Streamside, lake borders and marshes are typical of riparian areas.
Risk	In risk assessment, the probability that an adverse effect (injury, disease, or death) will occur under specific conditions of exposure to a risk agent.
Roost	A secure area where flying creatures such as bats and birds take rest during the active season of the year.
Scoping	A process to determine public opinion, receive comments and suggestions and determine issues during the environmental analysis process.
Sedimentation	A process that deposits soils, debris and other materials either on the ground surfaces or in bodies of water or watercourses.
Sensitive Species	Those species that are placed on a list by the Regional Forester for which population viability is a concern.

Silviculture	The art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.
Slope	The steepness of the land expressed as the amount (in percent) of vertical fall per 100 feet of horizontal run.
Spelunking	The recreational sport of exploring caves.
SRCC	Southern Regional Climate Center
Stand	A group of trees that occupies a specific area and is similar in species, age and condition.
Target Plants	Plants that an applied herbicide is intended to control.
Taxon	A taxonomic classification or group of organisms (ie, kingdom, phylum, class, order, family, genus, species).
Terrestrial	Found on dry land.
Threatened Species	Any species that is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range. Designated as a Threatened species in the Federal Register by the Secretary of Interior.
TMDL	Total Maximum Daily Load
Topography	The configuration of a land surface including its relief, elevation and the position of its natural and human-made features.
Toxicity	The quantity or degree of being poisonous or harmful to plant, animal, or human life.
Toxicity Category	US EPA classification of acute toxicity.
Triclopyr	Active herbicide in the commercial formulations Garlon 3 and Garlon 4, manufactured by Dow AgroSciences.
Transitory	An animal with no well defined home range.
Truck Maps	Maps of power line locations used by rural electric personnel in the field.
Turbidity	A measure of water clarity caused by suspended solids.
Viable Population	A self-sustaining population with a high probability of survival despite the foreseeable effects of demographic, environmental and genetic stochasticity and of natural catastrophes.
Volatization	To evaporate or cause to evaporate.
Watershed	The entire area that contributes water to a drainage system or stream.
Wetlands	Areas inundated by surface or groundwater with sufficient frequency to support, and under normal conditions do or would support, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats and natural ponds.

Wildlife	All non-domesticated mammals, birds, reptiles, insects and amphibians living in a natural environment, including game species and nongame species. Animals or their progeny (i.e., feral animals: including horses, burros and hogs), that once were domesticated, but escaped captivity, are not considered wildlife.
Woodland	Land that is covered with trees and shrubs. Woodland is differentiated from forest because a forest has a largely closed canopy. Woodland, however, has a largely open canopy, with sunlight penetrating between trees. Some types of woodland are essentially grasslands with shrubs and scattered trees.
Woody Stem Vegetation	Perennial trees and shrubs with lignified (hardened) stems.

APPENDIX 3 – FIGURES

Electronic files of all maps are available through the Forest Service Project Office in Russellville, Arkansas.

APPENDIX 4 – SURFACE WATER SAMPLING AND ANALYSIS PLAN

UTILITY CORRIDOR VEGETATION MANAGEMENT PROJECT

1.0 INTRODUCTION

The following Surface Water Sampling and Analysis Plan (SAP) is part of the Environmental Assessment (EA) proposal of the rural electric cooperatives (Arkansas Valley Electric Cooperative Corporation, North Arkansas Electric Cooperative, Inc., Ozarks Electric Cooperative Corporation, Carroll Electric Cooperative Corporation) for herbicide applications along power line rights-of-way (ROWs) in the Ozark and Ouachita National Forests located in Arkansas.

1.1 Site Locations

The Rural Electric Cooperative power line ROWs covered by this SAP are located on government owned lands in the Ozark and Ouachita National Forests. The rural electric cooperatives are responsible for approximately 425 miles of power lines that cross public lands in portions of 14 counties in Arkansas. Original ROW footprints vary from 20 feet to one hundred feet. An average ROW width of 50 feet was used to estimate total potential treatment acreage, which is approximately 2,563 acres. Treatment of the entire acreage will likely occur over multiple growing seasons.

The locations of the power line ROWs covered by this SAP are provided in each cooperative's "Truck Maps" and the GIS Maps created for this project.

1.2 Purpose

The purpose of this plan is to present the sampling and analysis procedures to be utilized for monitoring of the surface water along the power line ROWs described above. This plan, when approved by the Forest Service, will be adopted by each of the rural electric cooperatives participating in this EA and will be carried out by a third party employed by the specific rural electric company and approved by Forest Service personnel.

2.0 SCHEDULE

Surface water sampling will take place each growing season on Forest Service properties maintained by each rural electric cooperative participating in the permitted treatment activities. The first sampling event will take place in mid-summer (July) each year for areas treated through June. The second will take place at or near the end of the growing season (late September or early October) for areas treated in July through September.

Water sampling and analysis by a third party, employed by each participating electric cooperative and approved by the Forest Service, will be conducted in accordance with accepted standards and practices, as provided in this SAP and under the guidance of Forest Service personnel. Results of sampling activities will be provided to the Forest Service in a separate annual report for each electric cooperative company. These reports will be completed and submitted to the Forest Service no later than January 31st following herbicide application activities in the previous year's growing season.

A baseline sampling event will be undertaken by the rural electric cooperatives prior to the application of herbicide on Forest Service properties.

Following the initial post-treatment sampling event, surface water sampling frequency may be modified or discontinued based on analytical results and Forest Service approval.

3.0 SURFACE WATER SAMPLING PROCEDURES

3.1 Sample Locations

The power line ROWs within the analysis area were divided into one-mile increments for the purpose of surface water sampling site identification. Due to the number of miles of ROWs, the sample collection and analytical cost of surface water samples along every mile will be prohibitive. A representative sampling, based on ten percent of power line miles within the analysis area, was deemed sufficient to accomplish the required baseline sample. The increments for sample analysis, randomly selected using ArcGIS, were selected by the third party sampling professionals for each rural electric cooperative. A map of monitoring locations will be provided to the Forest Service with the analysis reports.

All perennial streams and standing water bodies present within 100 feet of an analysis area power line will be sampled from each randomly selected mile of the ROWs. If no perennial streams or other water bodies are present within the randomly selected mile, no sample will be collected. If the same perennial stream is present within 100 feet of the ROW at more than one point within the randomly selected mile, the perennial stream will be sampled at the most downgradient location. The surface water samples will be collected at the approximate downgradient edge of the ROWs where perennial streams move from the ROWs onto adjacent properties. Standing water bodies will be sampled nearest the ROW.

There are approximately 425 miles of power lines within the analysis area, some occurring within the same mile segments. ArcGIS was used to randomly select 10 percent of the segments within the analysis area to be sampled. The computer program accounted for the presence of multiple power lines in some areas and identified 43 mile segments. Of these randomly selected segments, 21 had no perennial streams or other water bodies present. The remaining 22 segments represent the collection area for the baseline sampling event. Of the randomly selected segments, four stream intersections were in the Ouachita NF, seventeen in the Ozark NF. Two additional samples will be taken for quality control, for a total baseline of 24 surface water samples.

3.2 Sample Point Identification

Sample points will be identified by assignment of a unique location name and number relating to the specific site (owner of power line ROW and county). GIS was used to document the location of each surface water sample. These GIS locations were identified and field checked during the data collection phase of the EA.

3.3 Sample Collection and Delivery to Laboratory

Surface water samples will be collected directly from the source as a grab sample. Each sample will be placed in new sample container provided by the receiving analytical laboratory. Sample containers will be properly labeled and recorded on a chain-of-custody sheet. Samples will then be placed in an ice chest and will be maintained with ice at approximately 4 degrees C until delivered to the receiving laboratory. The chain-

of-custody will be maintained through delivery to the laboratory and until final analyses are completed.

Each sample delivered to the laboratory will be evaluated for the parameters presented in Section 8. The laboratory will be instructed to provide the client with a report of each analytical parameter evaluated, which includes samples identified with levels above detection limits, the specific detection limit for that parameter and the method used for analysis. Full laboratory QA/QC results will be calculated and reported by the analytical laboratory.

4.0 DECONTAMINATION PROCEDURES

Each surface water sample instrument (stainless steel dipper) will be decontaminated as follows:

a) The sampling instrument will be washed using a non-phosphate detergent.
b) The instrument will be rinsed with distilled water.
c) The instrument will be cleaned with isopropyl alcohol to assure all potential herbicides are removed.
d) The instrument will be hand dried with clean paper towels and placed in a clean plastic bag for transport to the next sampling location.
e) All decontamination water will be containerized for proper disposal.

5.0 FIELD QUALITY CONTROL

The following sections provide information on the Quality Assurance/Quality Control (QA/QC) to be utilized in the surface water sampling and analysis program.

5.1 Sample Identification

Surface water samples will be identified by unique location names and numbers as described in Section 2.1. Arbitrary numbers will be assigned to duplicate and any other QA/QC samples.

5.2 Analytical Quality Control

Precision of the total measurement system will be estimated with duplicates. A duplicate sample will be analyzed with every Analytical Batch or a minimum of once in twenty (20) samples, which ever is the greater frequency. Duplicates will be sent to the receiving laboratory as "blind" samples along with the routine samples.

6.0 SAMPLE CONTAINERS AND PRESERVATION

Samples will be properly prepared for transportation to the receiving laboratory by placement in ice chests with ice to maintain 4 degrees centigrade temperature. Labels will be firmly attached to the sides of the containers and will contain the following information:

a) Sample location number
b) Name of rural electric cooperative
c) Sampling date and time
d) Analyses requested
e) Sample collector's initials

After the sample is collected and properly prepared for transportation to the receiving laboratory, it will be placed in an ice chest with ice for preservation and shipment. Care will be taken to package sample containers so that they will not leak, spill, vaporize or break. Each shipping container (ice chest) will be labeled with:

a) Sample collectors name, address and telephone number
b) Laboratory name, address and telephone number
c) Description of samples
d) Number of samples
e) Date of shipment

Properly completed chain-of-custody documentation, as described in Section 7.1, will be prepared and attached to the shipping container. The container will be sealed with packaging tape so that the chain-of-custody documentation will be immediately apparent to the receiving laboratory personnel receiving the container but will not be damaged or lost during shipping. The transport of samples to the Analytical Laboratory will be in accordance with Department of Transportation regulations, as necessary.

7.0 SAMPLE HANDLING, TRANSPORT AND CUSTODY

7.1 Chain-of-Custody Documentation

Chain-of-custody procedures will be followed to establish a written record concerning sample transport from the sampling site to the analytical laboratory. The sampling crew chief will be responsible for the care and custody of the samples collected until they are transferred or dispatched properly.

Each shipping container (ice chest) will have attached a chain-of-custody form completed by the sampling crew chief. After verification by the sample transporter, the original chain-of-custody will be sealed in an envelope and attached to the ice chest to be shipped to the receiving laboratory. A copy of the chain-of-custody will remain with the sampling crew chief. Upon receipt, the laboratory will complete and duplicate the form. The original chain-of-custody document will then be returned to the party responsible for maintaining the project files. The chain-of-custody record must contain the following minimum information:

- Sample collector's sample number
- Signature of sampler
- Date and time of each sample collection
- Place and address of each sample collected
- Matrix type of each sample collected
- Analysis requested
- Signatures involved in the chain of possession of samples
- Inclusive dates of possession of samples

7.2 Sample Shipment

Prior to leaving the sampling site, the sample transporter will inspect the condition of the samples along with the chain-of-custody documentation to verify that containers were correctly labeled and to confirm that samples were being shipped to the correct

laboratory(s). The transporter will then sign the chain-of-custody form and transport the samples directly to the analytical facility.

7.3 Receipt and Logging of Sample

A sample custodian will receive the samples at the laboratory. Upon receipt of the samples, the custodian will be required to inspect the condition of the sample containers, reconcile the information on the sample label with that on the chain-of-custody record, assign a laboratory number, log the sample in the laboratory logbook and store the sample in a secured storage area until assigned for analysis. Results of the inspection will be noted on the chain-of-custody record and the laboratory sample logbook. Discrepancies between the information on the sample label, on the chain-of-custody record and on the sample analysis request will be resolved before the sample is assigned for analysis.

8.0 LABORATORY ANALYSIS

A Forest Service approved laboratory, using methods listed on the National Environmental Methods Index or methods approved by the EPA, US Food and Drug Administration or the Forest Service, will analyze the surface water samples collected for the project. The chemicals proposed for use are: glyphosate; imazapyr; metsulfuron methyl; triclopyr; and picloram. Each rural electric cooperative will use a customized formulation from the proposed products. Monitoring points in each area will be representative of the products used. Products not used will not be sampled for. Analysis will be conducted per EPA and NEPA guidelines.

Samples found to be above Maximum Contaminant Levels (MCLs) or EPA's established Drinking Water Levels of Concern (DWLOCs) will be retested, If samples are still found to be above these levels, a contaminant source investigation would be appropriate followed by the implementation of mitigation measures to prevent future overloading.

9.0 DATA EVALUATION AND REPORTING

Data evaluation will conform to regulatory agency requirements (Forest Service and other agencies as required by the Forest Service). Duplicates analyzed by the analytical laboratory will be used to evaluate quality assurance and quality control (QA/QC). Results of each of these will be evaluated to document the integrity of sampling and analytical procedures.

The analytical laboratory will be requested to report the following:

- sample identification number(s)
- laboratory control numbers
- analytical procedure(s) used for each analyte
- maximum holding time for each analyte
- date and time of analysis for each analyte
- equipment calibration results and date of last calibration (where applicable)
- minimum detection limits for each analyte
- analytical results of analytes for each sample
- date data was reported

A summary report of all results will provided at the completion of each sampling event.

APPENDIX 5 – ECOREGIONS

ANALYSIS AREA ECOREGIONS

Ecoregion III Ozark Highlands

The topography of the Ozark Highlands ecoregion varies from steep slopes, near the large streams, to moderate relief hills on the broad plateaus or inter-stream areas. The Ozark Highlands have a more irregular physiography and a larger percentage of forested than adjacent regions, with the exception of the Boston Mountains to the south (USDA Forest Service 1999a, Woods et al. 2004). Karst features, including caves, springs and spring-fed streams are found throughout most of the region heavily influencing surficial water availability and water temperature (USDA Forest Service 1999a). Clear, cold, perennial, spring-fed streams are common, and typically have gravelly substrates; in addition, many small dry valleys occur. Soils are often cherty and have developed from carbonate rocks or interbedded chert, sandstone and shale; mesic Ultisols, Alfisols and Mollisols are common. Shale, chert and Precambrian igneous rocks are also present within the Ozark Highlands ecoregion (Omernik 1987, USDA Forest Service 1999a).

More than 60 percent of Ozark Highlands' total area is forested woodlands, although the forest covers nearly 100 percent of the upland habitats in more rugged sections. Oak-hickory is the predominant forest type, but mixed stands of oak and pine are also common. Pine concentrations within the Ozark Highlands are greatest in the southeastern portion of the ecoregion (USDA Forest Service 1999a). Cultivated land is mainly confined to small tracts in numerous valleys and small creek bottoms. Glades dominated by grass and eastern red cedar are found on shallow, droughty soils especially over dolomite. Primary land uses of the Ozark Highlands are poultry and livestock farming, logging, housing and recreation (USDA Forest Service 1999a, Woods et al. 2004).

Major ungulates are white-tailed deer and cattle. Coyote is the major predator. The mink, otter, beaver, black bear, fox and bobcat had declined but are recovering. Ozark Highlands supports opossum and some threatened and endangered bats. Bird species total 143 and include bald eagles, other raptors, turkey, various owls, wood ducks, roadrunners, kingfishers, various woodpeckers and various songbirds (many warblers). Habitat diversity (glades, sinkholes, caves) contributes to rich herpetofauna (rattlesnakes, copperheads, turtles and salamanders). The richness of fish species is great, including 18 endemics and some relics. Crustaceans (19 endemic crayfish) and molluscs (7 endemics) include some threatened and endangered species (USDA Forest Service 1994).

Ecoregion IV Dissected Springfield Plateau-Elk River Hills

The Dissected Springfield Plateau-Elk River Hills ecoregion is a moderately to highly dissected, hilly section of the Springfield Plateau, with gently sloping, narrow ridge tops separated by steep V-shaped valleys. The Dissected Springfield Plateau–Elk River Hills are underlain by cherty limestone of the Mississippian Boone Formation and contain many karst features. Cold, perennial, spring-fed streams are common within this ecoregion (USDA Forest Service 1999a, Woods et al. 2004).

The natural vegetation of the Dissected Springfield Plateau-Elk River Hills is characterized by oak–hickory and oak–hickory–pine forests (Anderson 2006). Uplands are typified by oak-woodland, mixed deciduous forest, or mixed deciduous-

pine forest containing black oak, white oak, blackjack oak, post oak, hickories and shortleaf pine. Mesic forests containing sugar maple, white oak, northern red oak and beech are common in ravines on north-facing slopes. Scattered limestone glades also occur within the Dissected Springfield Plateau-Elk River Hills. Cleared areas occurring on gently sloping ridge tops and in narrow valleys are common and mostly used as pasture. Primary land uses are woodland grazing, logging, livestock farming, recreation, quarrying and housing (Woods et al. 2004).

Ecoregion IV Springfield Plateau

The Springfield Plateau ecoregion is a smooth to gently rolling plain, karst features such as sinkholes and caves are common (USDA Forest Service 1999a). Cold, perennial springs are also common to this ecoregion and contribute substantially to stream flow in the summer and fall. Many streams flow year-round, but some dry valleys occur. Upland vegetation is primarily mixed deciduous forest (containing black oak, white oak, blackjack oak, post oak and hickories) with some mixed deciduous--shortleaf pine forest (Anderson 2006, Woods et al. 2004, USDA Forest Service 1999a**)**. Native vegetation found on floodplains and low terraces within the ecoregion include willows, maples, hickories, birch, American elm and American sycamore (Woods et al. 2004, USDA Forest Service 1999a). Originally, savannas or tall grass prairies were common and maintained by fire. Most of the forest and almost the entire prairie have been replaced by agriculture or expanding residential areas. Poultry, cattle and hog farming are primary land uses; pastureland and hayfields are common (Woods et al. 2004).

Ecoregion IV White River Hills

The White River Hills are moderately to highly dissected portion of the Salem Plateau containing the hills, ridges, karst features and entrenched, narrow valleys (Woods et al. 2004, USDA Forest Service 1999a). The White River Hills ecoregion is one of the more dissected areas in the Ozark region with local relief of 600 to 1,600 feet. Dissected Ordovician dolomite and some sandstone, with step-like topography of level crested buttes, lower benches and bottomlands are common (USDA Forest Service 1999a). Cliffs, sinkholes and caves are prevalent, with some of the largest caves in Missouri found in this region. Large springs, high-gradient sustained-flow streams, as well as many smaller losing streams that are often dry, are typical. Streams generally flow year-round, reflecting the influence of groundwater, but dry valleys do still occur (Woods et al. 2004, USDA Forest Service 1999a).

The natural vegetation occurring in the White River Hills ecoregion is a mosaic of oak and oak pine forest and woodland, interspersed with widespread limestone or dolomite glades. Uplands are mostly covered by mixed deciduous forest (containing black oak, white oak, blackjack oak, post oak and hickories) and also mixed deciduous-shortleaf pine forest however less steep uplands have been cleared and are used as pasture or hay fields (Anderson 2006, Fletcher and McDermott 1957; Rafferty 1996). Other natural vegetation includes oak-hickory forest, cedar glades, and in the west, oak-hickory-pine forest (Rafferty 1996). Glades consist of eastern red cedar, Ashe juniper, native grasses and sparse populations of post oak and elm (Rafferty 1996). The dissected topography of White River Hills and the thin, rocky soils provide little arable land (Rafferty 1996). Consequently, land cover is

principally woodland, and much of the area is held as public land (Chapman et al. 2002, Woods et al. 2004, USDA Forest Service 1999a).

Ecoregion III Boston Mountains

The Boston Mountains are mountainous, forested and underlain by Pennsylvanian sandstone, shale and siltstone. The maximum elevations are higher, soils have a warmer temperature regime and carbonate rocks are much less extensive than in the Ozark Highlands. Physiography is distinct from the Arkansas Valley with the upland soils being mostly Ultisols that developed under oak–hickory and oak–hickory–pine forests (Omernik 1987). The forests are still widespread across the ecoregion and commonly contain northern red oak, southern red oak, white oak and hickories in the uplands (Gerstacker 1881, USDA Forest Service 1999a, Lockhart et al. 1995, Harmon et al. 1996). Shortleaf pine grows on drier, south- and west-facing slopes underlain by sandstone. Pasture- or hayfields occur on nearly level ridgetops, benches and valley floors (USDA Forest Service 1999a). Population density is low; recreation, logging and livestock farming are the primary land uses. Water quality in streams is generally exceptional; biochemical, nutrient and mineral water quality parameter concentrations all tend to be very low (Woods et al. 2004).

Among the fauna in the Boston Mountains are white-tailed deer, black bear, bobcat, gray fox, raccoon, cottontail rabbit, gray squirrel, fox squirrel, eastern chipmunk, white-footed mouse, pine vole, short-tailed shrew and cotton mouse. The turkey, bobwhite and mourning dove are game birds in various parts of this Section. Songbirds include the red-eyed vireo, cardinal, tufted titmouse, wood thrush, summer tanager, blue-gray gnatcatcher, hooded warbler and Carolina wren. The herpetofauna include the box turtle, common garter snake and timber rattlesnake (USDA Forest Service 1994).

Ecoregion IV Upper Boston Mountain

The Upper Boston Mountains are dissected, rugged mountains with steep slopes, sharp ridges and narrow valleys (USDA Forest Service 1999a, Ozark Ecoregional Conservation Team 2003). Benches on the mountainsides occur frequently and are characteristic of the area. The Upper Boston Mountains ecoregion is generally higher and moister than the Lower Boston Mountains with elevations varying from 1,000 to 2,800 feet (USDA Forest Service 1999a). Mostly wooded, the Upper Boston Mountain region is composed of mixed deciduous forest and oak woodlands. The clearings are used as pasture or hayfields.

The major natural vegetation community of the Upper Boston Mountains ecoregion is oak–hickory forest. On upland areas: northern red oak, white oak, pignut hickory and mocker nut hickory dominate. Sweetgum, willows, birch, American sycamore, hickories, southern red oak and white oak are found on narrow floodplains and low terraces (USDA Forest Service 1999a, Woods et al. 2004). The forests of the Upper Boston Mountains are more closed and contain far less pine than those of the Lower Boston Mountains. North-facing slopes support mesic forests. The ecoregion is underlain by Pennsylvanian sandstone, shale and siltstone (USDA Forest Service 1999a). Water quality in streams reflects geology, soils and land use, and is typically exceptional; mineral, nutrient and solid concentrations as well as turbidity all tend to be very low. Summer flow in many streams is zero or near zero (Woods et al. 2004, USDA Forest Service 1999a).

Ecoregion IV Lower Boston Mountain

The Lower Boston Mountains are characterized by low mountains, rounded high hills and undulating plateaus. The ecoregion contains moderately-to-highly dissected high hills containing steep slopes and significant local relief and elevations of up to 1000 ft (Ozark Ecoregional Assessment Team 2003). The Lower Boston Mountains ecoregion is a mosaic of woodland, forest and savanna that contrasts with the denser, moister and more closed forests of the Upper Boston Mountains. Mostly forest and woodland; the ecoregion becomes more open to the west. Flatter areas are used as pastureland or hayfields (USDA Forest Service 1999a, Woods et al. 2004).

The natural vegetation of the Lower Boston Mountains ecoregion is oak–hickory–pine and oak–hickory forests. Mixed oak and oak-pine forests, woodlands or savanna occur on uplands. Northern red oak, white oak, post, scarlet, black, blackjack oak, pignut hickory, shagbark hickory, mocker nut hickory and shortleaf pine are the dominant native tree species of the area. On lower, drier south- and west-facing sites shortleaf pine dominates. On narrow floodplains and low terraces, sweet gum, willows, birch, American sycamore, hickories, southern red oak and white oak are common (USDA Forest Service 1999a, Woods et al. 2004, Ozark Ecoregional Conservation Team 2003). The ecoregion is underlain by Pennsylvanian sandstone, shale, chert and siltstone (USDA Forest Service 1999a, Ozark Ecoregional Conservation Team 2003). Summer flow in many streams is zero or near zero, but enduring pools fed by interstitial flow occurs (Woods et al., 2004, USDA Forest Service 1999a).

Ecoregion III Ouachita Mountains

The Ouachita Mountain ecoregion is made up of ridges, hills and valleys formed by the erosion of folded and faulted Paleozoic sandstone, shale and chert. The Ouachita Mountains are a continuation of the Appalachians, formed during the late Paleozoic Era. Structurally different from the Boston Mountains, the Ouachita Mountains are more folded and rugged than Ozark Highlands.

The natural vegetation of the Ouachita Mountain ecoregion is oak–hickory–pine forest. In 1994 dominants were shortleaf pine, white oak, mockernut hickory, northern red oak, post oak and black oak (Kreiter 1995). Hardwoods, primarily oaks, were also a major component on most sites (Foti and Glenn 1991). Today, loblolly pine and shortleaf pine grow in a distinctive mix of thermic Ultisol and Inceptisol soils (USDA Forest Service 1999a). In general, pine was virtually ubiquitous in the historic forests of the Ouachitas, varied greatly in dominance. Major land uses are logging, recreation, pastures and hay fields. Only in the valleys of the western Ouachita Mountains and westernmost Fourche Mountains did prairies become dominant in the landscape. Pasture/hay lands are found in the broader valleys of the Ouachita Mountains (USDA Forest Service 1999a, Woods et al. 2004).

Among the fauna in the Ouachita Mountains are white-tailed deer, black bear, bobcat, gray fox, raccoon, gray squirrel, fox squirrel, eastern chipmunk, white-footed mouse, pine vole, short-tailed shrew and cotton mouse. In various parts of this Section, the turkey, ruffed grouse, bobwhite and mourning dove are game birds. Songbirds include the red-eyed vireo, cardinal, tufted titmouse, wood thrush, summer tanager, blue-gray gnatcatcher, hooded warbler and Carolina wren. The herpetofauna include the box turtle,

common garter snake and timber rattlesnake. Endemics are Fourche Mountain salamander, Caddo Mountain salamander, Rich Mountain salamander, Ouachita madtom, Ouachita Mountain shiner, Kiamichi shiner, Ouachita darter, peppered shiner and Rich Mountain slitmouth snail. Threatened and endangered species include the red-cockaded woodpecker, bald eagle, American burying beetle, Arkansas fatmucket and rock pocketbook mussel. Other characteristic species include the Western diamondback rattlesnake and eastern collared lizard (USDA Forest Service 1994).

Ecoregion IV Fourche Mountains

The Fourche Mountains are rugged, east to west trending, narrow-crested mountain ridges that are separated by mostly narrow valleys. Elevations within the ecoregion range from 750 to over 2,600 ft (USDA Forest Service 1999a). Vegetation consists of pine-oak forests, oak forest, loblolly-shortleaf pine forest or oak-pine forest (Foti and Glenn 1991, Nuttall 1980). On highest ridge tops, white oak and post oak forests and woodlands are stunted by ice and wind (Nuttall 1980, Rowland 1930). Ridges are underlain by Pennsylvanian and Mississippian sandstone and shale valleys by sandy residuum (USDA Forest Service 1999a).

The Fourche Mountains ecoregion holds the only montane communities in Arkansas. North-facing, steep slopes harbor mesic vegetation including sugar maple and cucumber magnolia (Foti and Glenn 1991). South-facing slopes harbor drier forests dominated by shortleaf pine. Steep south-facing sites are composed of grassy woodland areas. Loblolly pine is native only to wet lowland sites such as riparian areas (USDA Forest Service 1999a, Woods et al. 2004).

Ecoregion III Arkansas Valley

The Arkansas Valley is an alluvial valley lying between the Boston Mountains to the north and the Ouachita Mountains to the south. In years past, the Arkansas Valley was considered part of the Ouachita Ecoregion (USDA Forest Service 1999a, Woods et al. 2004, Ouachita Ecoregional Assessment Team 2003). The ecoregion consists of plains, hills, floodplains, terraces and scattered mountains, largely underlain by interbedded Pennsylvanian sandstone, shale and siltstone (Ouachita Ecoregional Assessment Team 2003).

Prior to the 19th century, uplands were dominated by a mix of forest, woodland, savanna and prairie. While the floodplains and lower terraces within the ecoregion were covered by bottomland deciduous forest (Foti and Glenn 1991). Today, less rugged upland areas have been cleared for pasture or hayfields. Important land uses include poultry and livestock farming. Water quality is generally good and influenced more by land use activities than by soils or geology (USDA Forest Service 1999a, Woods et al. 2004).

Presently the fauna include white-tailed deer, black bear, bobcat, gray fox, raccoon, cottontail rabbit, gray squirrel, fox squirrel, striped skunk, swamp rabbit and many small rodents and shrews. In flooded areas, beavers, ibises, cormorants, herons, egrets and kingfishers are common. Endemics include the Magazine Mountain shagreen, longnose darter and Arkansas darter. Songbirds include the red-eyed vireo, cardinal, tufted titmouse, wood thrush, summer tanager, blue-gray gnatcatcher, hooded warbler and Carolina wren. The herpetofauna include the box turtle, common garter snake and timber rattlesnake (USDA Forest Service 1994).

Ecoregion IV Arkansas Valley Hills

The Arkansas Valley Hills ecoregion is composed primarily of rolling hills, valleys and cuestas, with occasional scattered low mountains 300 to 1,000 ft in elevation (USDA Forest Service 1999a). The Arkansas Valley Hills are underlain by Pennsylvanian sandstone and shale, with Ultisols being the most common soil type (USDA Forest Service 1999a). The ecoregions natural vegetation consists of oak–hickory forest and oak–hickory–pine forest (USDA Forest Service 1999a). Common trees native to the Arkansas Valley Hills include blackjack oak, post oak, red oak, white oak, hickories and shortleaf pine. Pastureland is currently extensive in the area, but rugged areas remain wooded. Poultry operations, livestock farming and logging are important land uses (Woods et al. 2004).

Ecoregion IV Arkansas Valley Plains

The Arkansas Valley Plains ecoregion is composed mostly of undulating plains with occasional hills and ridges 300 to 500 ft in elevation (Nuttall 1980, USDA Forest Service 1999a). The plains are flatter, drier, more open and have fewer topographic fire barriers in the west, but become increasingly interrupted by hills and ridges toward the east. Located in Fourche Mountains rainshadow, Arkansas Valley Plains were once covered by a distinctive mosaic of prairie, savanna and woodland (Croneis 1930, USDA Forest Service 1999a, Ouachita Ecoregional Assessment Team 2003). The valley receives annual precipitation total of 2-6 inches less than the surrounding regions due to this rainshadow effect, which is produced by a combination of prevailing western winds and mountain orographic effects (Ouachita Ecoregional Assessment Team 2003). This ecoregion is characteristically covered with oak-hickory forest, oak-hickory-pine forest, and in the extreme western part of Arkansas, cross timbers (USDA Forest Service 1999a). Wetlands occur in upland depressions and on flats with impermeable, clay-rich soils or pans. The woodlands are composed of post oak, black oak, white oak, hickories, maple, beech, elm, loblolly pine, shortleaf pine and red cedar (USDA Forest Service 1999a, Woods et al. 2004).

The shale-derived soils associated with the prairies of the Arkansas Valley Plains are thin and droughty. Droughty soils, reduced precipitation and general level topography create conditions that are highly conducive to the ignition and spread of fires. Stands frequented by fire are typically dominated by *Andropogon gerardii, Sorghastrum nutans, Panicum virgatum* and *Schizachyrium scoparium*.

Ecoregion IV Scattered High Ridges and Mountains

The Scattered High Ridges and Mountains ecoregion is composed of disjunct mountains and ridges in the Arkoma Basin ranging from 750 to 2,800 ft in elevation (USDA Forest Service 1999a, Woods et al. 2004). This ecoregion is characteristically covered by savannas, open woodlands, or forests dominated or co-dominated by oak-hickory forest and oak-hickory-shortleaf pine forest. Loblolly pine occurs but is not native to the area. The Scattered High Ridges and Mountains ecoregion is underlain by Pennsylvanian sandstone and shale (USDA Forest Service 1999a). Nutrient and mineral values (including turbidity and hardness) in streams are slightly higher than in other parts of the Arkansas Valley. The flat top of Magazine Mountain is covered with xeric, stunted woodlands. Mesic sites also occur and may contain beech–maple forests (USDA Forest Service 1999a, Woods et al. 2004).

FOREST COMMUNITIES

Ozark-Ouachita Dry-Mesic Oak Forest

GAP types:
T.1.B.3.a.II, *Quercus alba*, white oak - mixed hardwoods
T.1.B.3.a.III, *Quercus rubra* - Quercus spp., northern red oak - oak
T.1.B.3.a.IV, *Quercus falcata* - Quercus spp., southern red oak - oak
T.2.B.4.a.I, *Quercus* spp. – *Carya texana*, oak - black hickory

Found throughout the Ozark and Ouachita Highlands, this system ranges to the western edge of the Interior Low Plateau. The system is comprised of dry-mesic to mesic and gentle to moderately steep slopes. Soils are typically moderately to well drained and are more fertile than those associated with oak woodlands. A closed canopy of oak species (*Quercus rubra* and *Quercus alba*) often hickory species (*Carya* spp.) typify this system. *Acer saccharum* (or *Acer barbatum*) may occur on more mesic areas of this system. Wind, drought and lightening occasionally start fires that can influence this system. (Ouachita Ecoregional Assessment Team 2003).

"**Interior Highlands Glade-Barrens**" type includes three habitats: Central Interior Highlands Dry Acidic Glade and Barrens (and same ecological system); Central Interior Highlands Calcareous Glade and Barrens (and same ecological system); and Ozark-Ouachita Dry Oak Woodland (and same ecological system)

GAP types:
T.1.A.9.c.I, *Juniperus virginiana*, eastern red cedar
T.1.B.2.b.IV, *Juniperus virginiana*, eastern red cedar
T.1.B.3.a.V, *Quercus stellata*, post oak
T.2.A.2.b.I, *Juniperus virginiana* - Quercus spp., eastern red cedar - oak
T.2.B.3.a.II, *Juniperus ashei* - *Quercus* spp., white cedar - oak

Central Interior Highlands Dry Acidic Glade and Barrens

This system is found in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions. It occurs along moderate to steep slopes or valley walls of rivers along most aspects. Parent material includes chert, igneous and/or sandstone bedrock with well- to excessively well drained, shallow soils interspersed with rock and boulders. These soils are typically dry during the summer and autumn, becoming saturated during the spring and winter. Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata*, *Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils. This system is influenced by drought and infrequent to occasional fires. Prescribed fires help manage this system by maintaining an open glade structure (Ouachita Ecoregional Assessment Team 2003).

Central Interior Highlands Calcareous Glade and Barrens

This system is also found primarily in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions running along moderate to steep slopes and steep valleys, usually on southerly to westerly facing slopes. Typically, the system has limestone and/or dolomite bedrock with rocky moderately to well-drained shallow soils. During summer and autumn, the soils in the system often dry out with the winters and springs being saturated. Dominated by *Schizachyrium scoparium* the sytem is commonly associated

with *Andropogon gerardii*, *Bouteloua curtipendula* and calcium-loving plant species. Stunted woodlands are dominated by *Quercus muehlenbergii* and interspersed with *Juniperus virginiana*. Fire helps manage this system by restricting woody growth and maintaining more open glade structure (Ouachita Ecoregional Assessment Team 2003).

Ozark-Ouachita Dry Oak Woodland
This system is also found primarily in the Interior Highlands of the Ozark, Ouachita and Interior Low Plateau regions running along gentle to steep slopes and over bluff escarpments with southerly to westerly sides. Parent material can range from very shallow, well- to excessively well-drained calcareous to acidic soils. Sometimes fragipans occur that cause "xero-hydric" moisture conditions. *Quercus stellata*, *Quercus marilandica* and *Quercus coccinea* dominate the system. The understory is comprised of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. *Quercus stellata* is the major dominant in flatwoods with fragipans. Drought stress is the major influence that maintains this system (Ouachita Ecoregional Assessment Team 2003).

Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland type includes pine-hardwood co-dominated sites in three habitats: Ozark-Ouachita Pine-Oak Forest habitat; Ozark-Ouachita Pine-Oak Woodland habitat; and Ozark-Ouachita Pine/Bluestem Woodland habitat, all of which make up Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland ecological system.

GAP types:
T.1.A.9.b.I, *Pinus echinata*, shortleaf pine
T.1.B.2.b.II, *Quercus* spp. - *Pinus echinata – Carya* spp., oak - shortleaf pine - hickory
T.2.B.3.a.I, *Pinus echinata* - *Quercus* spp., shortleaf pine - oak

This system represents forests and woodlands found primarily in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma and southern Missouri. *Pinus echinata* is an important or dominant component. Although this system occurs throughout the region, there is local variation in the degree to which they were present. Fore instance, the system was historically prominent only in the southeastern part where sandstone derived soils of the Ozark Highlands were common (USDA Forest Service 1999a). However, *Pinus echinata* was limited from other areas by inadequate winter precipitation and nonconductive soils. In contrast, pine was "virtually everywhere in the historical forests of the Ouachitas" (USDA Forest Service 1999a). Mostly *Pinus echinata* occurs with a variable mixture of hardwood species. Hardwood compositions in these areas are much more closely related to aspect and topographic factors than is the pine component (Dale and Ware 1999, Ouachita Ecoregional Assessment Team 2003).

"**Ozark-Ouachita Riparian**" type includes two habitats:
Ozark-Ouachita Riparian habitat
South-Central Interior Large Floodplain habitat (Not found in the study area)

GAP types:
P.1.B.3.c.VII, *Quercus phellos*, willow oak
P.1.B.3.c.VIII, *Liquidambar styraciflua*, sweetgum
R.1.B.3.c.I, *Salix* - *Populus*, willow - cottonwood
R.1.B.3.c.II, *Betula* - *Platanus* - Acer, birch – sycamore - maple

Ozark-Ouachita Riparian

This system is found along streams and small rivers within the Ozark and Ouachita regions. The system often contains cobble bars and steep banks and has little to no floodplain development. It traditionally has higher slopes than larger floodplains and experiences periodic, strong flooding. It is often characterized by a cobble bar with forest right adjacent with little to no marsh development. Typical tree species include *Liquidambar styraciflua*, *Platanus occidentalis*, *Betula nigra*, maples species (*Acer* spp.) and oaks (*Quercus* spp.). The richness of the herbaceous layer and shrub layer can vary significantly from species-rich to species-poor. The shrub layer is typically composed of *Lindera benzoin*, *Alnus serrulata* and *Hamamelis vernalis*. Small seeps and fens can often be found within this system. These areas are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.) and other herbaceous species such as *Impatiens capensis*. Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers (Ouachita Ecoregional Assessment Team 2003).

The following table, excerpted from the 1999 USDA Forest Service Ozark-Ouachita Highlands Assessment, lists rare community types in the Ozarks-Ouachita Highlands

Table A5-1: 1999 USDA Forest Service Ozard-Ouachita Highlands Assessment

Table 3.13—Types of rare communities in the Ozark-Ouachita Highlands, with TNC and State nomenclature, global ranking, States of occurrence, and reason for rarity

Nomenclature	Global rank[a]	States of occurrence	Reason for rarity
		Forest and Woodland Types	
I.A.8.N.b.030. *Pinus echinata/Vaccinium* Dry shortleaf pine-oak forest	G2	AR, OK, MO	Few old growth examples
I.B.2.N.a.070. *Acer saccharum-Quercus rubra-Carya cordiformis* Mixed mesophytic forest	G2Q	AR, OK, MO	Limited distribution
I.B.2.N.b.070. *Q. alba/Vaccinium* spp. Stunted white oak woodland	G1G2	AR, OK	Limited distribution
I.B.2.N.a.280. *Q. alba-C. ovata/Ostrya virginiana* *Q. alba-C. ovata* forest association	G2G3	OK, MO	Few old growth examples
I.B.2.N.b.090. *Q. stellata montaine* Stunted post oak-blackjack oak woodland	G1	MO	Limited distribution
I.B.2.N.e.120. *Q. palustris-Q. bicolor/Carex critina/Sphagnum* spp. Pin oak-swamp oak seasonally flooded forest	G1Q	MO	Conversion to nonforest
I.C.3.N.a.050. *P. echinata-Q. velutina/Vaccinium* spp. Dry shortleaf-pine-oak-hickory forest	G2G3	AR, MO	Fire exclusion, few old growth examples
II.A.4.N.a.070. *P. echinata-Schizachyrium scoparium* Shortleaf pine-little bluestem woodland	G2	AR, OK, MO	Harvesting, fire exclusion
II.B.2.N.a.170. *Q.stellata-Q. velutina-Q. alba-(Q. falcata)/Croton michauxii* Post oak-black oak-white oak-croton woodland	G2Q	AR, MO	Disturbance, conversion
II.C.3.N.a.050. *P. echinata-Q. alba* Xeric shortleaf pine-white oak	G2		Fire exclusion
		Shrubland	
III.A.2.N.g.010. *Aruninaria gigantea ssp. gigantea* Giant cane shrubland	G2	AR, OK	Disturbance, conversion
III.B.2.N.a.080. *Toxicodendron radicans/Polymnia canadensis* Poison ivy-leaf cup	G2	AR, OK	Infrequent on sandstone talus

(continued)

Table 3.13—Types of rare communities in the Ozark-Ouachita Highlands, with TNC and State nomenclature, global ranking, States of occurrence, and reason for rarity (continued)

Nomenclature	Global rank[a]	States of occurrence	Reason for rarity
		Shrubland (continued)	
Toxicodendron radicans/Polymnia cossatotensis Poison ivy-leaf cup	G1	AR	Infrequent on novaculite talus
III.C.2.N.c.010. *Juniperus virginiana var. virginiana-Andrachne phyllanthoides* Eastern redcedar-andrachne	G2	AR, OK	Limited to certain streamside zones
		Grassland	
V.A.5.N.a.010. *Andropogon gerardii-Panicum virgatum* Tallgrass prairie	G2G3	OK	Conversion, fire exclusion
Andropogon gerardii-Calamagrostis canadensis-Helianthus grosseserratus Bluestem tallgrass prairie	G2G3	AR, OK, MO	Conversion, fire exclusion
V.A.5.N.a.100. *Schizachyrium scoparium-Sorghastrum nutans-Aristida lanosa-Polypremum procumbens* Southern sand prairie	G1Q	AR, MO	Conversion, fire exclusion
Schizachyrium scoparium-Silene regia Lowland sand prairie	G2?	OK, MO	Conversion, fire exclusion
Schizachyrium scoparium-Sorghastrum nutans-Danthonia spicata-Silene regia Glade	G2	OK, MO	Limited distribution
V.A.5.N.c.110. *Schizachyrium scoparium-Sporobolus neglectus* Chert glade	G1?	OK, MO	Limited distribution
V.A.5.N.c.120. *Schizachyrium scoparium-Bouteloua curtipendula-Atrostis hyemalis-Eleocharis spp.* Little bluestem hardpan prairie	G2?	OK, MO	Limited distribution

TNC = The Nature Conservancy.
[a] Ranking based on known distribution, with global rank "1" (G1) representing the rarest element of interest and G5 the most common; see Chapter 5 for a complete description of global and state ranks.

USDA, Forest Service. 1999. Ozark-Ouachita Highlands Assessment: *Terrestrial Vegetation and Wildlife.* General Technical Report SRS-35. p 201.

Field Verification of Plant Communities

ATOKA Environmental Biologists and support staff conducted extensive field surveys within the analysis area from April 2 to April 19 and June 11 to June 20, 2007. The primary focus of field surveys was to determine the suitability of habitat for and the abundance of PETS species populations occupying the analysis area. Floristic site examination procedures described in Goff et al (1982) were used, focusing on the US Forest Service PETS list of concern and non-native invasive plants as requested by Forest Service biologists. Along with surveying for the presence of PETS species, the dominant species for each plant community surveyed were also documented to determine habitat suitability and verify the analysis area AR-GAP Landcover data. The field survey information was compared to the plant communities compiled from AR-GAP and MSDIS 2005 Landcover data by using the available truck map data, digitized ROWs and 300-foot buffers of the digitized ROWs and intersecting the buffer with the AR-GAP and

MSDIS 2005 Landcover data. ArcGIS was then used to determine the quantity of specific habitats within the analysis area.

Although designed for coarse-filter evaluations, the AR-GAP and MSDIS 2005 Landcover data proved to provide a relatively accurate representation of the vegetation documented during field surveys (Appendix 5 Table A5-2). Of the 44 field sites where the dominant plant species were noted, 32 (72.5 %) were found to have the same vegetative cover as indicated in the AR-GAP and MSDIS 2005 Landcover data. Sites with discrepancies between field surveys and the AR-GAP Landcover data were, for the most part, in close proximity to the corresponding vegetation communities. Variations in field and AR-GAP and MSDIS 2005 Landcover data may be attributable to sites occurring on an ecotone between distinct terrestrial community types (8, 18.2%) or to ecotones located along riparian areas (3, 6.8%). The design of the AR-GAP and MSDIS 2005 Landcover data does not depict gradual changes in vegetation communities and instead creates a sharp line separating many vegetation communities in which a gradual change would be more appropriate. Only one (2.3%) of the 44 sites was riparian or in close proximity to the corresponding AR-GAP and MSDIS 2005 Landcover vegetation community.

Table A5-2: Field Survey Plots Where Vegetation Data Was Collected

Note all X and Y coordinates are in NAD 27 UTM Zone 15 in meters.

Date	Quad	County	X Coor-dinate	Y Coor-dinate	Ecoregion 3	Ecoregion 4	GAP Types	GAP Name	Habitat by GAP	Habitat found during field surveys
4/2/2007	Calico Rock	Stone	571488	3987409	Ozark Highlands	Dissected Springfield Plateau-Elk River Hills	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/3/2007	Boswell	Stone	583079	3988753	Ozark Highlands	White River Hills	T.2.B.3.a.I	Pinus echinata - Quercus spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/3/2007	Calico Rock	Baxter	568666	3997319	Ozark Highlands	White River Hills	T.2.B.3.a.I	Pinus echinata - Quercus spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/3/2007	Calico Rock	Stone	575107	3994186	Ozark Highlands	White River Hills	T.1.B.2.b.IV	Juniperus virginiana	Interior Highlands Glade-Barrens	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/3/2007	Strickler	Washington	386579	3961486	Boston Mountains	Lower Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/3/2007	Sylamore	Stone	582211	3981858	Ozark Highlands	White River Hills	T.1.B.2.b.IV	Juniperus virginiana	Interior Highlands Glade-Barrens	Interior Highlands Glade-Barrens
4/4/2007	Robinson	Benton	379687	4003349	Ozark Highlands	Dissected Springfield Plateau-Elk River Hills	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest/Interior Highlands Glade-Barrens
4/4/2007	Wheeler	Washington	376706	3994213	Ozark Highlands	Springfield Plateau	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/5/2007	Rudy NE	Crawford	380096	3954158	Boston Mountains	Lower Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/6/2007	Natural Dam	Crawford	372304	3954638	Boston Mountains	Lower Boston Mountains	T.1.B.3.a.V	Quercus stellata	Interior Highlands Glade-Barrens	Ozark-Ouachita Dry-Mesic Oak Forest/Interior Highlands Glade-Barrens
4/10/2007	Saint Paul	Franklin	421236	3958301	Boston Mountains	Upper Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/11/2007	Bidville	Franklin	410486	3943898	Boston Mountains	Lower Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland

Date	Quad	County	X Coor-dinate	Y Coor-dinate	Ecoregion 3	Ecoregion 4	GAP Types	GAP Name	Habitat by GAP	Habitat found during field surveys
4/11/2007	Fern	Crawford	400642	3946086	Boston Mountains	Lower Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Dry-Mesic Oak Forest/Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/11/2007	Fern	Crawford	403707	3954916	Boston Mountains	Lower Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/12/2007	Fallsville	Newton	457708	3958016	Boston Mountains	Upper Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/12/2007	Hunt	Johnson	441946	3936385	Boston Mountains	Lower Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Riparian
4/12/2007	Ludwig	Johnson	460543	3937241	Boston Mountains	Lower Boston Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/12/2007	Ozone	Johnson	462365	3951509	Boston Mountains	Lower Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/16/2007	Lurton	Newton	489764	3960146	Boston Mountains	Upper Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Dry-Mesic Oak Forest
4/16/2007	Sand Gap	Pope	490575	3952936	Boston Mountains	Upper Boston Mountains	T.1.B.3.a.II	Quercus alba	Ozark-Ouachita Dry-Mesic Oak Forest	Ozark-Ouachita Dry-Mesic Oak Forest
4/16/2007	Treat	Johnson	481247	3941796	Boston Mountains	Lower Boston Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Dry-Mesic Oak Forest
4/17/2007	Magazine Mountain NE	Logan	448711	3895427	Arkansas Valley	Scattered High Ridges and Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/17/2007	Paris	Logan	440800	3901169	Arkansas Valley	Scattered High Ridges and Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/17/2007	Simpson	Pope	490240	3932991	Boston Mountains	Lower Boston Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/17/2007	Simpson	Pope	492331	3929655	Boston Mountains	Lower Boston Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland

Date	Quad	County	X Coor-dinate	Y Coor-dinate	Ecoregion 3	Ecoregion 4	GAP Types	GAP Name	Habitat by GAP	Habitat found during field surveys
4/17/2007	Simpson	Pope	493669	3937312	Boston Mountains	Lower Boston Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/18/2007	Blue Mountain	Logan	441310	3891951	Arkansas Valley	Scattered High Ridges and Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Dry-Mesic Oak Forest
4/18/2007	Golden City	Logan	410380	3876674	Arkansas Valley	Scattered High Ridges and Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/18/2007	Golden City	Logan	410561	3876713	Arkansas Valley	Scattered High Ridges and Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/18/2007	Parks	Scott	412797	3854656	Ouachita Mountains	Fourche Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/19/2007	Buck Knob	Scott	408928	3843172	Ouachita Mountains	Fourche Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/19/2007	Buck Knob	Scott	412437	3842668	Ouachita Mountains	Fourche Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland/Ozark-Ouachita Riparian
4/19/2007	GoldenC	Scott	419273	3865632	Arkansas Valley	Scattered High Ridges and Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/19/2007	Horsesho e Mountain	Scott	378670	3857265	Ouachita Mountains	Fourche Mountains	T.1.A.9.b.I	Pinus echinata	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/19/2007	Horsesho e Mountain	Scott	379060	3848781	Ouachita Mountains	Fourche Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland
4/19/2007	Loving	Scott	370234	3849657	Ouachita Mountains	Fourche Mountains	T.1.B.2.b.II	Quercus spp. - Pinus echinata - Carya spp.	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland	Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland

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APPENDIX 6 – GEOLOGY AND SOILS

This appendix is divided into two sections, Geologic Resources and Soil Resources. Each section gives the predominant area categories followed by the specific formations or soils found within each.

GEOLOGIC RESOURCES

The U.S. Interior Highlands is a mountainous region spanning eastern Oklahoma, western and northern Arkansas, southern Missouri, and the extreme southeast corner of Kansas. The name is designated by the United States Geological Survey to refer to the combined mountainous region of the Ozarks and Ouachita Mountains, which form a distinct physiographic division. It is the only major highland region between the Rocky Mountains and the Appalachian Mountains in the United States.

The portions of the Ozark and Ouachita National Forests within the project area are located within the Interior Highlands geologic province, which is subdivided into the varied geography of the Salem and Springfield Plateaus, the Ozark and Ouachita Mountains, and the Arkoma Basin. In the project area, there are two predominant area categories, the Ouachita Mountains and the Ozark Plateau, which are divided by the Arkoma Basin. The specific formations for each area are detailed below.

Ouachita Mountains

The Ouachita Mountains, a portion of which is maintained as the Ouachita National Forest, are one of the major mountain ranges in the United States that run east to west. These mountains were thrust upwards, and were highly faulted and folded, during the Ouachita Mountain Orogony.

During early geologic time, the ocean shore line, which is now the Gulf of Mexico, was as far north in Arkansas as the current Arkansas River Valley. For millions of years, sediments washed in from the north and began filling the basin to the south. A subduction zone formed causing the South America continental plate to move to the north and eventually collide with the rocks and sediments within this basin, pushing them up and forming the Ouachita Mountains. During the Permian to the Jurassic periods, the Ouachita Mountains were some of the highest mountains on the earth. Over the millions of years following the receding of the South American continental plate, these faulted and folded mountains have been eroded down with as much as five (5) miles of materials washing to the south (Bush 1977).

The geologic formations now encountered within the Ouachita National Forest are discussed below.

Collier Shale Formation

This Late Cambrian to Early Ordovician Formation has some of the oldest rocks that outcrop in Arkansas. It is mainly a gray to black shale with some chert beds and some thin-bedded limestone. There are a few trilobites and conodonts found locally. The section exposed is approximately 1,000 feet thick but is deeper in the unexposed rock.

Crystal Mountain Sandstone Formation
This formation is Early Ordovician in age and is mainly massive, coarse grained, well-rounded, light gray sandstone. It contains some thin interbedded black chert and bluish gray limestone. This formation is known for its fracture infilling of quartz, and in thick units with vugs, there are quartz crystals formed. There are some conodonts fossils found locally. The thickness of this unit is approximately 850 feet.

Mazarn Shale Formation
This is an Early Ordovician Shale with small amounts of siltstone, sandstone and limestone containing small amounts of thin-bedded chert, which is found in the upper part of the unit. There have been a few conodonts and graptolites found in the shale. Thickness of the entire unit can vary from 1,000 feet to as much as 2,500 feet.

Blakely Sandstone Formation
The Blakely Sandstone is Middle Ordovician in age. The largest preponderance of the formation is shale, although the sandstone is the most massive bedding. The sandstone varies from a quartzite, with siliceous cementation, to a quartzite cemented with calcite. Some graptolites and conodonts have been found in shale. The formation varies from a few feet to approximately 750 feet thick.

Womble Shale Formation
This Middle Ordovician Period Shale is black with thin beds of limestone, sandstone and chert. Large, bull quartz or milky quartz have infilled some of the fractures in this unit. The thickness of this unit ranges from 500 to 1,200 feet.

Bigfork Chert Formation
The Bigfork Chert Formation is Middle to Late Ordovician and consists of a thin-bedded white to dark gray cryptocrystalline chert with small interlaying beds of shale, siltstone and gray limestone. This material, in the road construction business, is commercially referred to as “city pit.” It is used mainly for backfill material and road base material. The thickness varies from 450 to 750 feet thick.

Polk Creek Shale Formation
The Polk Creek Shale Formation is Late Ordovician in age. The shale beds are black with some black chert, gray quartzite and some limestone. The formation varies from 25 to 250 feet thick.

Blaylock Sandstone Formation
This Silurian Period Sandstone is thin to thick bedded with beds of micaceous black shale. In some locations the sandstone is a greywacke with small amounts of plagioclase, tourmaline, garnet, zircon and mica. The thickness of this formation varies from 5 feet to 1,200 feet thick.

Missouri Mountain Shale Formation
The Missouri Mountain Shale is Silurian in age. This is primarily shale interbedded with several conglomeritic zones of Novaculite and sandstone. The conglomerates are found near the base of the unit and thin beds of Novaculite are found near the upper parts near the contact with the overlying Arkansas Novaculite. The Missouri Shale unit can be as much as 300 feet thick.

Arkansas Novaculite Formation
The Arkansas Novaculite Formation is Devonian and Early Mississippian in age. The Formation is divided into three distinct units. The upper unit is white and in several cases is poorly

cemented. The middle unit is protographitic shale, which is sooty black except where weathered. The lower unit is white to gray having a calcareous cementation. These units have been slightly metamorphosed. These units are as much as 900 feet thick at the southern extremities and thin to the north.

Stanley Shale Formation

The Stanley Shale Formation is Mississippian in Age and is composed of dark, gray shale interbedded with fine-grained sandstone. One unit that is only found in the Stanly Formation is the Hot Springs Sandstone. At the base of the formation, the Hatton Tuff and as many as five thin layers of Novaculite, sandstone breccias are found. The formation varies in thickness form 3,500 feet to as much as 10,000 feet.

Jackfork Sandstone Formation

The Jackfork Sandstone is Pennsylvanian in age. It is a thin to massive quartzitic sandstone. The unit has several shale units in the lower and middle section. It ranges in thickness between 600 and 3500 feet thick.

Johns Valley Shale Formation

The Johns Valley Shale is Pennsylvanian in Age. This unit is usually gray-black clayey shale with many beds of brownish gray sandstone. In the frontal areas there are also limestone, dolostone and chert units. The thickness of the unit probably does not exceed 1,500 feet.

Atoka Formation

The Atoka Formation is Pennsylvanian in Age. The Atoka Formation was formed in a marine environment and is quite extensive in Arkansas. It is prevalent in the Boston Mountains, the Frontal Ouachita Mountains, as well as in the Arkansas River Valley. It is composed of gray silty sandstones and gray-black shale. There are a few coal seams in the Frontal Ouachita Mountains and the Arkansas River Valley. This unit has the largest coverage of any of the Paleozoic formations in Arkansas. This unit may be as much as 25,000 feet thick in the Ouachita Mountains.

Ozark Plateau and the Arkoma Basin Geologic Province

The portions of the Ozark National Forest analyzed by this study are within the geologic feature described as the Ozark Plateau and a portion of the Arkansas River Valley. These are also referred to as the Ozark Dome and the Arkoma Basin geologic provinces (Smith 1989).

The Ozark Plateau consists of rugged hills and deep valleys. The area contains deep river eroded gorges, with as much as 1,500 feet relief. The Plateau is referred to as the Boston Mountains. South of the Boston Mountains the land flattens out into the Arkansas Valley.

The Arkansas River Valley separates the Ozark Plateau, to the north and the Ouachita Mountains to the south. There is a portion of the Ozark National Forest in the northern province of the Arkansas Valley. The largest river in Arkansas (the Arkansas River) cuts though the Arkansas Valley. There are a few mountains in this province, with Magazine Mountain being the highest elevation in Arkansas.

All three of the provinces within the Ozark National Forest were formed by erosional processes, streams and rivers cutting through the various formations. Below are the geologic formations encountered within the Ozark National Forest.

Jefferson City Dolomite Formation
This is an early age Ordovician Period crystalline dolostone with chert and thin beds off sandstone, shale and some oolitic limestone beds. This formation is found in northern Arkansas and southern Missouri.

Cotter Dolomite Formation
This is an early aged Ordovician Period Formation consisting of two types. The first is a fine-grained, argillaceous, relatively soft, dolostone. This is often called "cotton rock." The second type is a more massive, gray dolostone that is denser than the first type. There are also some thin beds of green shale, thin-bedded chert and some cross-bedded sandstone.

Powell Dolomite Formation
This early aged Ordovician Period Formation is usually found as a fine-grained, limy, argillaceous dolostone. There are thin beds of sandstone, shale with some chert units. In most cases there is a conglomerate unit located at the base of the formation. In the lower part of the formation, there is locally found a unit of drusy quartz.

Everton Formation
This Middle Ordovician Period Formation has several lithologic characteristics found at different intervals throughout the formation. There are dolostone, sandstone and limestone units present. In some places within the formation there are traces of conglomerates, shales and cherts. The sandstone is difficult to distinguish from the overlying St. Peter Sandstone. The sandstones of both the Everton and the St. Peter formations are medium grained, white and well rounded.

St. Peter Sandstone Formation
This is a Middle Ordovician Period formation. It consists of massive bedded, well rounded, medium to fine grained, mostly friable, white sandstone. There are also some minor thin units of limestone, shale and a few dolostone units. The sandstone units are generally cemented with calcite. The St. Peter Sandstone is found from the Ozark Plateau as far north as Michigan, Minnesota and Wisconsin.

Joachim Dolomite Formation
This is a Middle Ordovician Period Formation. It consists of dolostone and dolomitic limestone with thin beds of shale and sandstone. Tidal depositions are frequently found throughout the formation. These units form mud-cracks, salt hoppers and calcite pseudomorphs. This formation has been found to be as much as 100 feet thick and is absent to the west.

Plattin Limestone Formation
This Middle Ordovician Period limestone is a fine grained, thin-bedded micritic member. It can be as much as 250 feet thick, but in most areas is much thinner. The limestone has traces of rounded sand grains as well as some calcite remnants in some of the units.

Kimmswick Limestone Formation
This Middle Ordovician limestone formation is a thin to thick bedded, fine to coarse-grained unit. There are numerous fossil fragments throughout the units. This member varies from 55 feet thick to missing altogether.

Fernvale Limestone
This Late Ordovician limestone formation is mostly massive and sometimes cross-bedded. There are locally some vugs infilled with clay. Numerous fossils are found throughout the section. This crinoidal limestone also contains nautiloids, brachiopods and bryozoans.

Cason Shale Formation
This formation ranges from the Late Ordovician Period to the Early to Middle Silurian Period. This formation consists of several rock types. There is oolitic limestone, sandy calcareous shale, phosphatic sandstone, as well as pelmatozoan limestone. This formation is coupled with the Brassfield Limestone Member by some scholars. Some foraminifera and conodonts have been found locally. This formation ranges from 25 feet at its thickest to missing altogether.

Brassfield Limestone Formation
This Early Silurian fossiliferous limestone varies from light gray to a deep red in color. There are traces of glauconitic material in the lower beds. This formation is mainly formed from fragments of crinoids, brachiopods, trilobites, bryozoans and gastropods. At its thickest, it is only 38 feet.

St. Claire Limestone Formation
This Early to Middle Silurian aged limestone is coarse-grained and highly fossiliferous. Pyrite is found in the lower few feet of this unit and it also contains algal buttons. The bedding is mostly massive and thick. This formation is exposed in Independence, Izard and Stone Counties, Arkansas. The thickness ranges from not present to 100 feet.

Lafferty Limestone Formation
The Middle to Late Silurian Period limestone is a gray-green to red micrite and contains some fossiliferous biomicrite. There are few fossils but a few foraminifers have been found locally. It ranges in thickness of 5 to 98 feet.

Penters Chert
This Early to Middle Devonian chert is fine-grained, fossiliferous, with dolomite. There are lenses of fine-grained limestone. The thickness ranges from 25 feet to 90 feet.

Clifty Limestone Formation
This is a Middle Devonian Period formation. It consists of thin, sandy limestone units. There are a few fossil brachiopods but the formation is only 2 feet to 4 feet thick and difficult to collect.

Chattanooga Shale Formation
The Chattanooga Shale is of Late Devonian to Early Mississippian in Age but appears to be all-Devonian in Arkansas. It is generally black, clayey shale. There is abundant pyrite in the upper part of the formation. The formation averages approximately 30 feet thick.

St. Joe Limestone Formation
The St. Joe Limestone is Early Mississippian in age. The formation is highly fossiliferous with crinoids, brachiopods, conodonts, ostracods and blastoids being found. The St. Joe varies in thickness from not present to 115 feet in thickness. There are several small beds of chert in several sections of the limestone.

Boone Limestone/Chert Formation
This is an Early to Middle Mississippian Period Formation. It is a gray, fine to coarse-grained fossiliferous limestone interbedded with chert. This formation is known for its karst features, such as sinkholes, caves and fissures. Crinoids are abundant but numerous other fossils are also found. This formation generally ranges from 300 to 390 feet thick.

Moorefield Shale Formation
This is a Late Mississippian Period Formation. It is characterized as a black, calcareous shale and siliceous limestone. There are very few fossils found in this formation. It varies in thickness from not found to 300 feet.

Ruddell Shale Formation
This is a Late Mississippian Period Formation. It consists of dark gray to greenish-gray fissle clayey shales with some dark-gray to black limestone concretions. Some scholars place this member within the Moorefield Formation.

Batesville Sandstone Formation
This is a Late Mississippian Period sandstone formation. The formation consists primarily of thin-bedded shale. The Hindsville, a fossiliferous limestone member is present in western Arkansas. At the basil contact, in several cases the formation is marked by the Boone Chert conglomerate. The overall formation is very thin to more than 200 feet thick, with the thickest portion found in Independence County.

Fayetteville Shale Formation
This Late Mississippian Period shale formation is a black, fissle, clayey shale. There are some units of calcareous sandstone found locally. The formation is known for being fossiliferous and septarian concretions have been found in the lower beds. This formation is being produced at this time for it natural gas. This shale outcrops around Fayetteville, Arkansas and thickens to the south and east. It is more than 200 feet thick at depth.

Pitkin Limestone Formation
This Late Mississippian limestone formation is fine to coarse grained and is oolitic bioclastic in nature. There are minor chert units and sequences of black shale interbedded with limestone found near the top and bottom of the formation. The formation is fossiliferous with the Archimedes bryozoan being a good marker fossil for this unit. The thickness of the unit ranges from 50 to 200 feet thick.

Hale Formation
This Early Pennsylvanian Period Formation is made up of two members; the Cane Hill and the Lower Cane Hill Units. The lower Cane Hill unit is composed of dark gray silty shale, interbedded with siltstone and thin bedded, fine-grained sandstone. The second unit, The Cane Hill Member is composed of thin to massive, sometimes cross-bedded, limy sandstone. The fossils that have been found in this member are mostly fragments. The thickness of the complete unit is from a few feet to as much as 300 feet.

Bloyd Shale Formation
The Bloyd Shale Formation is Early Pennsylvanian in age. This unit is made up of several members. These include the Brentwood Limestone Member, the Woolsey Member, the Dye Shale Member, the Kessler Limestone Member and the Trace Creek Shale Member. Several scholars place the Trace Creek Member in the Atoka Formation. The general thickness for the Bloyd Formation generally ranges from 170 to 200 feet.

Atoka Formation
The Atoka Formation is Pennsylvanian Period in age. This is a sequence of marine sandstones and shales dominating most of the Boston Mountains as well as being found in the Arkansas River Valley and in the frontal Ouachita Mountains. There are a few discontinuous coal beds

and coaly shale found in the Boston Mountains as well as in the Arkansas River Valley. There are many fossil plants found in these units. The Atoka Formation thickness may be as much as 25,000 feet thick in the Ouachita Mountains.

SOIL RESOURCES

The primary concern with soils in the study area concerns the potential for erosion. The following general descriptions provide some information on the erosion potential for the individual soil series based on physical characteristics and slope. This information is obtained from the individual county soil surveys published by the online Official Soil Series Description provided by the Soil Survey Staff, Natural Resources Conservation Service and USDA.

Alred Series
The Alred series consists of very deep well-drained soils formed in cherty hillslope sediments and the underlying clayey residuum. These soils are on moderately sloping to very steep uplands. Slopes range from 1 to 60 percent.

Avilla Series
The Avilla soil series consists of very deep, well-drained, moderately permeable soils that formed in gravelly and loamy alluvium. These soils are on nearly level to moderately sloping terraces. Slopes range from 1 to 12 percent.

Barling Series
The Barling soil series consists of very deep, moderately well-drained, moderately permeable soils formed in silty alluvium derived from siltstone, sandstone and shale. These soils are on level to nearly level flood plains in the Boston Mountains and the Arkansas River Valley. Slopes range from 0 to 2 percent.

Britwater Series
The Britwater soil series consists of very deep well-drained soils formed in alluvial sediments washed from cherty limestone or cherty dolomite uplands. These soils are on old, high stream terraces. Slopes range from 1 to 12 percent.

Brockwell Series
The Brockwell soil series consists of very deep, well-drained, moderately permeable soils formed in residuum weathered from sandstone bedrock. These soils are on gently sloping to moderately steep uplands in the Ozark Highlands. Slopes range from 2 to 20 percent.

Cane Series
The Cane soil series consists of deep, moderately well-drained soils that are permeable above a fragipan and are slowly permeable in the fragipan. These soils formed in colluvium, old alluvium, or valley fill from interbedded sandstone, shale, or cherty limestone of the uplands and are on nearly level to moderately sloping side slopes. Slopes range from 2 to 12 percent.

Captina Series
The Captina soil series consists of very deep, moderately well-drained soils on nearly level to moderately sloping uplands and old stream terraces of the Ozark Highlands. They formed in a thin mantle of silty material and the underlying colluvium and residuum weathered from limestone, cherty limestone and dolomite, or siltstone. Slopes range from 1 to 15 percent.

Carnasaw Series
The Carnasaw soil series consists of deep, well-drained, slowly permeable upland soils. These soils formed in residuum weathered from shale of Pennsylvanian age. These gently sloping to steep soils are on side slopes of forested uplands of the Ouachita Mountains and the Arkansas Valley and Ridges. Slopes are 1 to 60 percent.

Ceda Series
The Ceda soil series consists of very deep, well-drained, rapidly permeable soils that formed in loamy alluvium. These nearly level to very gently sloping soils are on flood plains of the Ouachita Mountains and the Arkansas Valley and Ridges. Slopes range from 0 to 3 percent.

Clarksville Series
The Clarksville soil series consists of very deep, somewhat excessively drained soils formed in hill slope sediments and the underlying clayey residuum from cherty dolomite or cherty limestone on steep side slopes and narrow ridge tops. Slopes range from 1 to 70 percent.

Clebit Series
The Clebit soil series consists of shallow, well-drained, moderately to rapidly permeable soils over hard sandstone that is tilted about 40 degrees from horizontal. These soils formed in material weathered from sandstone of Pennsylvanian age. These very gently sloping to steep soils are on mountain tops and mountain side slopes of forested uplands of the Ouachita Mountains and the Arkansas Valley and Ridges. Slopes are 2 to 60 percent.

Enders Series
The Enders soil series consists of deep, well-drained, very slowly permeable soils that formed in loamy and clayey residuum from shale, or interbedded shale and sandstone. These soils are on nearly level to moderately steep upland mountaintops and ridges and gently sloping to very steep mountain side slopes and foot slopes. Slopes range from 1 to 65 percent.

Estate Series
The Estate soil series consists of deep, well-drained soils that formed in loamy residuum weathered from interbedded sandstone and limestone. These soils are on upland side slopes and have slow permeability. Slopes range from 3 to 40 percent.

Gasconade Series
The Gasconade soil series consists of shallow and very shallow, somewhat excessively drained, moderately slowly permeable soils formed in thin clayey layers with a considerable amount of coarse fragments from residuum of the underlying limestone bedrock. These soils are on steep dissected upland landscapes and generally are isolated grade areas with 2-50% slope gradients.

Gatewood Series
The Gatewood soil series consists of moderately deep, moderately well-drained soils of the uplands. They formed on gravelly hill slope sediments and the underlying residuum from cherty limestone or dolomite and shale. Slope gradients range from 1 to 60 percent.

Guthrie Series
The Guthrie series consists of very deep poorly drained soils with a fragipan in the lower subsoil. The soil formed in silty material on upland flats and depressions with 0-2% slopes.

Hailey Series
The Hailey soil series formed in colluvium and residuum from cherty limestone. Consisting of deep excessively drained soils on steep side slopes and very narrow ridge tops, slopes are 5-70%.

Kenn Series
The Kenn soil series consists of very deep, well-drained, moderately permeable soils that formed in loamy alluvium. These level to gently sloping soils are on flood plains of the Ouachita Mountains and the Arkansas Valley and Ridges. Slopes are 0 to 4 percent.

Leadvale Series
The Leadvale soil series consists of deep to very deep, moderately well-drained soils with a fragipan. These soils formed in silty material in uplands or local silty alluvium from nearby uplands underlain largely by shale and siltstone or in places by sandstone, phyllite and slate. Leadvale soils are on slightly concave toe slopes, benches and terraces. Slope is dominantly less than 7 percent, but ranges from 0 to 15 percent.

Linker Series
The Linker soil series consists of moderately deep well-drained, moderately permeable soils that formed in loamy residuum weathered from sandstone. hese soils are on broad plateaus, mountains and hilltops and benches. Slopes are dominantly 1-15 percent, but range up to 30%.

Mano Series
The Mano soil series consists of very deep, moderately well-drained soils on hills. These soils formed in colluvial sediments from cherty limestone and the underlying residuum from cherty dolomite. Slopes range from 1 to 50 percent.

Mckamie Series
The Mckamie soil series consists of deep, well-drained, very slowly permeable soils that formed in clayey alluvial sediments of Pleistocene age stream terraces. These soils are on broad gently sloping to strongly sloping coastal plains. Slope is dominantly 1 to 8 percent, but ranges up to 29 percent near escarpments adjacent to drainage ways.

Moko Series
The Moko soil series consists of shallow and very shallow, well-drained and somewhat excessively drained soils that formed in loamy colluvium or residuum from limestone or dolostone. They are found on dissected uplands in the Ozarks of northern Arkansas. Slopes range from 3 to 100 percent.

Mountainburg Series
The Mountainburg soil series consists of shallow, well-drained, moderately to rapidly permeable, soils that formed in residuum of sandstone. These nearly level to very steep soils are found on upland ridge tops, plateaus and mountain sides. Slopes range from 1 to 65 percent.

Muskogee Series
The Muskogee soil series consists of moderately well-drained slowly permeable soils on nearly level to strongly sloping stream terraces. They formed in silty material and in underlying clayey sediments. Slopes range from 1 to 15 percent.

Nella Series
The Nella soil series consists of very deep, well-drained, moderately permeable soils. These soils formed in alluvium or colluvium and in residuum of limestone, sandstone and shale. They are on hillsides, benches and foot slopes. Slopes range from 2 to 60 percent.

Nixa Series
The Nixa soil series consists of very deep, moderately well-drained, very slowly permeable soils on upland ridge tops and side slopes of the Ozark Highlands. These nearly level to steep soils

formed in colluvium and loamy residuum weathered from cherty limestone. Slopes range from 1 to 35 percent.

Noark Series
The Noark series consists of very deep, well-drained, moderately permeable soils that formed in colluvium and clayey residuum from cherty limestones. These soils are on nearly level to very steep uplands of the Ozarks. Slopes range from 1 to 45 percent.

Portia Series
The Portia soil series consists of very deep well-drained soils with moderate permeability. They formed in residuum weathered from sandstone, siltstone and limestone bedrock. These soils are on nearly level to steep uplands of the Ozark Highlands. Slope range from 1 to 30 percent.

Rueter Series
The Rueter soil series consists of very deep, somewhat excessively drained soils that formed in colluvium and residuum from cherty limestones on steep side slopes and narrow ridge tops. Slopes range from 3 to 70 percent.

Sherless Series
The Sherless soil series consists of moderately deep, well-drained, moderately permeable soils that formed in residuum of interbedded shale and sandstone of Mississippian age. These gently sloping to moderately steep soils are on the tops and sides of low ridges in the valleys of the Ouachita Mountains. Slopes are 1 to 35 percent.

Sonsac Series
The Sonsac soil series consists of moderately deep well-drained soils formed in colluvium and the underlying residuum from limestone on upland side slopes. Slopes range from 5 to 70 percent.

Spadra Series
The Spadra soil series consists of deep, well-drained, moderately permeable soils formed in loamy alluvium. These soils are on stream terraces. Slopes are dominantly 0 to 3 percent, but range to 5 percent.

Steprock Series
The Steprock soil series consists of moderately deep, well-drained, moderately permeable soils formed in residuum and colluvium weathered from interbedded sandstone, siltstone and shale. These soils are on hillsides and ridges. Slopes range from 3 to 60 percent.

Taft Series
The Taft soil series consists of very deep, somewhat poorly drained soils with a fragipan in the subsoil. These soils formed in a silty mantle of loess or alluvium and the underlying residuum of limestone or shale. These nearly level soils are on upland flats, stream terraces and in depressions.

Wrightsville Series
The Wrightsville soil series consists of very deep, poorly drained, very slowly permeable soils that formed in old silty and clayey alluvium. These soils are on level to depressional areas on old stream terraces. Slopes are less than 1 percent.

Appendix 7 – Biological Evaluation of Herbicides

SPECIFIC HERBICIDES EFFECTS ON AQUATIC COMMUNITIES

Glyphosate (Roundup, Accord)

Glyphosate is strongly adsorbed to soil and is unlikely to enter the aquatic environment in more than trace amounts unless it is applied directly to water or washes from overhanging foliage (Duke 1988, Tatum 2004). Once adsorbed to soil, glyphosate is no longer available for uptake by plants and loses its herbicidal activity (Duke 1988). Glyphosate dissipates rapidly from bodies of water through microbial metabolism, adsorption to suspended sediments and by partitioning into bottom sediments (Duke 1988, World Health Organization [WHO] 1994, Giesy et al. 2000). Glyphosate residues in plant tissues tend to remain until foliage is shed or the plant dies and tissues begin to decay. The reported half-lives of glyphosate in vegetation typically are less than 24 days (WHO 1994, Giesy et al. 2000). Bioconcentration factors in aquatic organisms are typically <1, meaning that the concentration of glyphosate residues in tissues is less than the concentration in water (WHO 1994).

Imazapyr (Arsenal, Powerline, Stalker, Chopper)

Imazapyr is not strongly adsorbed to soil and therefore has the potential to be highly mobile. Field studies, however, indicate that in actual use, mobility is minimal (Mangels 1991). Degradation of imazapyr in soils occurs primarily through microbial metabolism (Weed Science Society of America [WSSA] 1994). The reported half-lives for imazapyr in soil in field studies ranged from 25–142 days (WSSA 1994). In water, imazapyr dissipates rapidly through photodegradation (Mallipudi et al. 1991). Reported half-lives in water ranged from 2–5 days (Mallipudi et al. 1991). In a forestry field study, levels of imazapyr residues in vegetation peaked soon after herbicide application and dissipated rapidly, falling to 10% or less of peak concentrations by day 14 (Michael and Boyer 1986). Imazapyr does not bioaccumulate in fish (McAllister et al. 1985).

Metsulfuron (Escort)

Metsulfuron is weakly adsorbed to most soils and may thus be mobile in a range of soil types (Michael et al. 1991). Dissipation from soil is due to microbial degradation and hydrolysis, with degradation occurring at a much faster rate under acidic conditions and higher moisture and temperature levels (WSSA 1994). Reported soil half-lives ranged from 7–42 days (WSSA 1994). Michael et al. (1991) reported that metsulfuron did not produce significant or persistent contamination of surface groundwater following a forestry application and water samples from surface depressions contain insignificant concentrations of the chemical. Metsulfuron does not bioaccumulate in fish (Kamrin 1997).

Triclopyr (Garlon)

Although triclopyr is not strongly adsorbed to soil, leaching does not appear to be a concern and only small quantities have been detected in runoff during field studies (Tatum 2003). Triclopyr in soil is readily degraded through microbial metabolism, with reported half-lives ranging from 30–90 days (Kamrin 1997). In water the main degradation pathway for triclopyr is photolysis (Tatum 2003). Reported half-lives in natural waters were typically less than four days and depended primarily on light intensity (Tatum 2003). Triclopyr residues tend to remain in plants until foliage is shed or the plant dies and tissues begin to decay (Tatum 2003). The estimated

half-life in above-ground drying foliage, such as in a forest overstory, was 2–3 months (Kamrin 1997). Triclopyr is not likely to bioaccumulate in aquatic organisms (Kamrin 1997).

Picloram (Tordon K)

Picloram is moderately to slightly toxic to fish and slightly toxic to aquatic invertebrates, (Agrochemicals Handbook 1991, USDA Forest Service 1984b, USDA Forest Service 2003d). Toxicity of picloram to aquatic animals was tested in various species of trout and *Daphnia magna*, a small aquatic invertebrate. Acute LC50 values for aquatic species tested ranged from about 5 to 75 ppm, with trout being the most sensitive (USDA 2000). Based on available data, picloram does not appear to be mutagenic and does not bioaccumulate in fish (EPA 1988).

The principal environmental risks of picloram relate to contamination of surface and groundwater and damage to nontarget terrestrial plants adjacent to areas of application via runoff or drift (Dow AgroSciences 1999, EPA 1995, EPA 2003). Picloram is extremely mobile, relatively persistent in soil and has the potential to contaminate groundwater (EXTOXNET 1996, EPA 1995, Durkin and Follansbee 2003). Picloram may also travel in runoff after heavy rainfall. The compound has been detected in the groundwater of seven states (EPA 1988, Walker et al 1992). Nontarget plants adjacent to areas of application may be exposed to concentrations of picloram many times the levels that have been associated with toxic effects (EPA 1995). Given its high persistence, it appears unlikely that picloram will degrade once it reaches groundwater, even over a period of several years (EPA 1995).

All picloram products are classified as "Restricted Use" pesticides based on their potential to contaminate groundwater and threaten non-target plants. Picloram may be applied only by or under the direct supervision of certified applicators (Dow AgroSciences 1999, USDA 2000). When using picloram and any other herbicides, it is imperative that the applicators strictly adhere to the Specimen Label (Dow AgroSciences 1999) and USFS standards for herbicide application. Picloram should not be applied in areas where runoff is possible or where soils have rapid permeability (such as loamy sand to sand) to a shallow water table. Soils containing sinkholes over limestone bedrock, severely fractured surfaces and substrates would allow direct introduction into the aquifer should not be treated with picloram (Dow AgroSciences 1999).

SPECIFIC HERBICIDES EFFECTS TO TERRESTRIAL WILDLIFE

Studies across taxon suggest that no adverse effects to terrestrial animals are plausible using typical or even very conservative worst-case exposure assumptions for the use of EPA and Forest Service-approved herbicides applied according to manufacturers' recommendations. However, the risk characterizations were conducted on laboratory animals and are limited compared to the large number of wildlife species that could potentially be exposed (USDA Forest Service 2003d). Due to the importance of honeybees as an ecologically beneficial insect, EPA requires manufacturers to evaluate toxicity of their products to honeybees. Glyphosate, imazapyr, metsulfuron, picloram and triclopyr are all considered nontoxic to honeybees (WSSA 1994, Kamrin 1997, USDA Forest Service 2003a, b, c, d, e).

In oral acute toxicity tests with mammals glyphosate, imazapyr, metsulfuron and sulfometuron are all classified as practically nontoxic, while triclopyr is classified as slightly toxic (WSSA 1994, Kamrin 1997). In dermal acute toxicity tests with mammals, glyphosate, metsulfuron and triclopyr are all classified as practically nontoxic, while imazapyr is classified as slightly toxic (WSSA 1994, Kamrin 1997). Glyphosate, imazapyr, metsulfuron and triclopyr showed no evidence of chronic toxicity in long-term testing with mammals (WSSA 1994, Kamrin 1997).

Picloram appears to be relatively nontoxic to terrestrial mammals. Individuals exposed to picloram excrete most of the compound, unchanged, in their urine (USDA 2000).

In acute oral toxicity tests with birds, imazapyr, metsulfuron and triclopyr are all considered to be practically nontoxic, while glyphosate is considered to be slightly toxic. In short-term dietary toxicity tests with birds imazapyr, metsulfuron and triclopyr are considered to be practically nontoxic (WSSA 1994, Kamrin 1997). Ducks, pheasant and quail had no mortality even at the highest levels of exposure to picloram (EXTOXNET 1996, USDA 2003). Glyphosate is considered to be slightly toxic, although this classification likely is an artifact of the testing protocol, since the LC_{50} values in birds were all greater than the highest dose tested (WSSA 1994, Kamrin 1997). Glyphosate, imazapyr, metsulfuron and triclopyr are not carcinogenic, or reproductive toxicants (WSSA 1994, Kamrin 1997).

Appendix 8 – Biological Information/PETS Species

Federally Threatened or Endangered Species

In the Northeast, bat populations are experiencing massive die offs due to a cold loving fungus called the white-nose syndrome (WNS). The syndrome is named after the white coloration that typically appears around the muzzle of infected individuals. The fungus is a member of the group Geomyces that live in soil, water and air. This group of fungus can grow and reproduce in refrigerator-level temperatures. This syndrome has killed over 100,000 hibernating bats in New York Vermont, Western Massachusetts and northwestern Connecticut. Currently, the vector or source of this fungus is unknown. WNS has infected populations of Indiana bat in the Northeast and conservationists are extremely concerned that it will spread to new populations of bats. Currently no WNS has been documented in Arkansas. Due to the possibility of its spread into Arkansas there is a closure order on all caves on National Forest lands in Arkansas except Balanchard Springs Caverns.

Gray Bat (*Myotis grisescens*)

Life History/Species and Habitat Description / Distribution

Gray bats (Federally Endangered) are medium-sized with a wingspan of 10-11 inches, and are the largest *Myotis* species in the eastern United States. They have grayish-brown fur and are the only *Myotis* species whose wing membrane attaches to their ankle instead of the base of the first toe. The gray bat range is limited to the limestone karst areas of the southeastern and central United States.

This species has very specific cave requirements; as a result, less than five percent of available caves are utilized. These requirements vary depending on time of year, age, and sex. Summer caves must be warm (55°-77° F), or with restricted rooms that can trap the body heat of roosting bats, and winter caves are very cold with a range in temperature between 42° and 52° F. These caves are deep with vertical walls and act as cold air traps. During transient periods, gray bats may use transient caves that have less restrictive requirements than summer and winter caves. In addition, males and yearling females will use a wider variety of caves and roost sites throughout the year than mature females.

Summer caves are typically located within 1 mile, rarely over 2 miles, from rivers and reservoirs over which they forage. Gray bats primarily forage on emergent aquatic insects.

Gray bats breed at winter caves during September. Females will store sperm over the winter and become pregnant after emerging in late March. A single offspring is born in late May or early June. Young become volant 20 to 25 days after birth.

Reasons for the decline of the gray bat are as follows:

1. Human disturbance of the bats,
2. Human disturbance to the environment such as vegetation manipulation in riparian areas and around caves, and road construction across streams,
3. Cave destruction from impoundments,
4. Cave commercialization, and
5. Natural sources of mortality.

Site-Specific Effects
Effects from both alternatives are the same.

The change from manual maintenance of power lines to maintenance with herbicides should not cause any direct or indirect effects this species. Gray bats primarily forage on emergent aquatic insects at night. There should be no change in this forage base due to implementation of this project. The project will not affect summer or winter cave use by this species. Daytime maintenance will not disturb this species.

Cumulative Effects
Manual maintenance of ROWs or maintenance with herbicides on National Forest lands or private lands should pose no cumulative risk for this species.

Indiana Bat (*Myotis sodalis*)

Life History/Species and Habitat Description/Distribution

The Indiana bat (Federally Endangered) is a medium-sized bat with a total length of 3 to 4 inches and a wingspan of 9.5 to 10.5 inches. This bat closely resembles the little brown bat (*Myotis lucifigus*) and the northern long-eared bat (*Myotis septentrionalis*). The Indiana bat usually has a distinctly keeled calcar; hind feet tend to be small with shorter hairs on the toes that do not extend beyond the toenails; and fur exhibits a faint three-colored pattern when parted, basal 2/3 brownish black followed by a narrow grayish band and a cinnamon brown tip. The fur of the belly and chest on an Indiana bat is lighter than the flat pinkish-brown fur of the back, but this character is not as distinct for the Indiana bat as the little brown bat and northern longear bat. Also, the Indiana bat has a smaller sagittal crest and tends to have a smaller, lower, and narrower braincase than the little brown bat. The Indiana bat is found throughout the eastern half of the United States.

Indiana bats hibernate in caves and mines during the winter. These sites tend to have temperatures between 39° and 46° F and relative humidity above 74% and below saturation. The Indiana bat has been documented using sites other than caves and mines (e.g. hydroelectric dam), but these sites have favorable microclimates. Summer habitat for Indiana bats is floodplains, and riparian and upland forest with trees that have ex-foliating bark for roosting. This bat will also use old fields and pastures with scattered trees for foraging habitats. Some tree species the Indiana bat will use for roosting are American beech (*Fagus grandifolia*), black gum (*Nyssa sylvatica*), black locust (*Robinia pseudo-acacia*), elm (*Ulmus* spp.), hickory (*Cayra* spp.), maple

(*Acer* spp.), pine (*Pinus* spp.), oak (*Quercu*s spp.), sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), sweet birch (*Betula lenta*), and yellow buckeye (*Aesculus octandra*). Most of these tree species have the proper characteristics for roost sites after they are dead or dying, but species such as shagbark hickory and white oak are used while they are still living. Romme, et al. (1995) found that maternity roost sites were usually located in areas with 60 to 80% canopy cover. Indiana bats will also utilize roosts where the canopy closure is higher than 80% when temperatures are above normal or during periods of precipitation.

Indiana bats forage in and around the forest tree canopy for aquatic and terrestrial flying insects. Some of these insects are moths (*Lepidoptera*), caddisflies (*Trichoptera*), stoneflies (*Plecoptera*), beetles (*Coleoptera*), flies (*Diptera*), leafhoppers and treehoppers (*Homoptera*), and lacewings (*Neuroptera*). Foraging heights are usually from 6 to 100 feet above ground level. Also, canopy closure for foraging habitat has been found to range from 30% to 100% in floodplain habitats.

Indiana bats begin to swarm in August-September, and breeding usually occurs in the latter half of this time period. After mating, females will enter directly into hibernation and store sperm over the winter. Females become pregnant after emerging the following spring. Indiana bats typically form maternity colonies with 100 or fewer adult bats. Young are born in late June or early July, and become volant within a month after birth.

Arkansas population estimate from priority 1 and 2 hibernacula and priority 3 and 4 when available for 2007 is 1,829 bats which is slightly down from 2,067 bats in 2005. This estimate is 0.4 % of the rangewide population estimate of 468,184.

Possible reasons for the decline of the Indiana bat are:

1. Human disturbance and vandalism of hibernacula caves,
2. Improper cave gates and structures,
3. Natural hazards such as cave collapsing or flooding,
4. Changes in cave microclimates,
5. Changes in land use practices (e.g. fire suppression and an increase in density of forest surrounding hibernacula caves), and
6. Chemical contamination (insecticides).

Site-Specific Effects

Effects from both alternatives are the same. Indiana bats are known to occur on Ozark National Forest and parts of the primary and or secondary zones for this species are inside the project area. There will be no change in roosting or foraging habitat due to this project. There will be no direct or indirect effects on this species due to changing maintenance methods on ROWs in the project area. There is a slight possibility that maintenance with machinery could disturb a colony of summer roosting bats but this is unlikely and would be a very infrequent event.

Cumulative Effects

There should be no cumulative effects due to manual maintenance or switching from manual maintenance to use of herbicides for ROW maintenance on National Forest Lands or private lands.

Ozark Big-eared Bat (*Corynorhinus townsendii ingens*)

Life History/Species and Habitat Description/Distribution

The Ozark big-eared bat is the largest and reddest of the five subspecies of *Corynorhinus townsendii*. The species is medium-sized and weighs from 0.2-0.4 ounces. It has very large (1 inch) ears that connect at the base across the forehead. The snout has prominent lumps due to the large facial glands. The Ozark big-eared bat closely resembles the eastern big-eared bat, but has tan instead of white underparts and brown instead of gray dorsal hair.

This species historically occurred in Northeastern Oklahoma, Northwestern Arkansas and Southwestern Missouri. The total population is believed to be comprised of less than 2000 individuals with the majority in Oklahoma. The Ozark big-eared bat is believed to be extirpated from Missouri. This species has been reported in Crawford, Marion, Franklin, and Washington counties in AR.

This species inhabits karst regions dominated by mature hardwood forests and utilizes caves year round as roosts. It primarily forages on *lepidoptera*. The primary threat is believed to be disturbance and vandalism of their cave habitats.

Site Specific Effects

Effects from both alternatives are the same. A change from manual maintenance of power line Rights of way to maintenance with herbicides should not affect this species roosting or foraging areas. There will be no direct or indirect effects on Ozark big-eared bat.

Cumulative Effects

There should be no cumulative effects on this species from manual right of way management or treatment with herbicides on forest service managed or private lands in or near the National Forests.

Implementation of ROW management should have no effect on this species or its foraging or roosting areas

Red-Cockaded Woodpecker (*Picoides borealis*)

In the mid-1800s, John J. Audubon described the Red-cockaded Woodpecker (RCW) as abundant in Southern pine forests. Today, only 10,000 to 14,000 individuals remain, living in a fragmented range in the southeastern United States. Unlike other woodpeckers, the RCW roosts in cavities in live pines requiring 80 to 120-year-old pines with red-heart disease for its cavities, and extensive pine and pine-hardwood forests to meet its foraging needs. Much of the Southeast has been cleared for agriculture and many remaining pine forests are unsuitable for the RCW. Because of the drastic loss and continued decline of habitat rangewide, the bird is federally classified as Endangered (NatureServe 2009). Basic biological and population data about RCWs have appeared in many technical publications.

Historically, RCWs occurred in diverse pine-dominated forests ranging in the eastern United States from New Jersey south through Florida, and west from Missouri through Oklahoma and

Texas. By the time RCWs were listed as federally endangered, suitable habitat had shrunk to one percent or less of its historic levels, with predictable declines in the numbers of birds. Surveys in Arkansas in the 1970s and 1980s revealed a population of at most a few hundred birds confined to public lands and scattered holdings of timber companies (James and Neal 1986).

On the Ouachita National Forest, Management Area 22 (MA22) includes areas restored or in restoration efforts to shortleaf pine-bluestem grass communities in the Ouachita Mountains of Arkansas and Oklahoma. Currently, the only active RCW clusters on the Ouachita National Forest are limited to restored shortleaf pine-bluestem communities within Management Area 22 in Arkansas (USDI-FWS 2000). No RCWs were seen during field surveys.

Site-Specific Effects

Effects from both alternatives are the same. There should be no direct, indirect effects to this species. The recovery plan for RCW allows for herbicide use for control of midstory vegetation. The change from manual maintenance of power lines to maintenance with herbicides should not affect this species. There are no active RCW clusters near the areas being treated and only a very small percentage of Management Area 22 will be treated therefore any food ingested from the treated area would be an insignificant percentage of their diet and should not affect the bird. Disturbance from manual treatment is unlikely and would be very infrequent.

Cumulative Effects

ROW maintenance with herbicides or manual treatment on National Forest lands or private lands should pose no cumulative risk for this species.

American Burying Beetle - (*Nicrophorus americanus*) - Endangered

Environmental Baseline

This species has been recorded from grassland, old-field shrub-land, and hardwood and pine forests. Vegetational community associations range from large mowed and grazed fields to dense shrub thickets. Oklahoma habitats vary from deciduous oak-hickory and coniferous forests atop ridges or hillsides to deciduous riparian corridors and pasturelands on valley floors. Soil characteristics are also important to the beetle's ability to bury carrion. Extremely xeric, saturated, or loose sandy soils are unsuitable for these burying activities. Historic collections were made when forests had been cleared and the land was largely agricultural and habitats associated with these collections were not clearly described. Adults live primarily above ground and eggs are laid in soil adjacent to a buried carcass.

Threats include habitat fragmentation, insecticides, and bug-zapper use as well as disturbance of soils and competition from vertebrate scavengers. Continued widespread population decline indicates vulnerability and/or a loss of suitably sized carrion.

The species is nocturnal and mobile enough to avoid direct effects of growing season burns, mowing or other disturbance factors and protected from dormant season burns due to spending the dormant season underground.

This species has exhibited a dramatic range collapse in recent times, having been reduced to less than 10 percent of its original historic range and probably much less than 1 percent of its original occupied habitat. There are certainly more than 5 and probably fewer than 20 existing

populations, with some at relatively low densities. More populations may be found in the future. Despite numerous surveys across the Forests over the years, there have been only two occurrence records noted with both being on the extreme western edge of the Mt. Magazine Ranger District in Logan County.

The Forests will continue to survey and monitor following accepted protocols for this species. Because of the mobility of this nighttime flying insect, it is possible that new occurrences will be found in the future.

Potential Effects

For herbicide maintenance there would be no ground turning activities associated with this project that would directly affect American Burying Beetles. The Herbicide alternative proposes to change maintenance methods within the project area from periodic mowing to periodic use of herbicides in areas where herbicide use is appropriate. This should produce a limited increase in native herbaceous vegetation that could increase available carrion on a small scale.

Maintenance with equipment might increase prey availability one every two or three years due to mortality of small birds or mammals killed by mowing but this is so infrequent this the effects are discountable. ABBs should be underground while manual maintenance is being performed.

Cumulative Effects

Threats such as habitat fragmentation, insecticide use, and bug-zapper use will continue on private lands. Continued widespread population decline indicates vulnerability and/or a loss of suitably sized carrion in part due to urbanization and human population increases.

Manual treatments and herbicide treatments of ROWs would lead to discountable cumulative effects on the species.

Magazine Mountain Shagreen (*Mesodon magazinensis*)

Life History/Species and Habitat Description / Distribution

This land snail is described as having a dusky brown to buff-colored shell, and is endemic to Mt. Magazine in Logan County. It is unknown elsewhere on the OSFNFs or anywhere else. Suitable habitat occurs on about 540 acres in two locally separated areas of the mountain; (1) on the north facing slopes of the summit and; (2) on north facing slopes of Bear Hollow. Habitat is characterized as steep, talus sites in rich mesic hardwood forest. This snail prefers a cool, moist climate and during warm, dry weather will move deeper into rock crevasses.

Site Specific Effects

Effects from both alternatives are the same. The restricted range of the Magazine Mountain shagreen makes it vulnerable to any land use change or activity that will have an adverse effect on the talus slopes it inhabits. Direct toxic chemical application to the species or drift of herbicides could have a detrimental impact on the species. Distance of suitable habitat for this species from Rights of Way and standards for use of herbicides will prevent any drift or off site transport of herbicides from reaching this species. There will be no direct or indirect effects on MMS from either manual maintenance or treatment with herbicides.

Cumulative Effects
The known population and range of this species is confined to the Ozark NF, forest-wide standards have been included to protect sites where it occurs. Even with the combination of impacts from past, present and, future activities occurring on public and private lands, no cumulative effects to the Magazine Mountain shagreen are anticipated with implementation of the Revised Forest Plan including ROW maintenance proposed in this project.

Regional Forester's Sensitive Species

Bachman's Sparrow (*Aimophila aestivalis*)

Environmental Baseline
Bachman's Sparrow is a ground nesting passerine historically found in the mature pine woodlands of the southern United States (Meyer et al. 2006, Sibley 2000). The species has recently suffered a significant contraction of the northern edge of its range, with local extirpations documented the in center of the Bachman's sparrow range (NatureServe 2007). Optimum habitat for the species consists of open mid-story habitats with a substantial amount of herbaceous understory vegetation (Meyer et al 2006, Mitchell 1998). Before the colonization of North America by Europeans, the species likely inhabited open pine forests of the southeastern United States almost exclusively (Jackson 1988, Plentovich et al. 1998). However, this sparrow is able to colonize recent clearcuts and early seral stages of old-field succession, but such habitat only remains suitable for a short period of time (Mitchell 1998, NatureServe 2007).

Bachman's Sparrows have repeatedly been shown to occur in greater abundance in areas that are frequently exposed to fire (Hunter et al. 2001, Meyer 2006). The species benefits from frequent growing-season burns, breeding wherever suitable habitat conditions exist (Mitchell 1998). In the absence of a short burning rotation, both mature stands and clearcuts quickly become unsuitable for nesting (NatureServe 2007). On sites occupied by Bachman's Sparrow, vegetation density was greater below 3 feet than above 3 feet and percent ground cover and percent grass cover were consistently higher (>58%) than unoccupied sites in Arkansas, Alabama, Florida, South Carolina and North Carolina (Haggerty 2000). However, vegetation densities below 3 feet and percent ground and grass cover in areas occupied by Bachman's Sparrow did not differ significantly from unoccupied areas of loblolly and shortleaf pine plantations in Arkansas (Haggerty 1998). *Aimophila aestivalis* forages entirely on the ground, with its primary food items consisting of arthropod species and plant seeds (Mitchell 1998, NatureServe 2007).

Bachman's Sparrows' breeding season typically begins in April and continues through August (Meyer 2006). Breeding *A. aestivalis* usually avoid sites with dense understory vegetation and in South Carolina are found breeding in one to five year-old pine stands (clearcuts) and power line ROWs, as well as in mature pine stands (Dunning and Watts 1990, Liu et al. 1995). Mature pine stands are suitable breeding habitat when the areas also have dense ground vegetation and open mid-stories (Dunning and Watts 1990, Gobris 1992). In shortleaf and loblolly pine plantations in Arkansas, females incubated eggs for 13 to 14 days (Haggerty 1998). The average nestling period was 9 days, and the average period between fledging and independence was 25 days. Both parents care for the young during these periods (Haggerty 1988). Breeding territory was 0.3-1.3 ha (average 0.62 ha) over one breeding cycle in southern Missouri (Hardin et al. 1982) and 2.49 ha over the entire breeding season in Arkansas (LeGrand and Schneider 1992).

Once a common inhabitant of southern pine forests, *Aimophila aestivalis* is now only locally abundant, with suitable habitat unoccupied especially when found in isolated patches (NatureServe 2007). The species has declined over the last century, mainly due to the alteration and destruction of its preferred early successional habitat (Dunning 1993, Dunning and Watts 1990).

Bachman's Sparrow - Survey Information

Bachman's Sparrows occur primarily in the southeastern United States from the central region of the peninsula Florida, north to limited areas of extreme southern Virginia and west through portions of Tennessee, Kentucky and Missouri to eastern Oklahoma and eastern Texas (Dunning 1993, Sibley 2000). Bachman's Sparrows may rarely occur in more northerly areas that were part of their historic breeding range, including most of Illinois, Indiana, Ohio, West Virginia and parts of Pennsylvania and Maryland (Dunning 1993, Meyer 2006). Bachman's Sparrows in the southern portion of the range are resident, while those in Missouri, Arkansas, eastern Oklahoma, Tennessee, Virginia, parts of North Carolina and extreme northern Mississippi and Alabama migrate south during winter (National Geographic Society 1999).

Within the analysis area, the Bachman's sparrow has been documented in Newton, Logan, Pope, Baxter, Franklin and Johnson Counties of Arkansas (ANHC 2007). No Bachman's sparrows were encountered during field surveys.

Bachman's sparrow is known to occur in Management Area 22 (MA22) that includes areas restored or in restoration efforts to shortleaf pine-bluestem grass communities in the Ouachita Mountains of Arkansas and Oklahoma. The project area does cross management area 22.

Bachman's Sparrow - Alternative Effects and Rationale

Effects to Bachman's Sparrow are considered here based on the possibility of occurrence of the species within the analysis area (ANHC 2007). Herbicide applications during ROW maintenance should not adversely affect this species if it were to be present. Extensive scientific studies indicate that the herbicides proposed for use are nontoxic to birds (WSSA 1994, Kamrin 1997, EXTOXNET 1996, USDA 2003). The selective spraying of woody vegetation only for ROW maintenance should increase the habitat quality for Bachman's Sparrow within ROWs and possibly provide suitable breeding habitat (Hunter et al. 2001). The use of heavy equipment for vegetation maintenance degrades critical wildlife habitat and produces high levels of noise, which can have adverse effects on breeding birds and other sensitive species of wildlife. The No Action Alternative has also been shown to cause the direct mortality of wildlife by inadvertently crushing or chopping individuals or nests. Adherence to the manufactures label and Forest Service standards should minimize any potential adverse effects to the Bachman's Sparrow from the utilization of herbicides for ROW maintenance within the analysis area.

Eastern Small-footed Myotis *(Myotis leibii)*

Environmental Baseline

Myotis leibii is the smallest bat species found in the eastern US, barely reaching three inches in length and having a wingspan of less than nine inches (Best and Jennings 1997, Harvey et al. 2004). In addition to being small, as its name implies, this species of bat has especially small feet relative to its body size.

The small-footed myotis has been documented most commonly in hilly or mountainous areas, in or near deciduous or evergreen forest, sometimes in open farmland (NatureServe 2006). *Myotis leibii* use a variety of roost sites throughout the year. Caves and mines are used as winter hibernacula. During warmer periods, the species may use rock shelters, fissures in cliffs and old mines and quarries (Best and Jennings 1997, Saugey et al. 1993). In Arkansas *M. leibii* may hibernate in rock glaciers (Saugey et al. 1993). Little is known of this bat's foraging behavior, although the species presumably forages primarily in the vicinity of forest and forest edge (Harvey et al. 2004). The most serious threat to *M. leibii* is human disturbance during hibernation (NatureServe 2006).

Eastern Small-footed Myotis - Survey Information

The distribution of the small-footed myotis is from eastern Canada south to Georgia and west to Oklahoma (Harvey et al. 2004). However, the small-footed myotis is thought to be uncommon throughout most of its range (Best and Jennings 1997). The total count for all hibernacula is approximately 3,000 individuals, with roughly 60% of the total number from just two sites in New York (Raven 2006). Within the analysis area, *M. leibii* has been reported in Newton, Logan and Polk Counties of Arkansas (ANHC 2007, Saugey et al. 1993). The potential habitat for this species is all Forest Service acres (except the St. Francis), or approximately 900,000 acres. The species has been documented in small numbers from only a few caves in the Ozarks (Harvey et al. 2004); however the potential for occurrence is considered to be Forest-wide (Raven 2006).

Geologic maps and GIS occurrence data provided by the Forest Service were used to determine areas within the analysis area likely to hold small-footed myotis habitat (sandstone overhangs and limestone caves). Areas deemed likely suitable for the species were surveyed for the presence of bat sign (guano and insect wings). A majority of the ROWs within the analysis area were visited to verify the parent material shown on geological maps. All talus areas encountered within the analysis area were also searched for bat sign. Surveyors documented several locations within the analysis area where sandstone overhangs where discovered. However, only one small cave with bat guano at its entrance was documented in the analysis area at Devil's Den State Park. These areas might provide marginal day-roost habitat for bats, although no caves suitable for bat hibernacula were documented. Additional surveys are not needed to improve the determination of effects to *M. leibii*, a sensitive species.

Eastern Small-footed Myotis - Project Effects and Rationale

Effects to the small-footed myotis are considered here based on habitat present and its potential occurrence within the analysis area (ANHC 2007). The species is highly sensitive to disturbance during hibernation. The effects of a crew treating ROWs with herbicide or mechanical treatment once every two or three years during the growing season would have no effect on hibernating bats. The small-footed myotis has not been documented within 1000 feet of the analysis area. However, many power line ROWs may provide suitable *M. leibii* night time foraging habitat, particularly where they are located adjacent to streams. Day time treatments would avoid foraging bats. Mitigation measures implemented for the protection of PETS species developed by the USDA, such as the protection of caves, karst habitats and riparian areas, should minimize the disturbance of sensitive bat species possibly inhabiting the analysis area (USDI 2002).

Longnose Darter *(Percina nasuta)*

Environmental Baseline

Percina nasuta is a rare species of darter mainly occupying the pools of clear, silt-free, upland streams and small rivers (Robison and Buchanan 1988). The species inhabits gravel and rubble riffles in spring and slower quieter waters over sand and silt in fall (NatureServe 2006). Individuals of the species have also been documented in large impoundments, but are not likely part of a viable population (MDC 2000a). Spawning has been documented in the riffles sections of the streams from late March to mid-May. During periods of low flow, the longnose darter is usually found in the deeper parts of the pools in little or no current, often over a sandy bottom and frequently near aquatic vegetation (Robison and Buchanan 1988).

The longnose darter appears to be very sensitive to environmental disturbance (Robison and Buchanan 1988). Habitat destruction and degradation due to reservoir construction are likely the greatest threats to the species (NatureServe 2006, Robison and Buchanan 1988). Other known threats include drought, pollution, sedimentation and altered temperature and flow regimes downstream from impoundments (Robison 1992a and 1992b, Wagner et al. 1984). *Percina nasuta* is found in several widely scattered populations, but those populations seem to be very small. Because of its scattered range, this species is vulnerable to the loss of populations with no likelihood of reestablishment (Robison and Buchanan 1988, USDA Forest Service 2005b).

Longnose Darter - Survey Information

The longnose darter historically occurred in medium streams to small rivers in northeast Oklahoma, southern Missouri and to the edge of the Ouachita/Ozark highlands in Arkansas (NatureServe 2006, Raven 2006). The species is believed to be very rare and possibly extinct in Oklahoma and Missouri. In Arkansas, the longnose darter inhabits the upper White River, the upper Little Red River and a few tributary streams of the western half of the Arkansas River (Robison and Buchanan 1988). Within the analysis area, *P. nasuta* has been reported in Benton, Crawford, Franklin, Johnson, Madison, Pope, Stone and Washington Counties of Arkansas (ANHC 2007). According to GIS occurrence data provided by the Forest Service no longnose darters have been documented within 1000 feet of the analysis area. No surveys were conducted for *P. nasuta* for this BE. Additional surveying for the longnose darter is not necessary to improve the determination of effects that might result from this project.

Longnose Darter - Alternative Effects and Rationale

Effects of the proposed action to the longnose darter are considered here based on the habitat present within the analysis area and its potential occurrence within the analysis area (ANHC 2007, USDA Forest Service 2005b). Many perennial and intermittent streams that may provide some suitable habitat for this species are present within the analysis area. However, the longnose darter has not been documented in any of the main water courses adjacent to the analysis area (Robison 1992, USDA Forest Service 2005b). Forest Service standards for management around riparian habitats emphasize low levels of disturbance and maintenance of mature forests (USDA Forest Service 2005b). Since *P. nasuta* are highly susceptible to disturbance and siltation of their aquatic habitat, utilization of these standards would minimize any potential adverse effects to longnose darter habitat. Standards to be used while treating ROWs will protect this species from any effects due to herbicide use.

The infrequent nature of manual treatments would reduce any sedimentation effects to acceptable levels for this species.

Diana Fritillary *(Speyeria diana)*

Environmental Baseline

Speyeria diana is a large forest dependent species of butterfly that is in decline over much of its range (Moran and Baldridge 2002, Vaughan and Shepherd 2005). The species utilizes edges and openings in moist, rich mountain forests or bottomlands along streams for breeding habitat. Grassland/prairie and shrubby areas, often near streams, are used for foraging (NatureServe 2006, USDA Forest Service 2005b, Vaughan and Shepherd 2005). Nectaring occurs on thistles and milkweeds and larvae utilize violets as host plants (NatureServe 2006, USDA Forest Service 2005b, Vaughan and Shepherd 2005). The species appears to range throughout the analysis area, where there is suitable wetland and prairie habitat with preferred nectar plants. Moran and Baldridge (2002) found that *S. diana* in the Ozark and Ouachita mountains was associated with small natural prairie openings, while those in central AR were found in wetland areas.

Speyeria diana has declined over the last century mainly, due to the alteration and destruction of wetland and prairie habitat and the associated loss of preferred nectar plants (Hammond and McCorkle 1983, Hammond 1995, Moran and Baldridge 2002). Populations exist only in the Appalachian Mountains and the Interior Highlands of the Ozark Plateau and Ouachita Mountains covering Arkansas, Missouri and Oklahoma (Carlton and Nobles 1996). Although the Diana fritillary is widespread, its populations are scattered within that range and fluctuate greatly between years. It appears most secure in the southern Appalachians, Arkansas and Missouri, but threats are present range-wide (Vaughan and Shepherd 2005). Surveys done by Carlton and Nobles in (1996) found *S. diana* populations were small and isolated and therefore at high risk for extinction (Moran and Baldridge 2002).

Diana Fritillary - Survey Information

The core of the distribution of *S. diana* is the southern Appalachians from central Virginia and West Virginia through the mountains to northern Georgia and Alabama. The species is also found in the Ozark Mountains of Missouri, Arkansas and eastern Oklahoma (Vaughan and Shepherd 2005). Within the analysis area, the Diana fritillary has been documented in Johnson, Logan, Newton, Scott and Yell Counties of Arkansas (ANHC 2007).

Surveys for the Diana fritillary were conducted along power line ROWs and extended approximately 300 feet on either side of the centerline. Searches were performed in June when adult butterflies are active (Moran and Baldridge 2002, Vaughan and Shepherd 2005). Surveys were conducted by walking power line ROWs and searching a variety of available habitats, including mature forest, forest opening and wetlands. In particular, areas that contained significant concentrations of nectar plants were searched carefully for S. Diana (Moran and Baldridge 2002). An adult male of the species was likely spotted on a ROW in Magazine Mountain State Park during field surveys, but was not captured for positive identification. Further surveying for *Speyeria diana* is not necessary to improve the determination of effects that might result from this project.

Diana Fritillary - Project Effects and Rationale

Effects to Diana fritillary are considered here based on presence of suitable habitat and the possibility of occurrence of the species within the analysis area (ANHC 2007, USDA Forest Service 2005b). There is an abundance of both reproductive and foraging habitat suitable for *S. diana* throughout the analysis area. However, herbicide applications during ROW maintenance should not adversely affect this species. Mowing at the wron time of year could destroy eggs or

larvae. Extensive scientific studies indicate that the proposed herbicides are nontoxic to honeybees (Kamrin 1997**,** USDA 2003, WSSA 1994). *Speyeria diana*, also in the class Insecta, would be protected by the implementation of forest-wide standards for herbicide application, which require a buffer around all wetlands, seeps and known plant locations. The selective spraying of woody vegetation only for ROW maintenance should reduce competition and release many of the nectaring plants preferred by the Diana fritillary. Bramble et al. (1997) found no discernable difference in adverse effects to butterfly species from herbicide and mechanically maintained ROWs in Pennsylvania.

Ouachita Leadplant (*Amorpha ouachitensis*)

Environmental Baseline

Amorpha ouachitensis is a small, woody shrub species of conservation concern within the family Fabaceae (NatureServe 2006, CPC 2007). The leaves of the Ouachita leadplant are pinnately compound with broadly elliptical leaflets and the species grows to approximately 6 feet in height. The species flowers from late April through May and develops fruit in May and June that persists on the plant throughout winter (CPC 2007). The Ouachita leadplant usually occurs in rocky, open areas having reliable soil moisture such as stream banks, floodplains and forest clearings (ONHI 2007, NatureServe 2007). *Amorpha ouachitensis* also occurs in roadside banks, roadside ditches and along ephemeral drainages. In the Ouachita Mountains, this species appears to prefer the edges of small streams and drainages (USDA Forest Service 2005a). This species is regarded as fire-independent, because it usually occupies habitats that burn; however, fire does not alter the habitat significantly enough to change suitability for the species (Zollner 2005).

Factors implicated in the decline of *A. ouachitensis* include habitat destruction and degradation through the alteration of stream banks and other wetland habitats. Forestry practices, such as clear-cutting and conversion of native forests to pine plantations may also indirectly threaten populations (NatureServe 2006, ONHI 2007).

Ouachita Leadplant - Survey Information

Amorpha ouachitensis is endemic to the Ouachita Mountains in west-central Arkansas and southeastern Oklahoma (NatureServe 2006). The Ouachita leadplant is also known from several locations on Mt. Magazine within the Ozark National Forest (Tucker 1989). The species is currently known from at least eleven populations in eight counties in Arkansas and three counties in Oklahoma (NatureServe 2006, ONHI 2007). Within the analysis area the Ouachita leadplant has been documented in Johnson, Logan, Franklin, Polk, Montgomery, Yell and Scott Counties in Arkansas (USDA Forest Service 2005a).

Surveys for the Ouachita leadplant were conducted along power line ROWs and extended approximately 100 feet on either side of the center line. No Ouachita leadplant populations were documented during surveys; however, the species has been documented within 1000 feet of the analysis area in Logan County, Arkansas. Further surveying for *A. ouachitensis* is not necessary to strengthen the determination of effects on the species that might result from this project.

Ouachita Leadplant - Alternative Effects and Rationale

Effects of the proposed action to the *A. ouachitensis* are considered here based on the habitat present within the analysis area and its potential occurrence within the analysis area (ANHC 2007). There is an abundance of habitat within the analysis area that may provide suitable for

the Ouachita leadplant. Although, the species has been documented within 1000 feet of the analysis area, individuals possibly inhabiting the analysis area should be protected by the implementation of forest-wide standards for herbicide application, which places a buffer around all stream banks and other sensitive areas. The avoidance of riparian areas/springs buffer zones and application of herbicides according to the manufacturers label and Forest Service regulations should minimize any possible adverse effects on *A. ouachitensis* by the proposed action.

Manual maintenance would keep this species mowed and probably eventually eliminate it from the corridor.

Bush's Poppymallow *(Callirhoe bushii)*

Environmental Baseline

Callirhoe bushii is a herbaceous perennial that produces showy magenta colored flowers and reaches approximately three feet in height (CPC 2007). The species usually inhabits open rocky woodlands, edges of glades and barrens, upland tall grass prairies, railroad and highway rights-of-way and ravine bottoms (NatureServe 2006). The substrate is usually calcareous, and the soil is typically deeper than that found on glades or barrens (Morgan 1980a, NatureServe 2006). This species is found in open sunny habitat with little vegetative cover and has never been documented in habitat with a closed canopy (NatureServe 2006, USDA Forest Service 2005b). This is regarded as a fire-dependent species since areas inhabited by this species were historically maintained by fire (Zollner 2005).

Threats to Bush's poppymallow include habitat destruction, collection by plant enthusiasts and herbicide application along roadside areas where it occurs (Kral 1983, NatureServe 2006, Tucker 1983a). Forest clearing projects can be detrimental if excessive physical disturbance occurs to the substrate and vegetation. In mesic habitats, conversion of hay meadows to cropland is a significant threat. Much of this type of historic habitat has already been destroyed by this activity. Many populations in Arkansas and southern Missouri are believed to have been lost as a result of the construction of Bull Shoals, Taneycomo and Table Rock Reservoirs (Kral 1983, Tucker 1983a). The disruption of natural fire regimes and the associated encroachment of woody vegetation are also regarded as a threat to *C. bushii* (NatureServe 2006).

Bush's Poppymallow - Survey Information

Bush's poppymallow ranges from extreme southwestern Missouri to northwest Arkansas and northeastern Oklahoma. Within the analysis area the species has been documented in Benton, Logan and Washington Counties of Arkansas.

Surveys within the analysis area for the Bush's poppymallow were conducted along the power line ROW and extended approximately 100 feet on either side of the center line. Field surveys were conducted in two sessions to maximize the likelihood of detecting the plant during the flowering period. No Bush's poppymallow populations were discovered during field surveys. Further surveying of *C. bushii* is not necessary to strengthen the determination of effects that might result from this project.

Bush's Poppymallow - Project Effects and Rationale

Effects of the proposed action to Bush's poppymallow are considered here based on the habitat present within the analysis area and the species potential occurrence within the analysis area (ANHC 2007, USDA Forest Service 2005b). Power line ROWs provide an abundance of habitat

within the analysis area suitable for the Bush's poppymallow and the species has been documented within 1000 feet of the analysis area. However, *C. bushii* was not found during field surveys. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. Utilization of forest-wide standards for herbicide application, such as buffer zones within 60 feet of plant locations, should minimize any possible effects on *Callirhoe bushii* (USDA Forest Service 2005a).

Maintenance by mowing would simulate the effects of fire and probably help to maintain this species.

Ozark Chinquapin *(Castanea pumila var. ozarkensis)*

Environmental Baseline

Once considered a locally abundant species across the Interior Highlands region, the Ozark chinquapin population is now declining and rarely reaches maturity due to chestnut blight, a fungal disease (NatureServe 2006, ONHC 2006, Paillet 1993). The species is most common in openings of frequently burned upland deciduous or mixed hardwood-pine communities on acid soils of ridge-tops, upper slopes adjacent to ravines and gorges and the tops of sandstone bluffs (Godfrey 1988, NatureServe 2006, Sullivan 1994). Because of the chestnut blight, most plants are stump sprouts less than 15 feet in height, usually growing in small clonal populations of 15 to 25 individuals (ONHC 2006, Paillet 1993). Ozark chinquapin is often locally abundant in fire-maintained woodlands and is considered a fire-dependent species (Godfrey 1988, USDA Forest Service 2005b, Zollner 2005).

The greatest threat to *Castanea pumila var. ozarkensis* is chestnut blight (*Endothia parasitica*), which was inadvertently introduced from Asia in 1930 (MDC 2000b, NatureServe 2006). The disease is responsible for the extirpation of the Ozark chinquapin from most of Alabama, and has severely reduced populations in many portions of the species range (Sullivan 1994). As a result of the introduction of this parasite, few mature trees of this species still exist, although sprouting from stumps is relatively common (Moore 2004, Tucker 1980). Also, loss of a natural fire regime has led to successional changes in the vegetative community that have adversely affected regeneration and growth of the Ozark chinquapin (USDA Forest Service 2005b).

Ozark Chinquapin – Survey Information:

Ozark chinquapin is almost completely restricted to the Ozark Plateau region of Oklahoma, Arkansas and Missouri, with disjunct populations in Louisiana, Mississippi and Alabama (Johnson 1987, NatureServe 2006). Until the introduction of the chestnut blight into the US and its subsequent spread, the Ozark chinquapin had been considered a locally abundant and widespread tree species in the Interior Highland region. Within the analysis area, the species has been documented in Baxter, Benton, Crawford, Franklin, Johnson, Logan, Madison, Newton, Pope, Scott, Sebastian, Stone, Washington and Yell Counties of Arkansas (ANHC 2007).

Surveys for *Castanea pumila var. ozarkensis* were conducted along power line ROWs within the analysis area and extended approximately 100 feet on either side of the line. Field surveys were conducted in two sessions to maximize the likelihood of detecting the plant during the flowering period. No Ozark chinquapin populations were discovered during field surveys. Further

surveying for the species is not necessary to strengthen the determination of effects that might result from this project.

Ozark Chinquapin - Project Effects and Rationale

Effects of the proposed action to the Ozark chinquapin are considered here based on the habitat present within the analysis area and the species occurrence within the analysis area (ANHC 2007, USDA Forest Service 2005b). The Ozark chinquapin has been documented within the analysis area, and there is an abundance of habitat within the analysis area suitable for the species. Although the species is present in the analysis area, no Ozark chinquapin was found during surveys. The proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. Utilization of forest-wide standards for herbicide application, such as buffer zones within 60 feet of plant locations, should eliminate any possible effects on *Castanea pumila var. ozarkensis* (USDA Forest Service 2005a).

Manual treatment of this species would keep it in a resprouting cycle. The individual trees may eventually die.

Ozark Chinquapin - Determination of Effects

As described in the “Effects” section above, it is the determination of this BE that use of herbicides for utility ROW maintenance "may impact individuals but not likely to cause a trend to federal listing or a loss of viability" to *Castanea pumila var. ozarkensis*, a Sensitive species.

Gulf Pipewort (*Eriocaulon koernickianum*)

Environmental Baseline

This monoecious plant species occurs on acid, sandy soil, in or near, permanently moist hillside seeps in its western distribution (Kral 1983, Tucker 1983a, Watson 1994), as well as bogs and prairie stream banks (Nature Serve 2007, USDA Forest Service 1989c). The small-headed pipewort appears to require full sun for optimum development and may benefit from disturbance such as fires that remove ground cover and debris (Watson et al 1994, Tucker 1983a).

Gulf pipewort is intolerant of shade, is probably an early-successional species and may be found at high altitudes (ANHC 2007, Nature Serve 2007, Watson et al 1994). All Oklahoma gulf pipewort populations documented in Watson et al (1994) were closely associated with sandy, hillside seeps occupied by herbaceous species and surrounded by oak-hickory woodlands, with some loblolly pine scattered throughout. Comparison of percent ground cover and associated plant species indicate that Oklahoma populations of *E. koernickianum* are positively correlated with bare ground and eight early successional herbaceous species and negatively correlated with mosses and leaf litter.

In the past 20 years, small-headed pipewort population numbers have declined over 50 percent in the western range of its distribution (AR, OK and TX) (Kral 1983, Tucker 1983a, Watson, 1989). Many factors are contributing to the decline of the species, including annual or weak perennial life history, no vegetative reproduction, low seed set, little seed bank contribution to population growth and maintenance, genetic homogeneity and restricted habitat. *Eriocaulon koernickianum* also has difficulty competing with surrounding vegetation (ANHC 2007, Watson et al 1994).

Gulf Pipewort - Survey Information

Within the analysis area, *E. koernickianum* has been reported in Benton, Franklin, Johnson, Logan, Madison and Pope Counties in Arkansas (ANHC 2007). Surveys for the small-headed pipewort were conducted along ROWs and extended approximately 100 feet on either side of the centerline. Field surveys were conducted in two sessions to maximize the likelihood of detecting the plant during the flowering period. No gulf pipewort populations were documented during surveys. Further surveying for *E. koernickianum is* not necessary to improve the determination of effects on the species that might result from this project.

Gulf Pipewort - Project Effects and Rationale

Effects to the gulf pipewort are considered here based on habitat present and its potential occurrence within the analysis area (ANHC 2007). There are many hillside seeps within the analysis area that may provide suitable habitat for the gulf pipewort. There is an abundance of habitat within the analysis area, which may be suitable for the gulf pipewort and the species has been documented within 1000 feet of the analysis area. However, the gulf pipewort was not found during field surveys of the analysis area. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. *Eriocaulon koernickianum* should also be protected by the implementation of forest-wide standards for herbicide application, which place a buffer around all wetlands, seeps and known plant locations. The small size of this plant may make its observation unlikely even if it is present. There is a possibility that individual plants could be treated with herbicide.

Manual ROW maintenance could affect individual plants but at the same time disturb the ground and providing a suitable habitat for new plants to grow.

Ozark Spiderwort *(Tradescantia ozarkana)*

Environmental Baseline

Tradescantia ozarkana is a herbaceous perennial having three pale rose-lavender to white petaled flowers that reaches approximately 20 inches in height (ONHI 2007). The species is associated with limestone or dolomite bedrock, and is usually found in steep, rocky, wooded slopes and ravines, bases and mesic lower slopes of bluffs, as well as dry to moist woodland ledges (MDC 2007, NatureServe 2006, ONHI 2007). The Ozark spiderwort has also been reported from sandstone by Watson (1989). Tradescantia ozarkana does not appear to be highly habitat- specific. Throughout its range, it has been recorded from rich, diverse and mainly deciduous woodlands (NatureServe 2006).

The main threats to the Ozark spiderwort include habitat loss and degradation and herbicide use (NatureServe 2006, Watson 1989, ONHI 2007). Residential development, conversion of natural areas to cropland, logging and impounding of rivers has contributed to the decline of Ozark spiderwort. However, the species is considered relatively secure despite some documented declines due to construction of dams/impoundments. *Tradescantia ozarkana* has been documented with population numbers in the hundreds and occasionally in the thousands of individuals, suggesting a taxon capable of sustaining itself when under natural conditions (NatureServe 2006).

Ozark Spiderwort - Survey Information

This species is endemic to a very limited geographic range in the Ozark Mountains of Missouri, Oklahoma and Arkansas, and to the Ouachita Mountains of western Arkansas and southeastern Oklahoma (ONHI 2007). Within the analysis area, *T. ozarkana* has been documented in Baxter, Benton, Johnson, Logan, Newton and Pope Counties of Arkansas (ANHC 2007).

Surveys within the analysis area for the Ozark spiderwort were conducted along the power line rights-of-way and extended approximately 100 feet on either side of the centerline. Field surveys were conducted in two sessions to maximize the likelihood of detecting the plant during the flowering period. No Ozark spiderwort populations were discovered during field surveys. Further surveying of *T. ozarkana* is not necessary to strengthen the determination of effects that might result from this project.

Ozark Spiderwort - Project Effects and Rationale

Effects of the proposed action to the Ozark spiderwort are considered here based on the habitat present within the analysis area and the species potential occurrence within the analysis area (ANHC 2007, USDA Forest Service 2005b). An abundance of habitat that may be suitable for the Ozark spiderwort exists within the analysis area, and the species has been documented within 1000 feet of the analysis area. However, Ozark spiderwort was not found during field surveys of the analysis area. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. There is the possibility that individual plants could receive limited herbicide application if they are next to a targeted wood. Utilization of Forest Service standards for herbicide application, such as buffer zones within 60 feet of plant locations, should minimize any possible effects on *T. ozarkana* (USDA Forest Service 2005a).

Manual maintenance of ROWs would tend to keep habitat open for this species without destroying plants. Most plants should resprout after treatment.

Nuttall's Cornsalad (*Valerianella nuttallii*)

Environmental Baseline

Valerianella nuttallii is a rare annual herbaceous flowering plant endemic to the Ouachita Mountains and Arkansas Valley of western Arkansas and eastern Oklahoma (ANHC 2007). In Arkansas, the species inhabits predominantly open shale glades and prairies with shale substrate. It may also be found in open woodland (often with shale substrate), openings in scrub woods, rocky open hillsides, embankments, roadsides and ditches (ANHC 2007, NatureServe 2006). In Oklahoma, Nuttall's cornsalad appears to prefer relatively flat, open areas with a low ground cover of herbs and grasses and shallow heavy clay soils, often overlying sandstone. *Valerianella nuttallii* is most frequently found near the bottom of broad roadside ditches (especially those subject to annual mowing) or other shallow depressions where standing water accumulates after the spring rains; however, it also occurs in hay meadows where similar conditions exist and grazing pressure is limited. This is regarded as a fire-dependent species since areas inhabited by this species were historically maintained by fire (USDA Forest Service 2005b, Zollner 2005).

The greatest threat to Nuttall's cornsalad is its narrow range, which only includes the Ouachita Mountains and Arkansas Valley of western Arkansas and eastern Oklahoma (NatureServe 2006). The species is strongly correlated with open shale glades and prairies with shale substrate and is

threatened with the mining of shale glades for fill material. Other threats include the encroachment of glade habitat by woody plants (especially eastern red cedar) in the absence of fire and the conversion of prairie to non-native pasture grasses (ANHC 2007).

Nuttall's Cornsalad - Survey Information

Valerianella nuttallii is now apparently restricted to western Arkansas. It was formerly reported in eastern Oklahoma, however, occurrences have not been confirmed there recently (NatureServe 2006). Within the analysis area, Nuttall's cornsalad has been documented in Logan and Sebastian Counties of Arkansas.

Surveys for Nuttall's cornsalad were conducted along power line ROWs within the analysis area and extended approximately 100 feet on either side of the center line. Field surveys were conducted in two sessions to maximize the likelihood of detecting the plant during the flowering period. No Nuttall's cornsalad populations were discovered during field surveys. Further surveying for the species is not necessary to strengthen the determination of effects that might result from this project.

Nuttall's Cornsalad - Project Effects and Rationale

Effects of the proposed action to *Valerianella nuttallii* are considered here based on the habitat present within the analysis area and the species' potential occurrence within the analysis area (ANHC 2007, USDA Forest Service 2005b). There is an abundance of habitat within the analysis area that may be suitable for the Nuttall's cornsalad. However, Nuttall's cornsalad was not found during field surveys and the species has not been documented within 1000 feet of the analysis area. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. Utilization of forest-wide standards for herbicide application, such as buffer zones within 60 feet of plant locations, should minimize any possible effects on this species.*V. nuttallii* (USDA Forest Service 2005a).

Manual maintenance of ROWs should simulate the effects of fire on this species and help maintaing favorable conditions for it.

Ozark Cornsalad (*Valerianella ozarkana*)

Environmental Baseline

Valerianella ozarkana is a rare annual herbaceous flowering plant endemic to the Interior Highlands of Arkansas, Oklahoma and Missouri (ANHC 2007). Ozark cornsalad habitat is described as sunny openings in deciduous wooded bottoms along intermittent streams, limestone and dolomite glades and rocky, open forests (MDC 2000b, USDA Forest Service 2005b).

The greatest threat to the Ozark cornsalad is its narrow range, which is restricted to the Interior Highlands region. Also, *V. ozarkana* is dependent on open woodland and glade habitat, which may be lost to the encroachment of woody species in the absence of fire or other disturbance (ANHC 2007, NatureServe 2006, MDC 2000b).

Ozark Cornsalad - Survey Information

Ozark cornsalad native range includes The Interior Highlands of Arkansas, Oklahoma and Missouri (ANHC 2007, NatureServe 2006). Within the analysis area *V. ozarkana* has been documented in Baxter, Benton, Madison, Stone and Washington Counties of Arkansas.

Surveys for Ozark cornsalad were conducted along power line ROWs within the analysis area and extended approximately 100 feet on either side of the center line. Field surveys were conducted in two sessions to maximize the likelihood detecting the plant during the flowering period. No Ozark cornsalad populations were discovered during field surveys. Further surveying for the species is not necessary to strengthen the determination of effects that might result from this project.

Ozark Cornsalad - Project Effects and Rationale

Effects of the proposed action to Ozark cornsalad considered here based on the habitat present within the analysis area and the species potential occurrence within the analysis area (ANHC 2007). There is an abundance of habitat within the analysis area that may be suitable for the Ozark cornsalad. However, *V. ozarkana* was not found during field surveys and the species has not been documented within 1000 feet of the analysis area. Although the species may potentially be present in the analysis area, the proposed action involves direct application of herbicide to woody species stems or spot spraying of individual plant foliage only. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. Utilization of forest-wide standards for herbicide application, such as buffer zones within 60 feet of plant locations, should minimize any possible effects on *V. ozarkana* (USDA Forest Service 2005a).

Manual maintenance of ROWs should simulate the effects of fire on this species and help maintaing favorable conditions for it.

Ozark Least Trillium (*Trillium, pusillum* var. *ozarkanum*)

Environmental Baseline

Trillium pusillum ***Trillium, pusillum* var. *ozarkanum*** is a perennial, herbaceous, flowering plant of conservation concern, endemic to the Interior Highlands of southern Missouri, Arkansas and southeastern Oklahoma (NatureServe 2007, ONHC 2007). The species *Trillium pusillum* is segregated into numerous varieties, depending on the authority followed. Within its range in Missouri, Arkansas and Oklahoma, only var. ozarkanum is reported and should not present identification problems with related taxa to the east (NatureServe 2007). Ozark least trillium differs from the other species of *Trillium* by its pedicelled flowers with white to pinkish-white petals that darken to rose-pink as they mature (Roe 1978).

Ozark least trillium usually occurs on the slopes of dry-mesic upland forest in cherty soils over calcareous substrates, dominated by an oak-hickory assemblage, but also reported from mixed hardwood-pine forests (ANHC 2007, MDC 2007, Steyermark 1963). Optimum habitat appears to include a partially open canopy. Thompson (1977) described its habitat in the Boston Mountains of Newton County, Arkansas as mixed mesophytic hardwood forest. Tucker (1983b) stated that while shade is absolutely essential, this taxon appears to be favored in woods that are not extremely dense and with a relatively light herbaceous cover value. Forests with a minimum of ground disturbance appear to support larger populations than those having either no disturbance for long periods of time or those having excessive disturbance (MDC 2007).

One of the greatest threats to *Trillium, pusillum* var. *ozarkanum* at many sites is loss of native ground flora due to colonization by aggressive non-native species (MDC 2007). The species is also threatened by the loss of habitat as a result of logging, land conversion and improper use of herbicides (ONHC 2007). Although known populations have not been intensely followed over a substantial period of time, Tucker (1983b) reported that populations within the heart of the range of Trillium pusillum var. ozarkanum in northwest Arkansas appear stable. However, several large populations of have been destroyed in northwest Arkansas by water impoundments and "with urban growth and land clearing activities" (Tucker 1983b). Many sites are being encroached on by development, and their long-term survival is questionable (NatureServe 2007). In Missouri, at least one known site was destroyed to build a golf course (Morgan 1980b).

Ozark Least Trillium - Survey Information

Trillium pusillum var. ozarkanum appears to be restricted to the Ozark and Ouachita Mountains of the Interior Highlands of southern Missouri, Arkansas and southeastern Oklahoma (NatureServe 2007, Roe 1978). The taxonomy of the entity reported as *T. pusillum var. ozarkanum* from Kentucky and Tennessee is in question and is probably not the same entity (Freeman 1994). Tucker (1983b) estimated 20,000-30,000 individuals (including seedlings) to exist in Arkansas. Populations range in size from relatively small with only a few individuals, to sites containing several thousand in Arkansas and Missouri (NatureServe 2007). Within the analysis area Ozark least trillium has been documented in Benton, Madison, Newton, Washington Counties in Arkansas (ANHC 2007). No Ozark least trillium populations were documented during surveys. Further surveying for Ozark least trillium is not necessary to strengthen the determination of effects on the species that might result from this project.

Ozark Least Trillium - Project Effects and Rationale

Effects of the proposed action to Ozark least trillium are considered here based on the habitat present within the analysis area and its potential occurrence within the analysis area (ANHC 2007). There is an abundance of habitat within the analysis area, which may be suitable for the species; however, Ozark least trillium has not been documented within 1000 feet of the analysis area. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody, tall growing species stems or spot spraying of individual plant foliage within analysis area ROWs only. Because shade is essential to this species, Ozark least trillium is not likely to occur within analysis area ROWs. Herbicide will not be broadcast, subsequently reducing impacts to non-target plant species. Utilization of forest-wide standards for herbicide application, such as buffer zones within 60 feet of plant locations, should minimize any possible effects on *Trillium pusillum var. ozarkanum*.

Maintenance of ROWs by mechanical methods would continue a disturbance pattern detrimental to Ozark least trillium.

Narrowleaf Ironweed (*Vernonia lettermannii*)

Environmental Baseline

This endemic species is known only from western Arkansas and eastern Oklahoma within the Ouachita Mountain Region. This species occurs on gravel bars and rock ledges along 5th order perennial streams within the Ouachita, Cossatot, Fourche LaFave, and Poteau River drainages in Arkansas and the Mountain Fork River drainage in Oklahoma. This species was first reported to

occur within a riparian area within a shale glade. New data and locations show that the habitat for the ironweed is riparian but is not limited to those areas adjacent to shale glades (USDA FS 2005b).

Narrowleaf ironweed - Survey Information

Trillium pusillum var. ozarkanum appears to be restricted to the Ozark and Ouachita Mountains of the Interior Highlands of southern Missouri, Arkansas and southeastern Oklahoma (NatureServe 2007, Roe 1978). The taxonomy of the entity reported as *T. pusillum var. ozarkanum* from Kentucky and Tennessee is in question and is probably not the same entity (Freeman 1994). Tucker (1983b) estimated 20,000-30,000 individuals (including seedlings) to exist in Arkansas. Populations range in size from relatively small with only a few individuals, to sites containing several thousand in Arkansas and Missouri (NatureServe 2007). Within the analysis area Narrowleaf ironweed has been documented in Scott County in Arkansas. A population of the Narrowleaf ironweed is documented next to an area proposed for treatment (ANHC 2007). Further surveying for Narrowleaf ironweed is not necessary to strengthen the determination of effects on the species that might result from this project.

Narrowleaf ironweed - Project Effects and Rationale

Effects of the proposed action to Narrowleaf ironweed are considered here based on the habitat present within the analysis area and its potential occurrence within the analysis area (ANHC 2007). There is habitat within the analysis area it has been documented within 100 feet of the analysis area. Although the species may be present in the analysis area, the proposed action involves direct application of herbicide to woody, tall growing species stems or spot spraying of individual plant foliage within analysis area ROWs only. Utilization of forest-wide standards for herbicide application in or near streamside zones should minimize any possible effects on *the* ironweed.

There would be no change in impacts with manual treatment of ROWs.