# Buttermilk Hill/Talbott Hollow Blowdown Project
# Fire and Fuels Working Paper

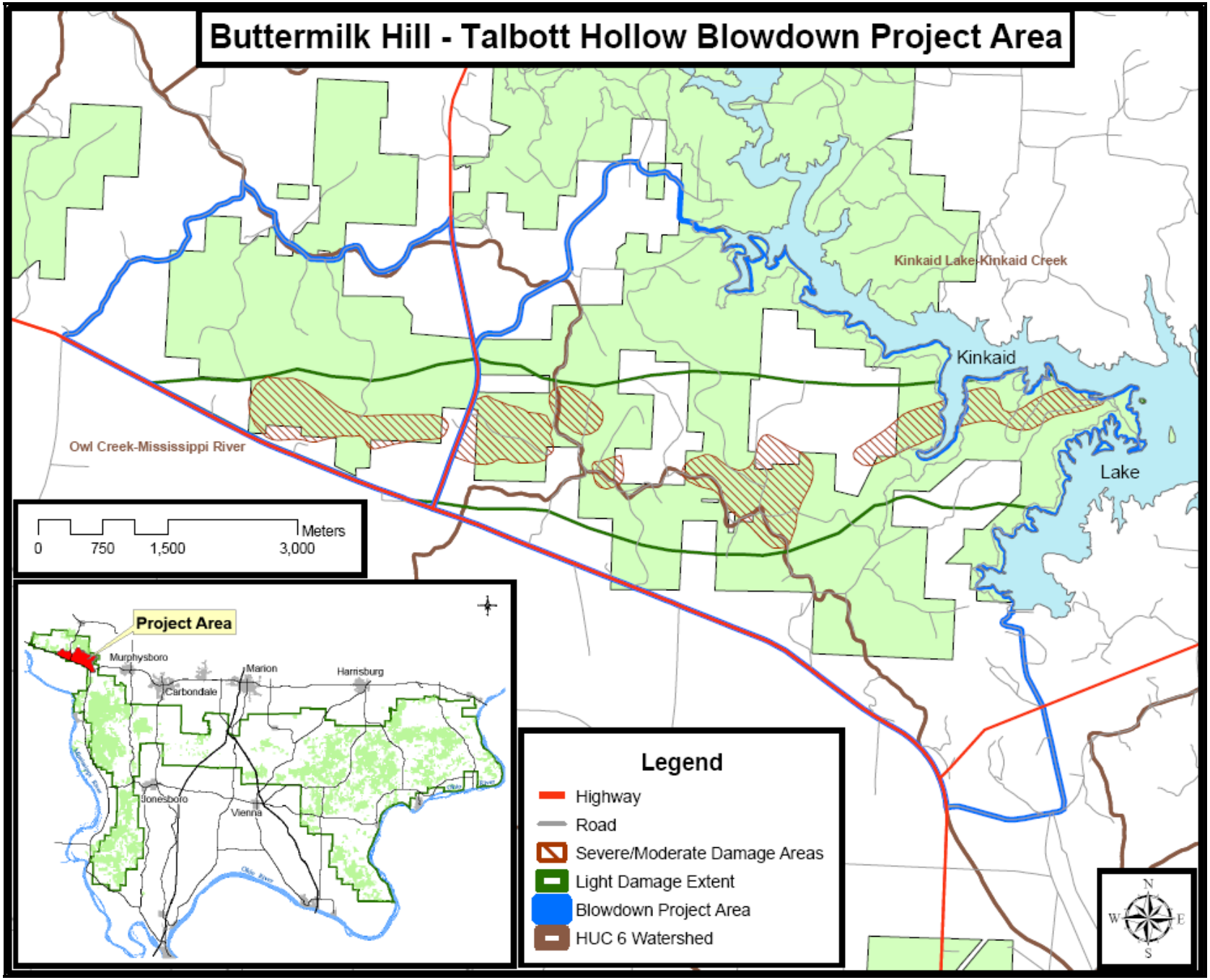
## Introduction

The Mississippi Bluffs Ranger District of Shawnee National Forest (Forest) proposes to burn approximately 5650 acres of private and National forest lands in the Buttermilk Hill/Talbott Hollow Blowdown Project. It also proposes about 25 acres of chipping and mastication on private land near at risk structures to reduce fuel loads prior to burning. This paper describes the current and desired future conditions regarding Fire Regime Condition Class (FRCC), and the expected direct, indirect, and cumulative effects to fuels resources and FRCC of implementing the proposed action and of the "No Action" Alternative.

**Background and Project Area:** In late September a tornado crossed parts of Jackson County, Illinois, affecting approximately 3800 acres of private land and Shawnee National Forest land in T8S, R3W, Sections 19 and 28-33, T8S, R4W, Sections 20-29, 33-36, T9S, R3W, Sections 5-6, and T9S, R4W, Section 1. In several places moderate and severe canopy damage (areas estimated to have greater than 50% of the ground covered in trees) was sustained, totaling approximately 900 acres. Approximately 800 acres of this was on National Forest System (NFS) lands. The severe damage was mapped from the air and divided into five distinct areas. A sixth was added after additional ground reconnaissance. Unusually for tornado damage, many trees were "snapped off" about 8-15 feet from the ground, leaving heavy fuel loadings locally and many future snags. Over a wider area light damage resulted, such as occasional broken limbs, tops, and isolated windthrown trees and clusters of trees. The extent of light and scattered damage was also surveyed and mapped from the ground (Map 1).

The area of largest severe canopy damage (area 1) has heavy loadings of large fuels of mostly yellow poplar, American beech, and mixed oak species, though little carrying fuels were left initially. In the other five areas canopy damage was scattered and discontinuous among most mature and immature hardwood stands, though there are isolated heavy concentrations of fuels throughout. However, pine plantations, particularly White Pine, within areas 2, 3, and 4 were decimated. High 1000-hr fuel loadings and nearly continuous conifer slash in these stands could pose control problems for fire suppression operations.

Several ideas for treating the resulting changed conditions were posited by the Forest Service, including salvage timber harvests, mechanical fuels reduction, prescribed burning, commercial and non-commercial firewood sales, and allowing private landowners to treat their lands without any federal assistance. Prescribed burning was chosen as the cornerstone of the treatment proposal due to its expected relative lack of controversy, lower implementation costs, the rapidity with which planning might be accomplished, and the ecological benefits associated with it. Given the topography and alignment of roads, the potential burning area was expanded beyond the light and heavy




**Map 1. Project Area Map.**

damage areas to the nearest easily defendable control line such as a paved road or the shore of Lake Kinkaid. The project area therefore is bounded by State Highways 3 and 149 on the south, Kinkaid Lake and Spillway Rd on the east and northeast, Forest Rd 638C, Gum Ridge Rd, and Dry Hill Rd on the north, and Logan Hollow Rd on the west. The project area lies in the Kinkaid Lake - Kinkaid Creek, Owl Creek – Mississippi River, and the Worthen Bayou 6th Hydrologic Unit Code (HUC) watersheds. The project is within the Greater Shawnee Hills Ecological Subsection, and has been further types as Land Type Association 1 (West Deep Loess).

Nationally, the realization of the need to reduce wildland fire risks to communities and natural resources and restore healthy ecosystems had grown steadily. After several record-setting fire seasons in the 1990s and 2000s, renewed emphasis was placed on reducing risks by many land management agencies and organizations at all levels and locations throughout the country. For the USDA Forest Service and the Department of Interior, this was embodied by the National Fire Plan, Healthy Forests Initiative, Healthy Forest Restoration Act, *Protecting People and Sustaining Resources in Fire-adapted Ecosystems:* A *Cohesive Strategy*, and *A Collaborative Approach for Reducing Risks to Communities and the Environment: 10-Year Strategy* and its *Implementation Plan*, and other policy and direction. One of the fundamental tenants behind this strategy was that it would take collaboration on many levels and with many stakeholders to succeed, as fires and ecosystems do not observe political or ownership boundaries.

## Desired Future Conditions

Desired future conditions for Shawnee National Forest lands in the project area are found in the Shawnee National Forest Land and Resource Management Plan. In general, Forest resources are to be managed at the ecosystem and landscape scale in a sustainable manner, and in such a way that biological diversity and ecosystem integrity is maintained and restored. This project is located within the Even-Aged Hardwood Forest (EH) and the Water-Supply Watershed (WW) Management Areas. Desired Future Conditions for these areas are based on the best available science concerning the nature of the ecosystems and the outputs demanded by the public from current resources. These conditions are described below.

### Even-Aged Hardwood Forest (EH)

Overall, the even-aged hardwood forest is a natural appearing landscape with stands of hardwood trees in various age and size classes interspersed with both permanent and temporary openings. Stands range from seedlings to mature age and vary in size and shape. Oak and hickory and associated understories dominate. The land supports a variety of wildlife, ranging from species that utilize early successional stages to those requiring mature-stand characteristics. Because some trees may be up to 200 years old prior to harvest, the areas display some old-growth characteristics, such as multi-layered canopy, large snags, cavities and large fallen logs (Forest Plan Ch. V, page 59).

- Oak-Hickory composition objectives vary by ecological units as listed below:

- Greater and Lesser Shawnee Hills LTA's 1, 2, 4, 5, 7 -- 70-90% in uplands and 30-90% on low slopes and alluvial plains (Forest Plan Ch V, page 59).

In addition, the Forest Plan gives the following direction for the EH Management Area:

- Management provides for maintenance of the oak-hickory forest-type and ecological restoration of areas that have been planted with non-native pine… Management activities that may be seen include prescribed burning… (Forest Plan Ch V, page 59).

**Water-Supply Watershed (WW)**

Management emphasis is on protection of water supplies through implementation of filter-strip guidelines, best-management practices, shoreline-stabilization and the restriction of new road construction… The forest is a landscape of predominantly hardwood trees. Because some trees may be up to 200 years in age, the areas display some old growth characteristics, such as multi-layered canopy, large snags, cavities and fallen logs. Management will be used to maintain or restore the oak-hickory ecosystem (Forest Plan Ch. V, page 90).

- Acceptable composition ranges: Oak and hickory should range from 70 to 90 percent in the uplands and 30 to 90 percent on low slopes adjacent to stream terraces and floodplains (Forest Plan Ch. V, page 90).

## Need for Change Statement (Why Propose a Project?)

Current fuel loadings would increase the intensity and severity of any wildfires that could take place, leading to higher risk to private property and natural, cultural, and human resources. Fires in this area could experience higher rates of spread, higher intensities, longer and more profuse spotting, and would therefore inevitably grow larger and cost more to suppress. Since the project area lies partially within a municipal watershed and is surrounded by and in some cases envelops private land and property, such a wildfire is not desirable. Changes in fuel properties are needed to avoid negative impacts from such a fire.

Oak and hickory regeneration in most of the area is not adequate to maintain its dominance in the stand. Seedlings of these species cannot survive in the intense shade created by planted pines and invading shade-tolerant native and non-native species. As all stands tend towards climax maple-beech forests, there is a loss of landscape and community diversity, and a corresponding loss of plant and animal diversity, including some that are unique and special. Non-native invasive species are found in the area and further contribute to degraded ecosystems.

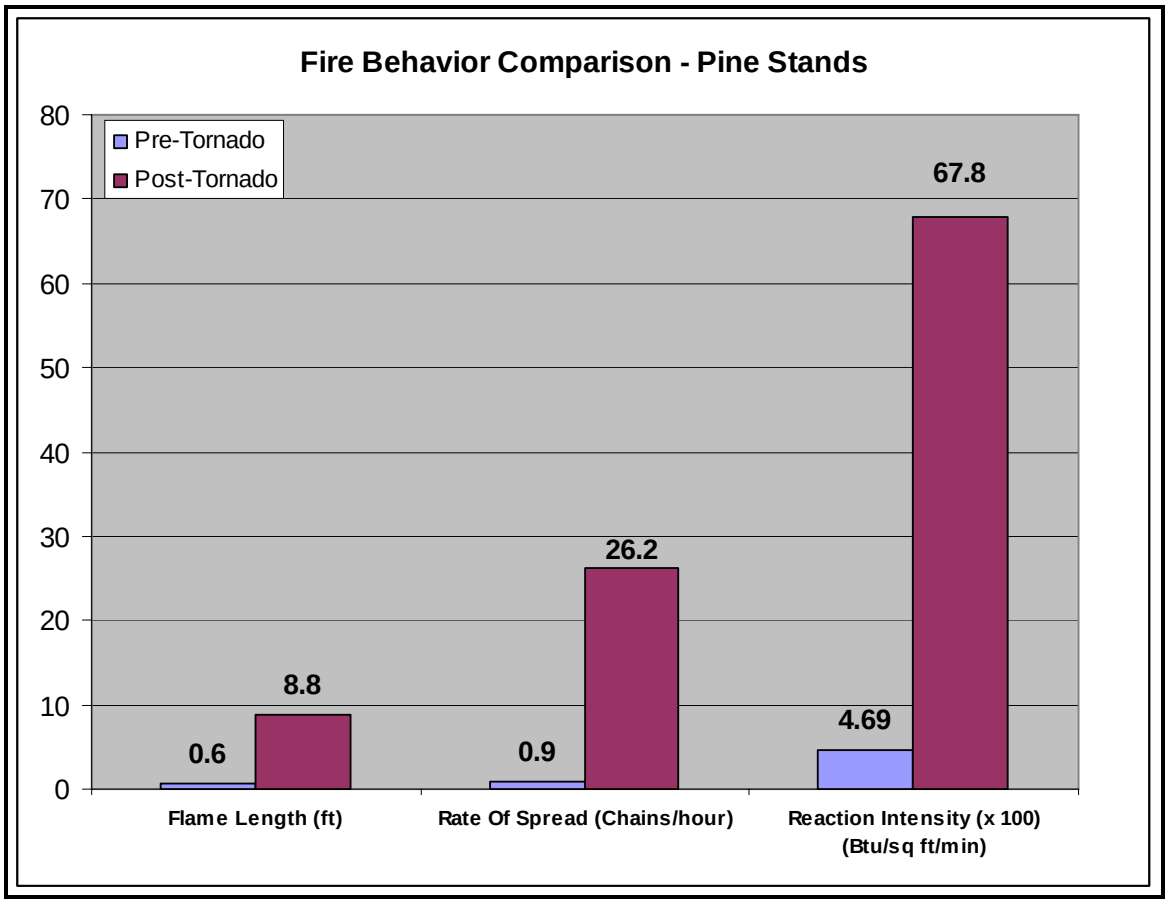



**Figure 1. Predicted fire behavior outputs for undamaged and heavy damage pine stands.**

**Objectives:**

- To reduce the risk of a severe wildfire:
  - Reduce amount and continuity of fuels.
- To begin to restore a healthy native hardwood forest:
  - Stimulate germination and growth of sun-loving species (oak and hickory),
  - Maintain and/or improve natural community diversity and species richness, and
  - Reduce non-native invasive species.

## Project Description

### Alternative 1 - No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. No prescribed burning, fireline construction or mechanical fuel treatments would be implemented to accomplish project goals.

**Alternative 2 - The Proposed Action**

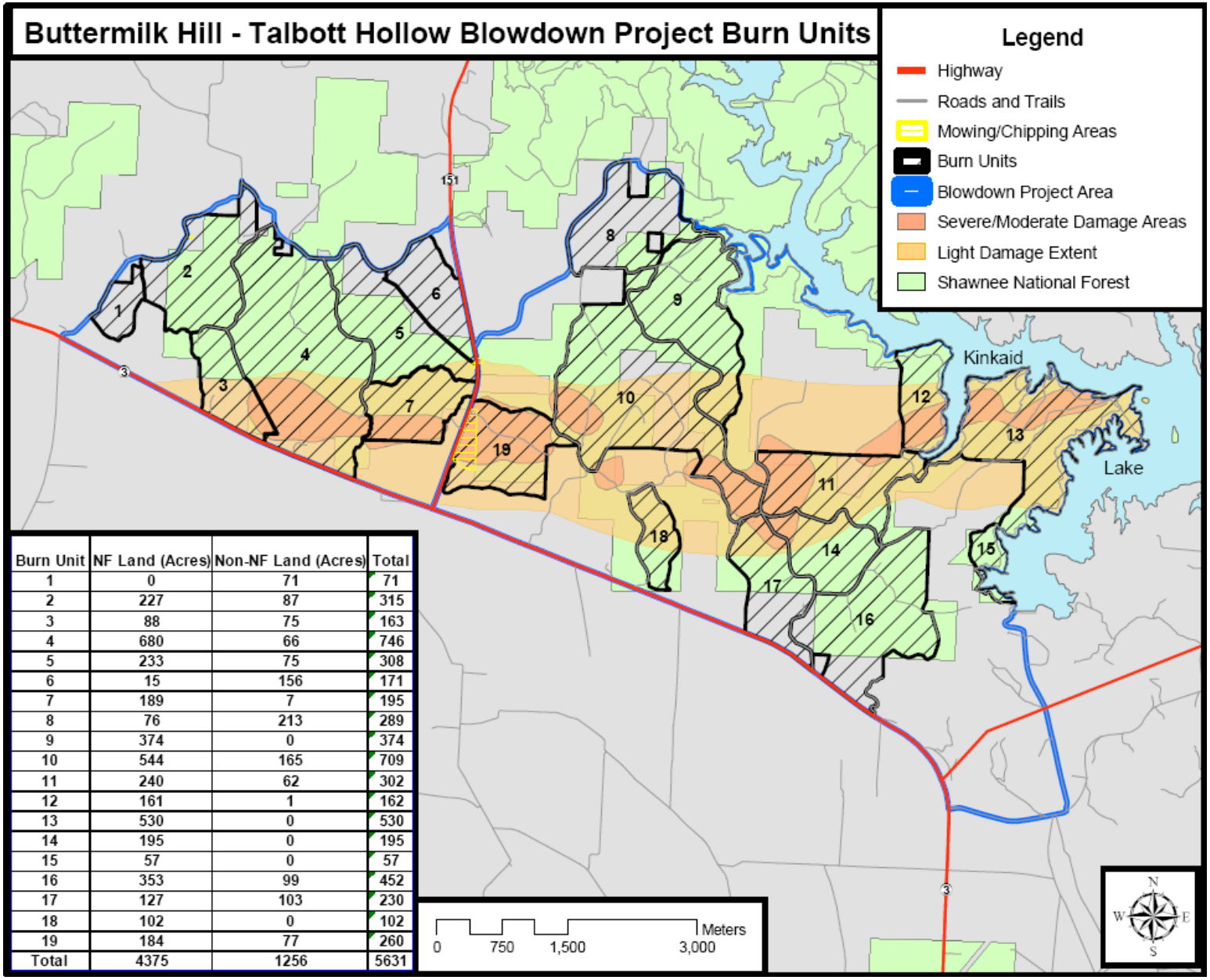
Under Alternative 2, the Proposed Action, the following would occur:

1. Prescribed fire treatment of up to approximately 5650 acres of private lands and NFS lands. The project area would be subdivided into several burn units to make burns more manageable (see Map 2), yet keeping unit size large enough to mimic presettlement fire regimes and keep per acre costs down. Burns will be lit with handheld devices or from the air using a plastic sphere dispenser or helitorch.
2. Construction of up to 11 miles of firelines where necessary to contain the burn, taking advantage of pre-existing control lines where possible. Where lines must be constructed, hand-raking or leafblower lines are preferred, but up to two miles of the total may be constructed with bull dozers. Dozer line may be needed near heavy fuel concentrations, structures, and other areas of high value.
3. Mow, chip, cut and pile or scatter, or remove firewood from the vicinity of certain structures (approximately 25 acres total) to create defensible space prior to burn implementation. Other miscellaneous structure protection measures such as moving woodpiles or debris, establishing hoselays or sprinkler systems, or blowing leaves away from outbuildings may be necessary prior to or during burn implementation. Work would be accomplished through landowner contribution, contract, or force account.
4. Monitor vegetation response to fire to ensure project objectives are met, and if not, to help revise burn prescription or project design.

Burns would be conducted between September 1 and May 1. First entry on all units would be made within two years if possible. Successive burns would be made after 2-5 years. Burn frequency may be adjusted if monitoring shows that the desired future condition is already reached or is not going to be reached within 10-15 years. Approximately three burns per unit are anticipated.

| Comparison of Alternatives | Alternative 1 (No Action) | Alternative 2 (Proposed Action) |
|---|---|---|
| Acres Treated with Prescribed Fire | **0** | **5650** |
| Miles of Hand-dug Fireline Constructed (Maximum) | **0** | **11.0** |
| Miles of Dozer-built Fireline Constructed (Maximum) | **0** | **2.0** |
| Acres Mechanically Treated | **0** | **25** |

**Table 1: Comparison of Alternatives**




| Burn Unit | NF Land (Acres) | Non-NF Land (Acres) | Total |
|---|---|---|---|
| 1 | 0 | 71 | 71 |
| 2 | 227 | 87 | 315 |
| 3 | 88 | 75 | 163 |
| 4 | 680 | 66 | 746 |
| 5 | 233 | 75 | 308 |
| 6 | 15 | 156 | 171 |
| 7 | 189 | 7 | 195 |
| 8 | 76 | 213 | 289 |
| 9 | 374 | 0 | 374 |
| 10 | 544 | 165 | 709 |
| 11 | 240 | 62 | 302 |
| 12 | 161 | 1 | 162 |
| 13 | 530 | 0 | 530 |
| 14 | 195 | 0 | 195 |
| 15 | 57 | 0 | 57 |
| 16 | 353 | 99 | 452 |
| 17 | 127 | 103 | 230 |
| 18 | 102 | 0 | 102 |
| 19 | 184 | 77 | 260 |
| Total | 4375 | 1256 | 5631 |

**Map 2. Blowdown Burn Units.**

# Description of Project Area Resources

## Fire Regime Condition Class - Desired and Current Conditions

From the perspective of fuels and vegetation resources, desired future conditions are those in which the characteristics of the vegetation and processes that shaped it are allowed to function as it did historically, while minimizing unwanted consequences to the human environment. Thus we need to study past conditions to learn how to achieve desired future conditions. Restoration ecologists and fire managers have developed a standardized terminology and a methodology to describe the health, resilience, and integrity of ecosystems, incorporating disturbance, succession, and other ecological concepts. This is called Fire Regime Condition Class (FRCC). It is called "Fire Regime Condition Class" to reflect the keystone role fire plays in many ecosystems, but it is meant to include vegetation dynamics, multiple types of disturbance, landscape patterns, and the complex interrelationships of all of these (www.frcc.gov). It uses two factors to diagnose departure from reference conditions: 1) Vegetation Composition and Structure, and 2) Changes in fire regime (e.g. Fire Frequency, Extent, and Severity under natural conditions, which include aboriginal use of fire and other disturbances but not Euro-American influences). The degree of departure is known as Condition Class. This section will be used to describe current conditions, including FRCC, for the project areas. The predicted effects to FRCC and other fuels characteristics such as fuel loading and continuity, and fire behavior characteristics such as Flame length (FL) and Rate of Spread (ROS) will be discussed for each Alternative in later sections.

### Vegetative Composition and Structure

Over the past 200 years, environmental changes have affected the quantity, distribution and composition of plant communities in Illinois. In the past, disturbances such as tornadoes, fire and primitive agriculture created and maintained a mosaic of plant communities. Community type was strongly influenced by the frequency and severity of fires, as well as topography (Anderson 1991). Higher frequency/severity fire regimes were associated with flatter areas and grassy systems, with topographical roughness serving to slow fire spread (Stambaugh and Guyette 2007). Prior to Euro-American modification, vegetation in Illinois was dominated by tallgrass prairie in the flatter portions (typically, the northern ¾ of the state), forests in the more steeply dissected, unglaciated, or river-break areas, and savannas or woodlands on intermediate sites. The ecotone between forest and prairie was abrupt in some places, but more often was not, with intrusions of forests and savannas into the prairie province, and areas of prairie and savanna occurring in a matrix of forest (Anderson 1991). Further, these "soft" edges likely shifted over time and space as the extent and intensity of disturbance regimes changed (Packard and Mutel 1997). Recurrent fire and occasional canopy disturbance in forests, woodlands, and savannas seem to be the mechanism that allowed for continuous oak recruitment for at least 5000 years (Lorimer 1985).

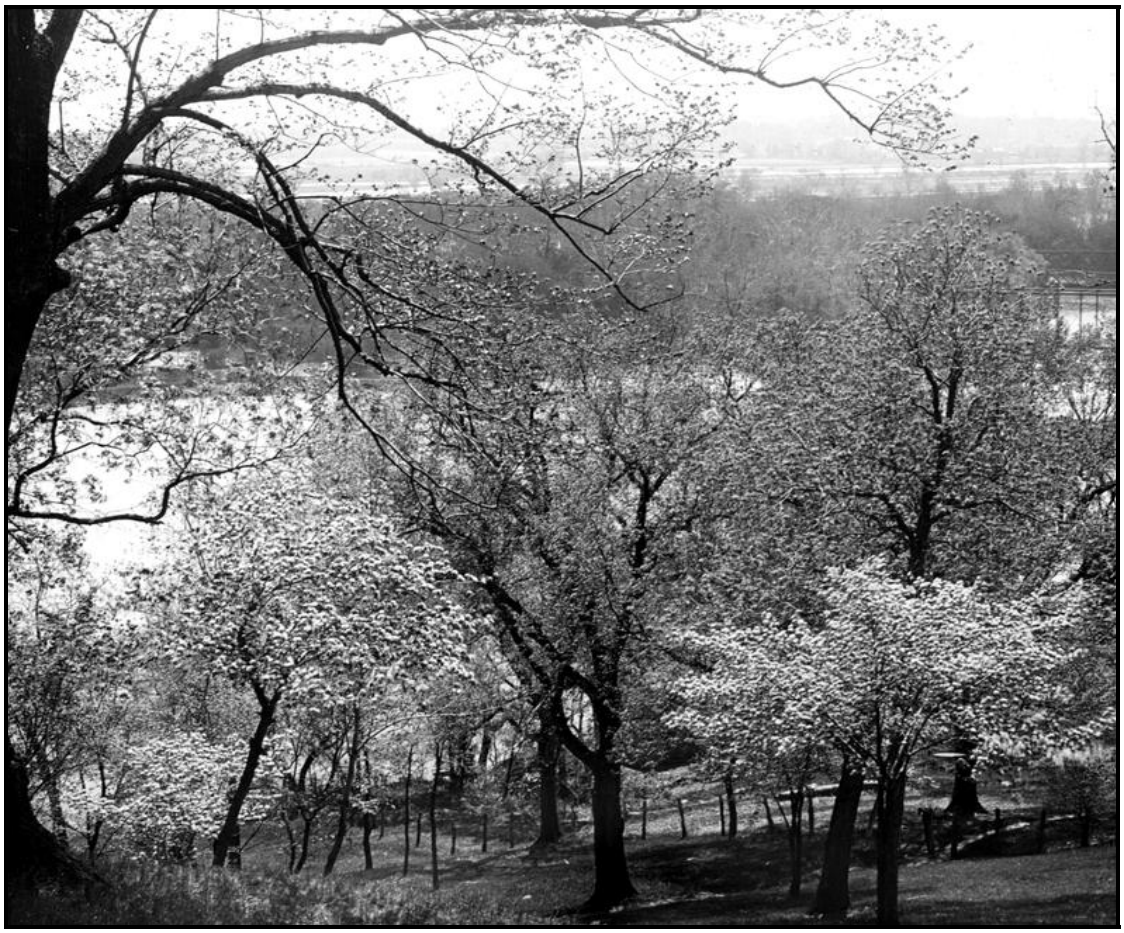


**Figure 2. The Pine Hills in 1920. Note the scattered trees and open character of the understory and the low stem density. Photo by Paul J Sedgwick (courtesy University of Chicago Library, Special Collections Research Center).**

Fralish et al (2002) summarized several earlier works and extensively reviewed General Land Office (GLO) survey notes from 1806-1810 as part of the reconstruction of presettlement forest communities of the Shawnee National Forest. For all stands in the Greater Shawnee Hills Ecological Subsection, Land Type Association 1 (LTA1), which includes the project area, white oak had the highest importance values (42.5%), followed by black oak (17.4%), and hickory (8.8%). Mesophytic species had an importance value of 25% as a group, though no single species had an importance value higher than 4.5% (yellow-poplar). Presettlement forests were mostly composed of rather large trees, with medium – high stocking. Witness trees averaged 15.8" dbh. Stand stem density was 77 trees per acre, yielding a basal area of ~106 $ft^2$/acre. Importance values for the oak-hickory group were much higher when considering the four drier Ecological Land Types (ELTs). Oak importance values decreased from the Southwest ELT (83.7%) to 50.6% on the Alluvial ELTs, with a corresponding increase in mesophytic species importance (Table 2). This and many other studies throughout the eastern biome highlight the overwhelming dominance of oaks and other shade intolerant species, especially on drier sites.

| Characteristic | Southwest | South | Ridgetop | North | Low | Alluvial | **Total** |
|---|---|---|---|---|---|---|---|
| Number of Witness Trees | 149 | 250 | 606 | 354 | 472 | 234 | **2063** |
| Species Richness (# of species) | 15 | 17 | 19 | 19 | 23 | 26 | **32** |
| Oak Species Importance Values | 83.7 | 81.9 | 76.9 | 72.2 | 70.2 | 50.6 | **69.2** |
| Mesophytic Species Importance Values | 14.0 | 15.4 | 16.0 | 22.2 | 24.1 | 43.8 | **25.0** |
| Tree Quadratic Mean Diameter (In) | 16.1 | 15.0 | 15.3 | 16.4 | 15.9 | 16.7 | **15.8** |
| Density (# of trees/acre) | 58 | 87 | 66 | 84 | 87 | 95 | **77** |
| Basal Area ($ft^2$/acre) | 81.8 | 107.2 | 83.1 | 122.6 | 119.4 | 144.2 | **105.6** |

**Table 2. Stand characteristics of the Ecological Land Types (ELTs) in the Greater Shawnee Hills, Land Type Association 1. Adapted from Fralish et al 2002.**

## Fire Frequency and Extent

Tree ring analysis, pollen cores, pioneers' and early travelers' accounts, and historical records all show that prior to the rise of modern American culture, fire was a much more familiar visitor to the central hardwoods landscape, including the Shawnee National Forest, than it is now. Oak and other deciduous tree species first appeared about 11, 500 years BP following the retreat of the Wisconsinan ice sheets, and prairies expanded into the region during the warm, dry, Hypsithermal period that occurred about 8500-5000 years BP (Franklin 1994). Prairies and savannas were invaded in places by woody species following the Hypsithermal, so that at about 2000 years BP forests of the region were likely characterized as oak-hickory and mixed-mesophytic, with inclusions of prairie, savanna, glades, and barrens (Fralish et al 1991). Native Americans were in the area by this time and undoubtedly had an affect on vegetation types, including using fire. However, Euro-Americans seemed to have used fire even more frequently. Parker and Ruffner (2004) report that mean fire return interval (MFI), or the time on average that fire occurs on a site, actually decreased on a southern Indiana barrens from 23 years before settlement to 5 years after. Fire intervals in the Missouri Ozarks similarly decreased from about 11.96 +/- 2.4 years to 3.64 +/- 0.35 years (Guyette and Cutter 1997). Note that this is a long-term average, rather than an exact period. Fires likely occurred more frequently sometimes, less frequently others. Using stumps from four study areas in the western part of southern Illinois, Robertson and Heikens (1994) found fire frequency diminished dramatically after about 1930, perhaps in concert with organized fire protection. The oldest scars were ~130 years old, but dating tree age proved difficult due to the decayed heartwood. Of the 80 fire scars discovered, only nine had occurred in the last 60 years. Pointedly, 65 scars had occurred in the previous 60 years. At the Big Ranch site (USDA Forest Service owned and within the Illinois Ozarks Subsection), the composite MFI would have been 4.6 years in the 60 years prior to 1930, whereas only 1 fire scar was recorded in the subsequent 60 years. Interestingly, different areas within the site showed different years of fire scarring. This suggests either that some trees were not scarred as fire passed, or that that particular area did not burn. Fires are known to be quite variable

in their tendency to induce scarring and to leave islands of unburned fuel, which can sometimes be quite extensive within the fire perimeter. Since not all trees are scarred in a fire, it is likely that we are actually underestimating fire frequency. Due to the absence of suitable trees in Illinois (most were logged, cleared, or have decayed), the dendrochronological record of fire frequency is not near as complete in Illinois as it is in Missouri and other states. However, inferences can be made using historical accounts and empirical data from nearby areas with similar climatological, vegetative, and human occupancy characteristics.

Guyette et al (2006) found a strong correlation between human population density and fire frequency. In a study in the Arkansas Ozarks, for instance, MFI increased to a maximum of about 1.43 at the height of Cherokee population density. He also found strong relationships with climate variables including mean annual temperature, and drought and inversely with topographic roughness. Higher mean annual temperatures yield greater vegetation (fuels) growth rates, longer growing season, and longer periods of vegetation flammability. Droughts cause a grater portion of the fuel bed to be available to burn. Droughts seem to be related to both high fire occurrence numbers and large fire occurrence. Topographic roughness is thought to hamper fire spread by causing the fire to back slowly downhill at least at times, by hindering spread because of rock outcrops or fuel discontinuities, or providing an aspect-driven higher moisture area (Stambaugh and Guyette 2007, Guyette et al 2006, Anderson 1991).

It is important to note that tree-ring records are only reliable indicators for fire occurrence where there are trees to scar. In grassland areas such as prairies, barrens, and savannas, there are no fire scars, but fire was clearly there. Woody encroachment ensues almost immediately following cessation of burning or other disturbances, especially on rich sites. In a southern Illinois barren, nearly annual prescribed fires initially expanded the importance of prairie associated species, but after 14 years without fire tree basal area had more than doubled and stem density increased 67% (Anderson et al 2000). Al large body of work has been conducted on shortleaf pine stands as well. Batek et al (1999) found that mean fire-free periods increased from about 6 years in the lower sections of the Current River watershed to about 12 years in the upper, more topographically rough sections of the study area. Fire frequency also increased to 12 years on the north and east (lee side from the prevailing wind) sides of the river.

Data is poor concerning fire extent in presettlement times. Other studies in the interior west and Midwestern prairies suggest the average fire “patch size” to be extremely large compared with modern fire size. Ladd (2007) puts this reduction at 1% to .01%. Miller (1920) found evidence of widespread fire activity in southern Illinois, including the Illinois Ozarks. From the top of Bald Knob, he could see six separate smoke columns on March 23, and numerous smoldering patches on adjacent hillsides. He estimated that two square miles (~1280 acres) were already blackened within his viewshed. He described a later trip of several miles in which the majority of ridges were burned, nearly devoid of understory vegetation, and littered with dead trees. He estimated that “fully 80% of the mature trees at Fountain Bluff, in Jackson County, and on the pine hills of Union County, show fire scars due to burning.” Fire histories in the Ozarks Highlands of Missouri and

**Figure 3. Fires as seen from Bald Knob, March 23, 1920. Photo by Paul J Sedgwick (courtesy University of Chicago Library, Special Collections Research Center).**

Arkansas reveal that widespread fires (scarring >25% of study sites) occurred every 8.5 years between 1748 and 1808, often coinciding with drought conditions. If this sample is representative of the entire [Missouri and Arkansas] Ozarks, it means "an area the size of the Ozarks (12,950,000 ha or 50,000 $mi^2$) burned about every 20 years" (Guyette et al 2006). Similar spikes in fire occurrence and extent occur today on the Shawnee, but to a much lesser extent (see Figure 4).

A strong majority of approximately 80-90% of fires occurred during the dormant season (Grissino-Mayer 2007, Guyette et al 2006). It is difficult to tell climatological season of burn according to fire scar chronologies, but many early accounts place most ignitions in late summer or fall after herbaceous fuels had cured or leaves had fallen. Ladd (2007) considers that nearly "100% of [published] presettlement accounts of fire in Missouri, Illinois, and Iowa refer to annual fire, usually in autumn." An oral account of early 20$^{th}$ century burning activities in the Hutchins Creek area of Union County similarly mentions annual fall burning (USDA Forest Service). At some point during the Euro-American era the majority of burning shifted to spring, likely to improve forage for livestock and to

take advantage of longer or windier days. Lightning accounts for few fires in the region, and those that did occur probably took place in the summer. Fire records for the Shawnee NF show only 8 recorded lightning-caused fires in the past 20 years. However, some reports attribute as much as 15% of fire occurrence in the Ozark-Ouachita National Forest in the Arkansas Ozarks and across the south as lightning –caused. The Ozark-Ouachita National Forest and the Land Between the Lakes in Kentucky each have recorded multiple large scale (>1000 acre) lightning caused fires in the past four years (Fryar 2007, McCoy 2007, Personal Communication).

## Current Conditions

### Vegetation Composition and Structure

Today's ecosystems are not without disturbances, though the type and extent of disturbance has radically changed. Modern agriculture and other development have disrupted natural cycles and suppressed much of the natural plant and animal community diversity that once existed in Illinois. In some areas, major plant communities have been lost to agriculture and development. At least 1400 acres of private land in the project area had been disturbed by clearing, farming, and other activities in the past 10 years, while another 2400 acres of Forest Service land have been harvested, converted to wildlife openings, or in some way modified since acquisition. These tended to change stand structure and composition outside the range of historic variability, since areas were selectively logged, clearcut, or planted with different (often non-native) vegetation, and fire was removed as a disturbance.

Though the project area was once dominated by drought- and fire-tolerant vegetation and open stand structure, these vegetative features have in large part disappeared, and the remaining areas are rapidly changing. Each community type within the forest matrix seems to have been affected by fire exclusion. The "hill prairies" and barrens of the Greater Shawnee Hills, once dominated by a rich herbaceous layer of grassland affinities, is now heavily encroached by woody stems. This change can happen quite fast, even on low-quality sites (Anderson et al 2000). Woodlands and savannas, once dominated by widely spaced fire-resistant trees, are now nearly devoid of ground cover, mostly shaded, and without significant oak-hickory regeneration. Formerly dry forests now support multi-layered canopies of mesophytic species (Shotola et al 1992, Haugen 2003), especially in the understory and midstory. The deepening shade can have a concomitant negative impact on total species richness (Iverson and Hutchins 2002, Hutchinson et al 2005). Fires in southern Illinois sandstone barrens were found to increase herbaceous cover and total species richness, while unburned plots decreased in herbaceous cover over the same time period (Taft 2003).

| Fralish et al. Data | | | Project Data | |
|---|---|---|---|---|
| Greater Shawnee Hills | | | Greater Shawnee Hills | |
| Trees per acre | 78 | | Trees per acre | 220 |
| Basal area per acre | 105 | | Basal area per acre | 100 |
| | | | | |
| Species Importance Values | | | Species Importance Values | |
| Xerophytic Species | IV | | Xerophytic Species | IV |
| Quercus alba | 45.5 | | Quercus alba | 33.5 |
| Carya Spp. | 7.8 | | Carya Spp. | 20.1 |
| Quercus velutina | 16.8 | | Quercus velutina | 10.1 |
| Quercus rubra | 2.8 | | Quercus stellata | 4.8 |
| Other Quercus | 1.7 | | Other Quercus | 4.4 |
| SUBTOTAL | 74.6 | | SUBTOTAL | 72.9 |
| | | | | |
| Mesophytic Species | IV | | Mesophytic Species | IV |
| Acer saccharum | 1.9 | | Acer saccharum | 5.1 |
| Nyssa sylvatica | 2.0 | | Nyssa sylvatica | 4.6 |
| Liriodendron tulipifera | 2.7 | | Liriodendron tulipifera | 1.2 |
| Fraxinus spp. | 4.1 | | Acer rubrum | 2.4 |
| Ulmus spp. | 4.2 | | Sassafras albidum | 2.7 |
| Other Mesophytes | 4.4 | | Other Mesophytes | 1.3 |
| SUBTOTAL | 19.3 | | SUBTOTAL | 17.5 |
| | | | | |
| Midcanopy Species | IV | | Midcanopy Species | IV |
| Cornus spp. | 4.3 | | Cornus florida | 1.7 |
| Morus rubra | 0.7 | | Ostrya virginiana | 7.2 |
| Gleditsia triacanthos | 0.4 | | Ulmus alata | 0.7 |
| Other Midcanopy | 0.4 | | Other Midcanopy | 0.0 |
| SUBTOTAL | 5.9 | | SUBTOTAL | 9.7 |

**Table 3. Presettlement vs. current forest data for Shawnee National Forest sites in the Greater Shawnee Hills. Courtesy Paul Tikusis.**

The values found by Fralish et al (2002) for presettlement forests are far different than what is currently found on most sites in the Shawnee National Forest, including those in the project area. Tikusis (2008) found significant increases in density and compositional shifts for current forests in the Greater Shawnee Hills when compared to the Fralish et al's presettlement data (Table 3). There was a threefold increase in stem density, while volume remained nearly the same. White and black oaks showed serious declines in importance values, while red oaks and hickories increased. Age classes showed a significant shift as well. Though oak importance values remained similar, most of this figure came from the few large, remaining individuals left in dominant canopy positions. There was almost no advanced oak regeneration.

Multiple lines of evidence show that oaks, particularly those in the white oak group, are in decline throughout the region. Abrams (2003) summarized several studies to document this trend. Fralish et al (1991) found that in the Shawnee Hills, white oak occupied dominant canopy positions on 81% of all sites at the time of survey, but currently occupies 21, 30, and 53% of sites on north slopes, south slopes, and ridge tops, respectively. More alarmingly, this trend is predicted to accelerate. In a study of Shawnee National Forest data, Haugen (2003) found the total growing stock of white oak trees in the 1.0 -2.9 inch and 3.0-4.9 inch dbh categories decreased from 5.2 million to 3.7 million trees between 1985 and 1998. Though expanding in other portions of its range, red oak on the Shawnee is seeing drastic decline, due to the senescence of dominant canopy trees and the lack of recruitment into the advanced regeneration pool. In Haugen's study (2003) red oak trees in the 1.0-2.9 inch dbh size class increased 6%, while red oaks in the 3.0-4.9 inch dbh size class decreased by 60%. Conversely, black and sugar maples increased by 19% in the 1.0-2.9 inch dbh size class and 79% in the 3.0-4.9 inch dbh size class in the same time period. The invasion of maples and other mesophytic species and the subsequent decline in oak importance is both widely and thoroughly documented throughout the east (Shotola et al 1992, Abrams 2003, Brose et al 1998, Parker and Ruffner 2004, Nowacki 2008).

**Fire Frequency and Extent**

Fires still do occur in the region, and in the vicinity of the project areas. However, the spatial extent of these fires is greatly reduced from historical levels. Fire occurrence (i.e. number of ignitions) is likely much decreased, and large fires are rare.

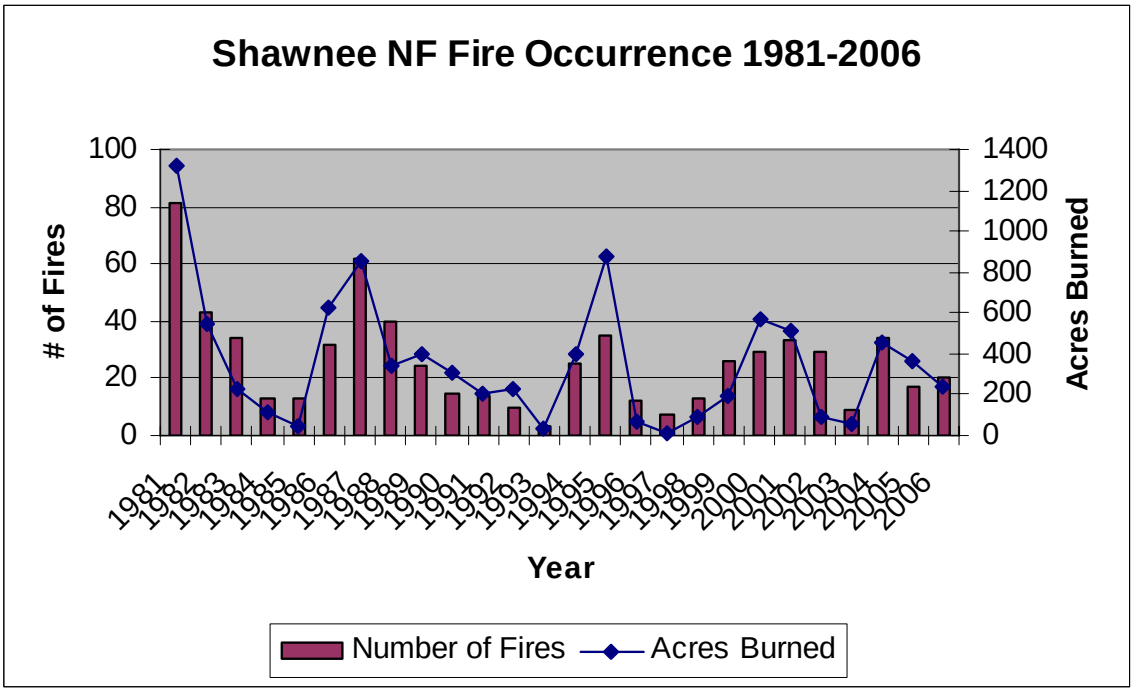



**Figure 4. Fire occurrence for Shawnee National Forest, 1981-2006.**

The two recorded fires that occurred with the project areas between 1986 and 2006 were only 1 and 2.5 acres. Since the project area covers approximately 9500 acres, this means that it would take over 54,000 years for fire to cover the entire project areas (assuming that no fires that originated outside the project areas burned into them). The subsection-wide MFI (SHF lands only) is also very long at 1540 years. It must be noted, however, that two fires of approximately 400 acres occurred in the early 1980s, one immediately east of the LaRue-Pine Hills Natural Area in the Camp Hutchins area, and one in the Cedar Lake watershed in LTA 1. Twenty fires greater than 100 acres have occurred on the Shawnee National Forest since 1971. The timing of fires is similar to that reported for the era prior to the 20$^{th}$ century. According to an analysis of fire occurrence from 1995 to 2004, 90% of the fires reported for the Shawnee National Forest occurred between September 24 and April 23 (Shawnee National Forest 2006). Fires are overwhelmingly human-caused, and multi-fire days are common (Figure 5).

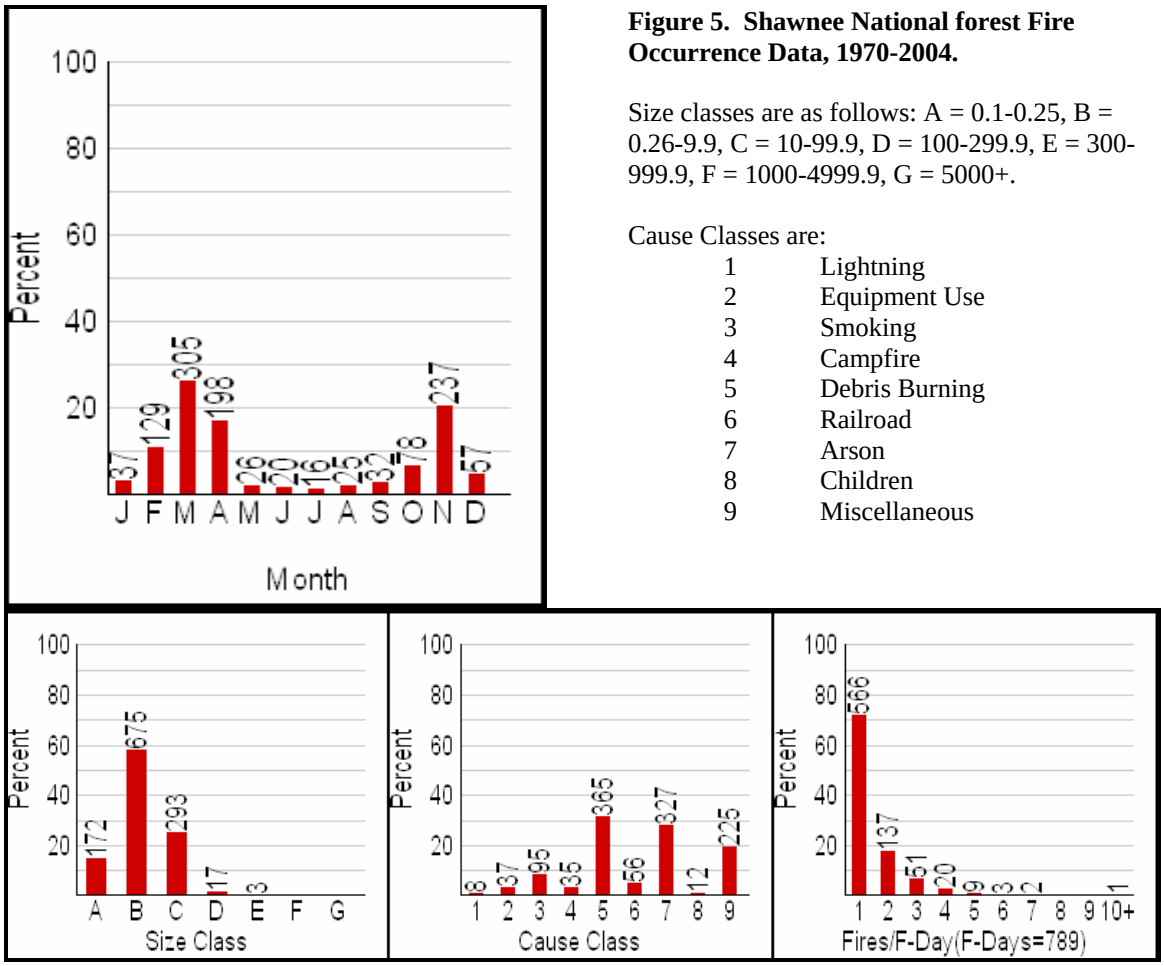



**Figure 5. Shawnee National forest Fire Occurrence Data, 1970-2004.**

Size classes are as follows: A = 0.1-0.25, B = 0.26-9.9, C = 10-99.9, D = 100-299.9, E = 300-999.9, F = 1000-4999.9, G = 5000+.

Cause Classes are:

| | |
|---|---|
| 1 | Lightning |
| 2 | Equipment Use |
| 3 | Smoking |
| 4 | Campfire |
| 5 | Debris Burning |
| 6 | Railroad |
| 7 | Arson |
| 8 | Children |
| 9 | Miscellaneous |

## Fire Regime Condition Class Determination

As stated earlier, Fire Regime Condition Class refers to the health and biodiversity of ecosystems, incorporating disturbance, ecological succession, and other current ecological concepts. It consists of the twin concepts of Fire Regime and Condition Class. Fire Regime refers to the characteristics of fire frequency, severity, extent, and possibly other characteristics of fire in a location. Condition Class is defined for a landscape as the degree of departure from a reference condition. Three condition classes have been widely adopted (Schmidt et al 2002). Condition Class 1 (FRCC 1) means the landscape has vegetation, fuels, and disturbance characteristic of the natural regime. Key ecosystem components are intact. More simply put, it is within the natural or historical range of variability. Note that here “natural or historical” includes anthropogenic disturbances up to the time of widespread Euro-American modification. Condition Class 3 (FRCC 3) indicates a high degree of departure from the reference condition, including departure from vegetation-fuel composition and fire frequency/ severity or both. There is a high risk of losing one or more key ecosystem components. Condition Class 2 (FRCC 2) indicates a moderate degree of departure and a moderate risk of losing key ecosystem components, and is somewhere between FRCC 1 and 3. Several approaches can be taken to address FRCC: locally derived midscale, landscape scale, or stand-scale assessments,

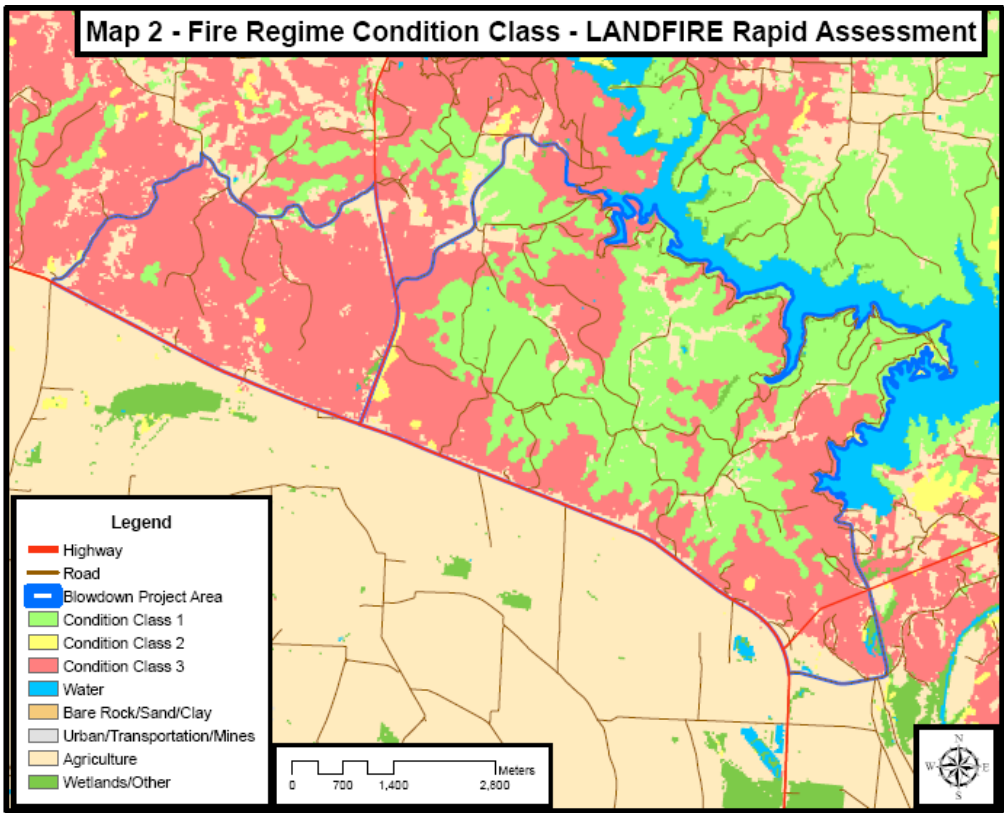
the Interagency Fire Regime Condition Class "guidebook process" (which attempts to quantify each parcel within the landscape as to degree of departure and then combines them for a landscape result), or use the broad-scale data available from a national FRCC mapping effort, LANDFIRE. This analysis will use some of the first and last methods.

Large portions of the project area and surrounding watersheds are in agricultural use. Since this vegetation is often not flammable, non-native, monoculture, and so intensively managed, it is hard to classify it as natural vegetation. It is therefore not placed into any condition class but given its own category. The effect is to reduce the base amount of acres that can be found in a given condition class. Similarly, urban areas, transportation routes, bare rock, soil, wetlands, or open water are given their own categories.

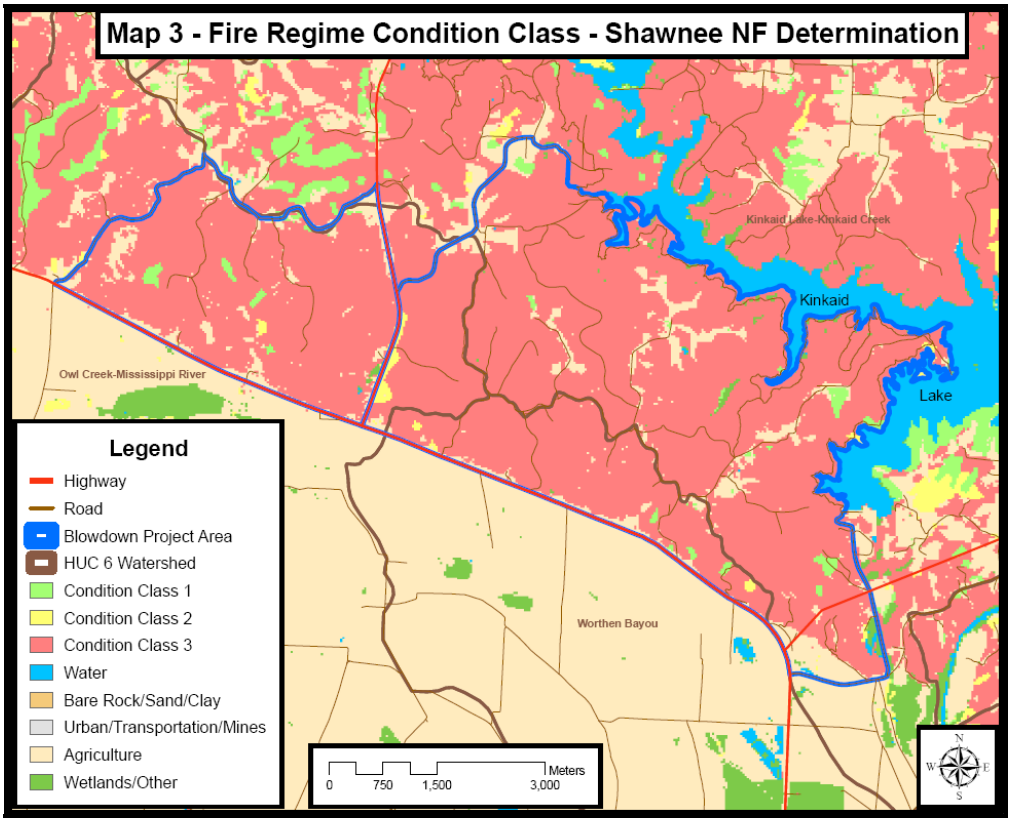
Most consider oak-hickory forests and woodlands, including those in the subsection and the project areas, to be in Fire Regime I, or subject to frequent (0-35 years), low and mixed severity fires (Schmidt et al 2002, Nowacki and Abrams 2008). Prairies or other grasslands may be considered Fire Regime II, or frequent (0-35 years), high intensity (stand replacement) fires, since most of the fuel bed is consumed during each burn. Cove hardwoods and other mesophytic systems likely are considered here Fire Regime III: infrequent (35-200 years), low and mixed severity fires. Swamp or other systems may fall under Fire Regime V, or extremely long return (200+ years), replacement severity fires.

Map 2 shows historic Fire Regime Condition Class for the Blowdown project and surrounding areas as defined by the LANDFIRE project Rapid Assessment (RA). The RA used existing data sets, satellite imagery, and expert opinion to capitalize on earlier work by Schmidt et al (2000), which sought to elicit fire and vegetation characteristics nationwide at the 1 $km^2$ resolution. Care should be taken when using this data at the landscape and especially project level, as it was designed for a national or similar scale assessment. Also, quality assurance was not expected to be very high for the Rapid Assessment. Most federal and state agencies are refining the data using local expertise and smaller scale assessments. In fact, most of the national database (that will replace the rapid assessment) is being built using field-sampled and ground-truthed data. Many locations are also refining the decisional pathways and breakpoints with the latest available local and regional knowledge. Despite these weaknesses, some telling information is apparent. The majority of the project areas are shown as Condition Class 3, with some inclusions of other Condition Classes interspersed.

Local data seems to agree with the broad scale LANDFIRE assessment. We would expect that in the project area most of the uplands should be considered Fire Regime I (0-35 years MFI, low-moderate intensity) and Condition Class 2 and 3 (moderate and high departure from reference conditions). Many early accounts of forest structure suggest that the reference condition for nearly all communities was much more open than is found today (see figure 6). The development of the shade-tolerant midstory and understory in formerly oak-dominated forests has been well-documented (Shotola et al 1992), as has woody plant invasion into formerly open, grassy communities (Anderson et al 2000). Given the high degree of departure, it seems that most of the project areas would warrant a Condition Class 3 rating for vegetative composition and structure. The exceptions would be on the sites where vegetation is resistant to change, such as the most xeric, thin-soiled barrens, which may rate a Condition Class 2, and deep-soiled, mesic coves and swamps are not likely much departed in structure or fire functioning and may rate as Condition Class 1.




**Map 3. Fire Regime Condition Class as determined by the LANDFIRE Rapid Assessment**




**Map 4. Fire Regime Condition Class as determined by the Shawnee National Forest.**

Local definitions depart from the LANDFIRE RA data in some places. In the area around Buttermilk Hill and Forest roads, for instance, the LANDFIRE RA data shows large areas in Condition Class 1. These areas are almost entirely outside the range of historic variability, since there are several pine and yellow poplar plantations, and black locust and mixed mesophytic hardwood stands on ridge tops and other sites formerly dominated by oaks. Other stands have had the oak selectively removed, resulting in mesophytic stands. Where mixed oak stands still exist, most have maple, beech, and other mesophytes dominating the regeneration and midstory layers. Invasive plants also are common in the herbaceous and shrub layer in many areas. Given their departure from historic composition and structure, these areas should certainly be classified as Condition Class 3. Map 3 shows the local Shawnee National Forest determination of fire regime condition class for the project area. This made by comparing current stand typing to landscape position, and factoring in disturbance history. Mesophytic stands in low landscape positions (coves, stream terraces, etc.) were considered Fire Regime III, Condition Class 1. Mesophytic stands and non-native pine stands in upland positions were considered Condition Class 3. Oak-hickory stands in upland positions were considered Fire Regime I, Condition Class 3 unless there had been some activity that could help create or maintain historic stand structure or oak-hickory regeneration, i.e. a prescribed burn, wildfire, or harvest plus planting. These stands were considered Fire Regime I, Condition Class 2.

These compositional and structural changes have been influenced by, and in turn influenced changes in fire frequency and extent. Current MFI for the areas seems to be on the order of or greater than a ten-fold increase. Nearly all sites have missed several fire return intervals. In forested areas, this has allowed seedlings of maple, beech, elm, ash, and other fire-intolerant species, which previously had been restricted to moister landscape positions that rarely burned, to proliferate in the understory in all topographic positions and on all aspects. The understory and midstory in many stands is now dominated by these species (Haugen 2003). The abundance of the above species limits the amount of sunlight reaching the forest floor. These species also tend to be shade-tolerant, so their seedlings can persist in the understory and expand their relative importance in an increasingly shaded forest. Leaves of these trees are thinner, more flaccid, and decompose much faster than those of oaks (Nowacki and Abrams 2008).

**Figure 6. Flaccid leaves and barren ground found underneath a mesic midstory in a project area stand formerly dominated by oaks.**

Litter formed underneath these trees is compact and retains moisture, decreasing its effectiveness as a fuel bed. The increased shade results in an understory microclimate that has become cooler and more humid, and often there is very little or no vegetation under maple-beech canopies. Thus fire ignitions are less common, and even if a fire were to start, it would likely have a lower intensity and less complete spatial coverage of the landscape.

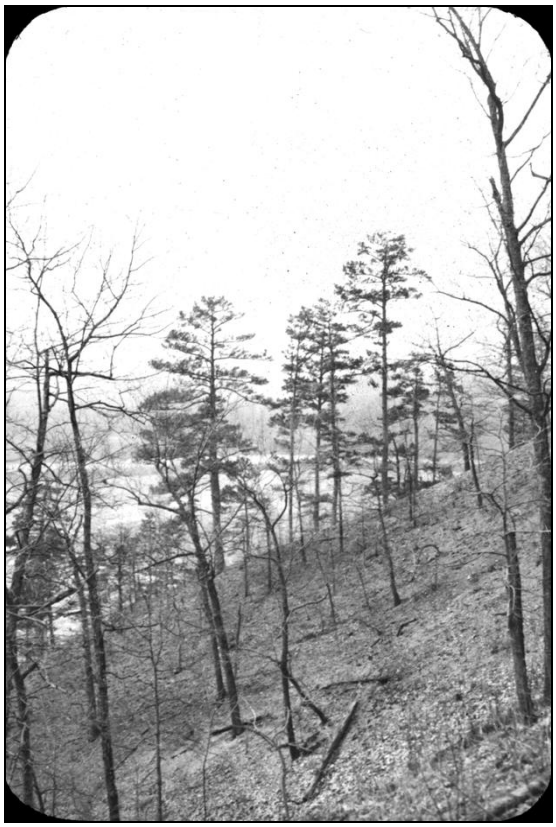


**Figure 7. La-Rue Pine Hills in 1920. Note the open character of the landscape.**

As shown above, most studies put MFI for the central hardwoods at 3-30 years in presettlement times, with the bulk of southern Illinois data suggesting 8-15 years (Charles Ruffner, personal communication). MFI shorter than this is typically associated with Euro American settlement during the 19th and early 20th century. Oaks and hickories help facilitate such a disturbance regime through leaf physiology. Unlike mesophytic species, which have leaves that tend to rapidly decompose and create moisture-holding mats, oak and hickory leaves are stiff. This causes the leaf litter layer to be more loosely packed, which allows more air circulation around the leaves. This creates a deeper, drier, and more flammable fuel bed. This fuel bed also dries faster after a rain event. The shape of the oak and hickory leaves, coupled with a tendency toward a more open canopy, allows greater light and stronger wind velocities to reach the forest floor, drying the fuel bed even more.

Figures 8 and 9 show the number and acreage of fires by vegetation type on Shawnee National Forest fires in the nearby Illinois Ozarks between 1986 and 2004.

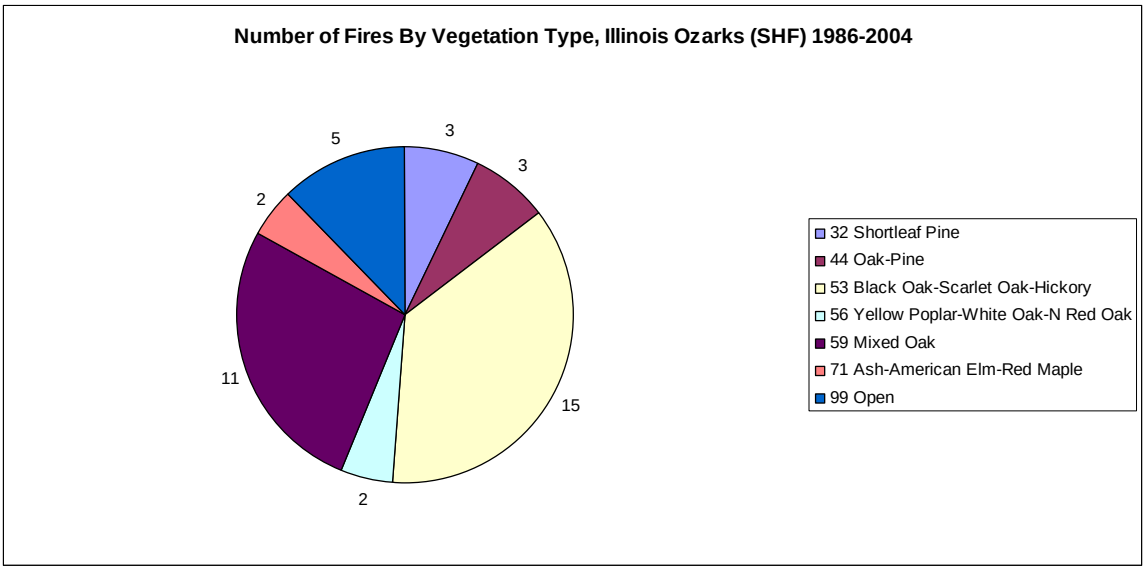



**Figure 8. Number of fires by vegetation type in the Illinois Ozarks, Shawnee National Forest fires 1986-2004. Only data from fires in which vegetation type is reported is included.**

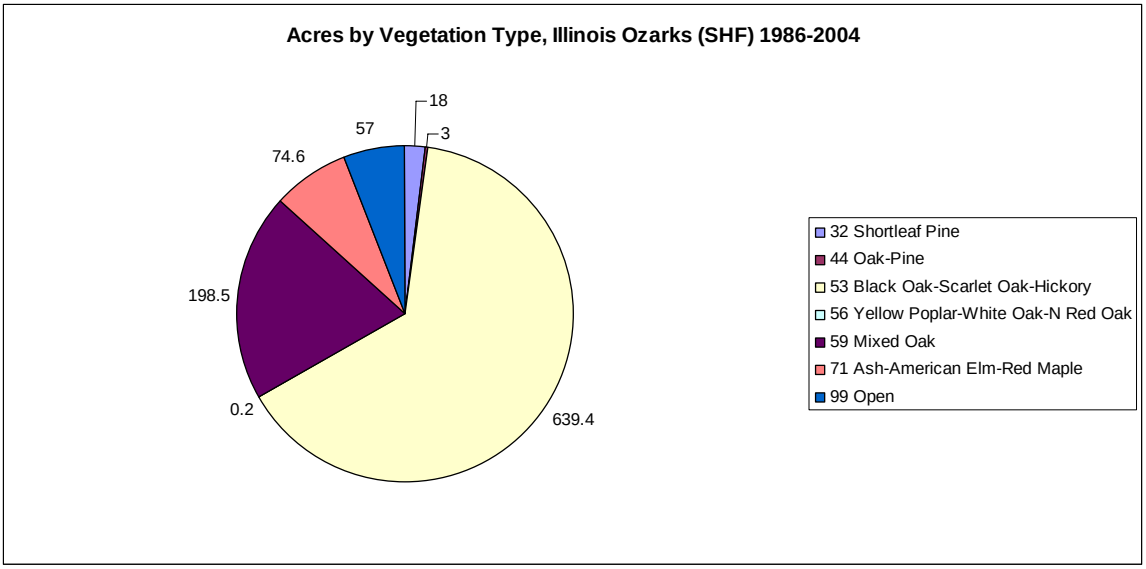



**Figure 9. Acres Burned by Vegetation Type in the Illinois Ozarks, Shawnee National Forest fires 1986-2004. Only data from fires in which vegetation type is reported is included.**

The intensity of fires (and hence mortality), when they do occur, may be greater than reference conditions due to the higher fuel loads and shifting of the majority of burning to the spring when temperatures may be warmer, winds faster, and trees may be already entering their annual growth cycle. Spring fires may be less severe to soil resources, however, since soil moistures tend to be much higher in the spring than fall.
The near complete removal of fire from the landscape in frequency and extent gives all the project areas a current rating of Condition Class 3 for fire characteristics. Combining the vegetative structure and composition ratings, the majority of the project areas (and the subsection as a whole) get a composite Condition Class rating of 3.

## Fuel Description - Current Conditions

The area of severe canopy damage centered on the mouth of Talbott Hollow, dubbed Heavy Blowdown Area 1, has high loadings of large-diameter fuels of mostly yellow poplar and mixed oak species, though little carrying fuels were left initially. One eyewitness reported that many of the leaves were deposited by the tornado north of Kinkaid Lake. Storm debris was even found in Perry County several miles north of the project area. During the summer of 2007 grass, forbs, and vines rapidly invaded the site, adding carrying fuels. In Heavy Blowdown Areas 5 and 6 damage was restricted to hardwood stands. In places resulting fuel loads were quite high, though canopy damage was less continuous. In the other three areas canopy damage was scattered and discontinuous among most mature and immature hardwood stands, though there are isolated heavy concentrations of fuels throughout. However, pine plantations, particularly White Pine, within these areas were decimated. High 1000-hr fuel loadings and nearly continuous conifer slash in pine stands could pose control problems for fire suppression operations. Ice storms in the winter and spring of 2008 did not result in significantly greater fuel loading in the project area.

The eastern part of Area 1 as seen from the air one week after the tornado. Most trees damaged were young mixed hardwood trees.

The mouth of Talbott Hollow (Area 1) one week after the tornado. Note the damaged outbuildings in the background.

Area 3 as seen from the air one week following the tornado. Fuel loadings in a similar stand were measured at 78 Tons/Acre.

Area 4 from the Waterfall Trail approximately two weeks following the tornado. This pocket was interspersed with lightly damaged forest.

Area 4 as seen from Buttermilk Hill Rd approximately two weeks after the tornado.

Area 5 as seen from the air one week following the tornado.

**Figure 10. Blowdown Damage Photos.**

To accurately gauge the loading and arrangement of fuels in the blowdown project area, modified Brown's planar intercept transects (Brown 1974) were installed at 60 plots across the project area (2 plots had three transects each). Plots and transects were stratified for category of storm damage (37 for Moderate/Severe, 14 for Light, and 12 for No Damage) and systematically placed at fixed distances to avoid bias in choosing plot locations. Plot locations that fell on private lands that we did not have permission to enter were dropped, as was one plot that fell in Lake Kinkaid. Constants used to calculate fuels loading were taken from the National Park Service's Fire Management Handbook Software (USDI National Park Service), and specific gravities were taken from the Wood Handbook (Forest Products Laboratory 1999) following methods used by Kolaks et al (2003). Fuel bed descriptions for the various areas of the project are listed on Table 4, while Table 5 displays components of the fuel beds in greater detail. No Damage" plot data was combined for analysis since community/fuel type was not differentiated in the field. Plot photos and data sheets are found in the project record.

| Mod/Severe Canopy Damage Area | Predominant Timber Type(s) | Fuel Model(s) | Average Fuel Loading |
|---|---|---|---|
| Area 1 | Yellow Poplar, American Beech, Mixed Oak | SB2 | 25 |
| Area 2 | Black Locust, Mixed Oak, Shortleaf Pine | SB3 | 16 |
| Area 3 | White Oak, Mixed Oak, White Pine | SB3 | * |
| Area 4 | White Pine, Black Locust, Shortleaf Pine, Mixed Oak | SB3 | 31** |
| Area 5 | Mixed Oak, White Oak, Mixed Hardwoods | SB2 | 37 |
| Area 6 | Mixed Oak, White Oak, Black Oak/Scarlet Oak/Hickory | SB2 | 32 |
| | | **Average** | **28** |
| Light Canopy Damage Area | Predominant Timber Type(s) | Fuel Model(s) | Average Fuel Loading |
| All Areas | Mixed Oak, Yellow Poplar, Shortleaf Pine | TL6 | 19 |
| | | **Average** | **19** |
| No Canopy Damage Area | Predominant Timber Type(s) | Fuel Model(s) | Average Fuel Loading |
| Oak Stands | Mixed Oak, White Oak, Red Oak | TL6 | 15 |
| Mixed Mesophytic Stands | Yellow Poplar, Black Locust, Mixed Hardwoods | TL2 | 15 |
| | | **Average** | **15** |

**Table 4. Fuel Properties for the Buttermilk Hill – Talbott Hollow Blowdown Project Area**.

* No transects fell within Area 3.

** White Pine Stands within this area averaged 78 tons/ac, with 70 tons/ac stemming from down woody material.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| No Damage | No Damage | Light Damage | Heavy Damage Pine Stands | Heavy Damage Hrdwd Stands | Fuel Condition | | Fuel Bed |
| Low Load Hardwood Litter (TL2) | Oak-Hickory (TL6) | Oak-Hickory (TL6) | Moderate Load Blowdown (SB3) | Low Load Blowdown (SB2) | Stand Type (Fuel Model) | | |
| Mesophytic Litter | Oak Leaves | Oak leaves, some herbaceous | Pine Slash | Herbs, leaves, hardwood slash | Primary Carrying Fuel | | |
| Discontinuous | Continuous | Continuous with scattered jackpots | Discontinuous; max patch size ~25 acres | Discontinuous; max patch size ~50 acres | Continuity | | |
| 1.3 | 1.3 | 1.5 | 1.4 | 1.5 | 1 hr | | Fuel Loading (Tons/Acre) |
| 1.5 | 1.5 | 1.6 | 1.7 | 1.4 | 10 hr | | |
| 3.7 | 3.7 | 4.5 | 10.0 | 4.7 | 100 hr | | |
| 2.9 | 2.9 | 2.9 | 56.7 | 13.0 | 1000 hr | | |
| 0.17 | 0.17 | .28 | 2.1 | 0.34 | Depth (ft) | Litter/Slash | |
| 3.3 | 3.3 | 5.6 | 70.0 | 4.3 | Load (T/A) | | |
| 0.2 | 0.2 | 0.25 | 0.8 | 0.33 | Depth (in) | Duff | |
| 2.1 | 2.1 | 2.7 | 8.2 | 3.6 | Load (T/A) | | |
| N/A | N/A | N/A | N/A | N/A | Height (ft) | Herbaceous | |
| 0.05 | 0.05 | 0.05 | 0.0 | .08 | Load (T/A) | | |
| N/A | N/A | N/A | N/A | N/A | Height (ft) | Shrub | |
| 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | Load (T/A) | | |
| **14.8** | **14.8** | **18.8** | **78.0** | **26.7** | **Total (T/A)** | | |
| 1806 | 1936 | 1936 | 1935 | 1884 | Surface Area/ Volume Ratio ($ft^{-1}$) | | Fuel Particle |
| 0.04232 | 0.02296 | 0.02296 | 0.01345 | 0.01829 | Packing Ratio | | |

**Table 5. Current fuel bed properties for various areas within the Buttermilk Hill – Talbott Hollow Blowdown Project. Non-measured (default) values are in blue.**

# Analysis of Alternatives

## Fuels Resources

The temporal boundary of analysis will be 15 years into the future for fuel bed properties and fire regime condition class. Cumulative effects are not expected to last beyond 15 years because the proposed action alternative would be completed by then and there would be enough time for the resulting vegetation changes to be evident. Though fire exclusion spanning several decades is largely responsible for the vegetation composition changes as shown above, fuels in the project area have only been influenced by litter influx and decay and can be thought to have reached a temporal equilibrium, though over time fuel loading and distribution will change as forests convert to mesophytic species dominance without disturbance. Therefore past activities completed within the last ten years (1998-2008) will be analyzed for cumulative effects. The overall project area form the spatial analysis boundaries because the only area fuels and condition class ratings affected will be those where project activities take place.

The attributes of the fuel bed that will be analyzed for each damage class include fuel loading and continuity since these would most directly affect fire behavior. Fire Behavior characteristics that will be analyzed include Rate of Spread, Flame Length, Reaction Intensity, since this figure is independent of slope, wind, or rate of spread. Where fuel bed properties were lacking, I used default values for White Oak/Red Oak/Black Oak communities from the Fire Characteristics Classification System (FCCS). For fire behavior prediction purposes, Scott and Burgan (2005) fuel models were used. Heavily damaged hardwood stands were assigned Fuel Model SB2, Low Load Blowdown, while conifer stands were considered SB3, Moderate Load Blowdown. Lightly damaged areas were typed as TL6 Moderate Load Leaf Litter. Undamaged areas were modeled using TL6 for oak-dominated stands or TL2 for mesophytic stands to account for the reduction in leaf litter load and increase in compaction. Where they existed, measured values for down woody fuels were substituted for default values. For unmeasured values such as surface-area-to-volume ratio, default values from Scott and Burgan were used.

## Alternative 1 – No Action

***Direct and Indirect Effects*** - Under this alternative no prescribed fire or other fuel reduction activities would take place. No immediate change (direct effects) would be noted to fuels properties or resulting fire behavior. Over 15 years, however, fuel properties would change. Fuel would decay over time, especially in the smaller size classes. This reduction would be partially offset by the influx of new snags and coarse woody debris as currently standing tornado-damaged trees and branches fall. Coarse woody debris would take much longer to completely decay than fine fuels. In a mixed hardwood stand in Indiana, a prescribed burn 8 years following a tornado produced much longer flame lengths and energy released because of the presence of a heavy loading of incompletely decayed 1000-hr fuels (Peterson, personal communication 2007). Since fuel loads (especially 100 and 1000-hr fuels) would remain high and in a continuous

arrangement in places, fire risk would remain elevated throughout the analysis period. If a wildfire were to happen, fuels could be mostly consumed, especially in smaller sixe classes. Smoke production and soil heating would be much higher under this scenario (see also the Soils and Watershed working paper) than under prescribed burning as in Proposed Action Alternative. Gradually wildfire risk would decrease as excess fuels decompose and hold more moisture. The direct effects of Alternative 1 under no fire and wildfire scenarios are shown in Table 7. In areas with severe canopy damage, woody invaders and sprouts will gradually increase the overall loading. Wind blown leaves would add to the herb and vine dominated carrying fuels, adding more loading and horizontal continuity (which would yield more continuous spread). In these exposed and hence drier sites, primary productivity (growth) will be greater, large fuels will be slower to decay, and the surface microclimate will be warmer, drier, and susceptible to good burning conditions more frequently than in adjacent closed canopy sites. In areas with an overhead canopy, there would also be changes to fuel properties. Litter depth and loading here is probably in an equilibrium state, fluctuating about a mean as litter fall and decomposition are likely balanced. In heavy damage and light damage areas, fire risk would remain slightly elevated due to the presence of increased woody fuels, but where there is an intact canopy overhead burning conditions would not appreciably change.

***Cumulative Effects*** - Few actions are known during the analysis time period that might alter fuel loading or arrangement. Wildfire occurrence, insect or disease outbreaks, ice storms, or tornados or other wind events might alter fuel loadings, but are difficult to predict. Wildfires burned very few acres (3.5) of Forest Service land in the previous 10 years in the project area. If this amount burned again, it would not enough to alter the FRCC rating or fuel bed properties for the project areas as a whole. However, due to the increased fuel load and exposure of those fuels to the drying effects of sun and wind, there is a greater chance of a fire start in the area, and a much greater chance of experiencing high intensity fires with rapid growth and higher resistance to control. Some timber harvest on private lands in the project area is known to be planned (about 76 acres) and more is expected in the next 15 years, though the intensity and extent of the harvests are unknown. This will serve to increase fuel loading, especially in larger size classes. Kolaks et al (2003) found commercial thinning (a similar activity) to increase 100 and 1000-hr fuel loads by 300%. This would compound the increased loading as a result of the tornado and serve to increase fire risk. However, there is limited acreage planned for harvest within the analysis period so the spatial extent and overall (project-wide) effect would be limited. Utility right-of-way maintenance would reduce fuel load within the corridor and change vertically arranged grasses and shrubs to horizontally arranged fuel, reducing its flame length and spread rate characteristics. There are no cumulative effects other than the changes described above from implementing Alternative 1.

## Alternative 2 – Proposed Action

***Direct and Indirect Effects*** – Under this alternative, project area fuels would be reduced by prescribed burning within the proposed burn units and mowing, chipping, and scattering fuels near selected structures. The combustion of leaf litter and woody debris

would reduce the loading, depth, and continuity of the fuel bed, rendering it temporarily with a very low risk for further burning. Leaf litter, pine needles, grass, and fine woody debris (1 and 10-hr fuels) would likely be reduced by about 100% in the places where it

Figure 11a. Low-intensity prescribed fire inside of a leaf blower-constructed line.

Figure 11b. Area one month after burning. Note the lower bark char on a few stems and reduced leaf litter depth.

**Figure 11. Photos of prescribed fire and immediate effects in southern Illinois.**

burns regardless of moisture conditions (Figures 13 - 16) according to the First Order Fire Effects Model (FOFEM) 5.2.1. This is thought to be an overprediction of consumption, since burns on the Shawnee National Forest frequently do not consume the entire litter layer and there is always a mosaic of burned and unburned patches within the burn perimeter. Burn coverage is estimated at 50-90% of the burn unit. FOFEM runs suggest a maximum of 9% mineral soil would be exposed during very dry conditions in pine stands, and none in hardwood stands under any moisture scenario. Since fine fuels "carry" the fire, even a mosaic burn that does not consume large fuels would drastically reduce the future wildfire potential until the carrying fuels are built back up. In one study under an oak stand in Ohio, Graham and McCarthy (2005) found that 75% of the litter depth had returned three growing seasons after a fire. 100% of the litter layer would be rebuilt after 8-12 years, and about this time litter influx would equal decomposition. However, the presence of large fuels could contribute to higher heat outputs, longer flame lengths, greater spotting potential, and in general pose more resistance to control during a fire, so it would be advantageous to at least partially consume these as well during prescribed burning operations. These fuels only burn when 1000-hr fuel moisture is sufficiently low and/or prolonged or significant heat source is in close proximity to them. Prior experience of the Shawnee National Forest indicates that total consumption of 1000-hr fuels is rare under normal prescribed burning conditions. Given the somewhat random nature of the "jackpots" within the tornado-damaged areas, flame length, rate of spread, and reaction intensity would be quite variable on a small spatial scale. Some of these piles of heavy fuels, particularly pine, could produce flame lengths in excess of 20 feet, whereas some adjacent areas with only litter fuel to burn may produce flame lengths under two feet.

Future prescribed fires would consume fuel, create new snags that will become available fuel, change decay rates of residual fuel and new fuel influxes, and may alter fuel conditions, fire occurrence, and stand structure and composition that influences future fuel properties.

Figure 12a. Large log after prescribed burn in southern Illinois. The log charred in places but mostly did not consume.

Figure 12b. It is unknown if this snag was dead prior to the burn or created by it. Most large trees are unharmed from burns.

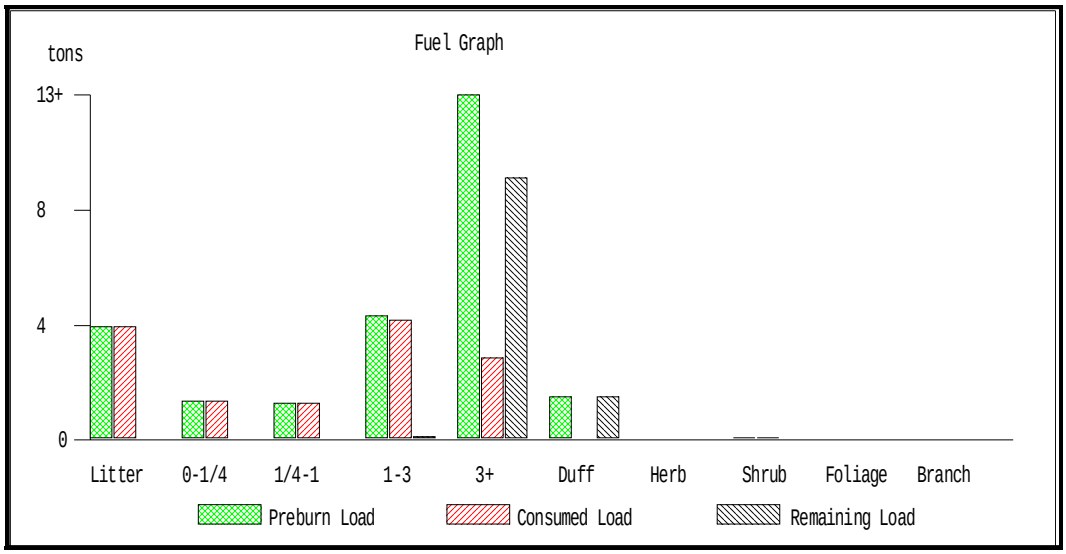



**Figure 13. Predicted fuel consumption in heavily damaged hardwood stands.**

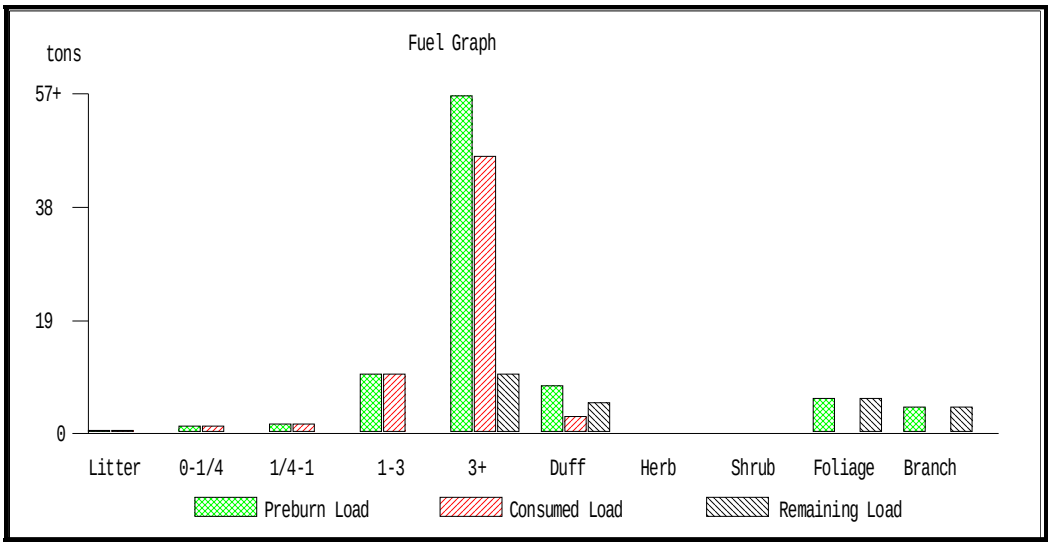



**Figure 14. Predicted fuel consumption in heavily damaged pine stands.**

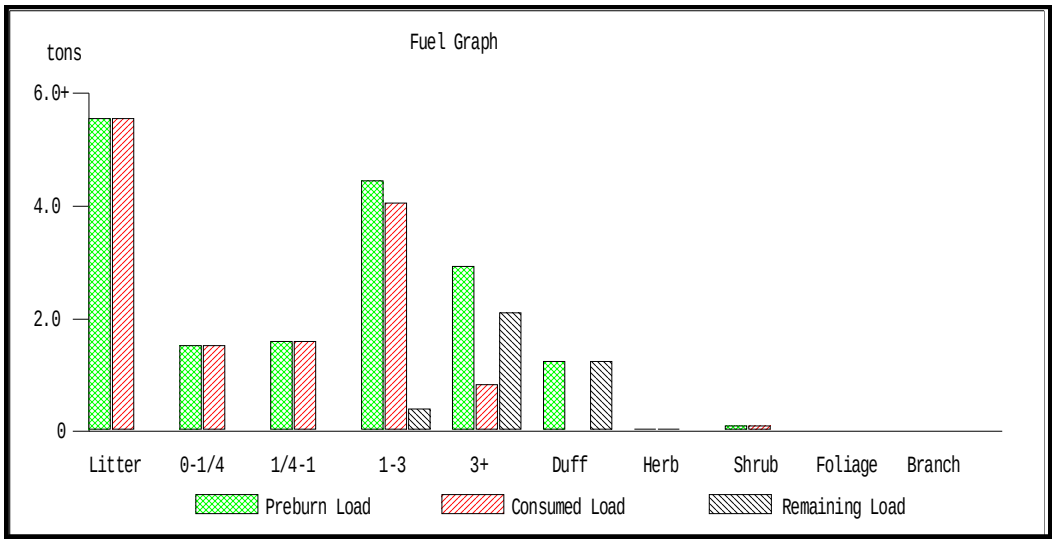



**Figure 15. Predicted fuel consumption in lightly damaged stands.**

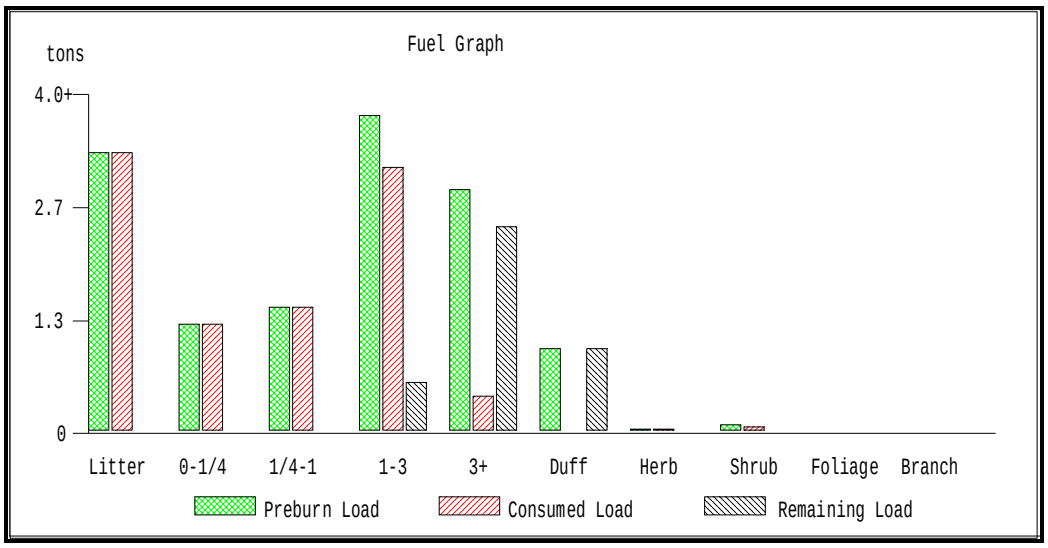



**Figure 16. Predicted fuel consumption in undamaged stands.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| No Damage | No Damage | Light Damage | Heavy Damage Pine Stands | Heavy Damage Hrdwd Stands | Fuel Condition | | Fuel Bed |
| Low Load Hardwood Litter (TL2) | Oak-Hickory (TL6) | Oak-Hickory (TL6) | Moderate Load Blowdown (SB3) | Low Load Blowdown (SB2) | Stand Type (Fuel Model) | | |
| Mesophytic Litter | Oak Leaves | Oak leaves, some herbaceous | Pine Slash | Herbs, leaves, hardwood slash | Primary Carrying Fuel | | |
| Discontinuous | Continuous | Continuous with scattered jackpots | Discontinuous; max patch size ~25 acres | Discontinuous; max patch size ~50 acres | Continuity | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1 hr | | Fuel Loading (Tons/Acre) |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 hr | | |
| 0.6-1.2 | 0.6-1.2 | 0.4-1.0 | 0.0 | 0.1 | 100 hr | | |
| 2.3-2.7 | 2.3-2.7 | 1.8-2.5 | 15.3-26.9 | 9.4-11.3 | 1000 hr | | |
| 0.17 | 0.17 | .28 | 2.1 | 0.0 | Depth (ft) | Litter/Slash | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Load (T/A) | | |
| 0.2 | 0.2 | 0.25 | 0.8 | 0.33 | Depth (in) | Duff | |
| 2.1 | 2.1 | 2.7 | 8.2 | 3.6 | Load (T/A) | | |
| N/A | N/A | N/A | N/A | N/A | Height (ft) | Herbaceous | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Load (T/A) | | |
| N/A | N/A | N/A | N/A | N/A | Height (ft) | Shrub | |
| 0.1 | 0.1 | 0.0 | 0.0 | 0.0-0.1 | Load (T/A) | | |
| **5.0-6.1** | **5.0-6.1** | **5.0-6.3** | **32.0-43.6** | **11.1-13.8** | **Total (T/A)** | | |
| 1806 | 1936 | 1936 | 1935 | 1884 | Surface Area/ Volume Ratio ($ft^{-1}$) | | Fuel Particle |
| 0.04232 | 0.02296 | 0.02296 | 0.01345 | 0.01829 | Packing Ratio | | |

**Table 6. Predicted fuel bed properties for various areas within the Buttermilk Hill – Talbott Hollow Blowdown Project under Alternative 2 under varying moisture scenarios. Does not include crown fuel loading. Source: FOFEM 5.2.1.**

| Table 7: Comparison of Anticipated Effects | | Alternative 1 (No Action) | | Alternative 2 (Proposed Action) |
|---|---|---|---|---|
| | | No Fire | Wildfire | Prescribed Fire |
| Fire Regime Condition Class (Acres) | • Condition Class 1 | 129 | | 132 |
| | • Condition Class 2 | 85 | | ~3880 |
| | • Condition Class 3 | 8303 | | ~4612 |
| Fire Regime Condition Class (%) | • Condition Class 1 | 2 | | 2 |
| | • Condition Class 2 | 1 | | ~45 |
| | • Condition Class 3 | 97 | | ~53 |
| Total Dead Fuel Load (Tons/Acre) | • Heavy Damage – Hardwood Stands | 28 | | 11-14 |
| | • Heavy Damage – Pine Stands | 78 | | 32-44 |
| | • Light Damage – All Stands | 19 | | 5-6 |
| | • No Damage Oak Stands | 14 | | 5-6 |
| | • No Damage Mesophytic Stands | 14 | | 5-6 |
| Flame Length (Feet) | • Heavy Damage – Hardwood Stands | N/A | 10.1 | 8.1 |
| | • Heavy Damage – Pine Stands | N/A | 15.5 | 12.4 |
| | • Light Damage – All Stands | N/A | 2.1 | 1.7 |
| | • No Damage - Oak Stands | N/A | 2.0 | 1.6 |
| | • No Damage - Mesophytic Stands | N/A | 0.6 | 0.5 |
| Rate Of Spread (Chains/hour) | • Heavy Damage – Hardwood Stands | N/A | 29.3 | 21.6 |
| | • Heavy Damage – Pine Stands | N/A | 69.1 | 51.1 |
| | • Light Damage – All Stands | N/A | 2.1 | 2.1 |
| | • No Damage Oak Stands | N/A | 1.9 | 1.9 |
| | • No Damage Mesophytic Stands | N/A | 0.5 | 0.5 |
| Reaction Intensity (Btu/sq ft/min) | • Heavy Damage – Hardwood Stands | N/A | 8210 | 6780 |
| | • Heavy Damage – Pine Stands | N/A | 8650 | 7148 |
| | • Light Damage – All Stands | N/A | 2688 | 2220 |
| | • No Damage Oak Stands | N/A | 2688 | 2220 |
| | • No Damage Mesophytic Stands | N/A | 823 | 682 |

Fuel loading, depth, and continuity, reduced in all categories after the initial burn, will increase as new leaf litter, herbaceous fuels, and snags/logs are added to the system (Holden et al 2005). Previous analysis indicates a diminishing rate of change on fuel bed properties under such a periodic burning regime. Each burn would likely top kill most small stems, but only a few larger trees would be killed. As these few stems die, the canopy becomes more open and more subject to the drying effects of sun and wind, and fuel loading increases as trees die and eventually fall. Subsequent burns consume less fuel, but may burn with higher intensity due to the changed microclimate in the understory, and the possible colonization by grassy fuels. Modeled fire behavior outputs are shown in Table 7. These outputs were made using the moisture scenario D2L2. This is the same moisture scenario used in Scott and Burgan's *Standard Fuel Models for Fire Behavior* (2005) to compare various fuel models under steady burning conditions. Mowing of grassy and brushy fuels will change the arrangement from vertical to horizontal, reducing rate of spread, flame length, and fireline intensity. In the few areas where this happens, cutting of downed fuels with chainsaws and chipping or scattering them will reduce the slash height and increase the surface-area-to-volume ratio, both having the immediate effect of reducing rate of spread, flame length, and fireline intensity (Glitzenstein et al 2006). In addition, the smaller particle size will lead to increased decomposition rates and higher moisture absorption capacity.

| | |
|---|---|
| | |
| Unburned stand with a many small understory trees, deep shade, and limited herbaceous growth. | Low-intensity prescribed fire in a southern Illinois oak stand with a maple midstory. |
| | |
| After three burns, this oak stand has an increase in light and herbaceous cover. | After three burns, this stand has more light on the forest floor and numerous oak seedlings. |

**Figure 17. Expected differences based on past prescribed fire experience in southern Illinois.**

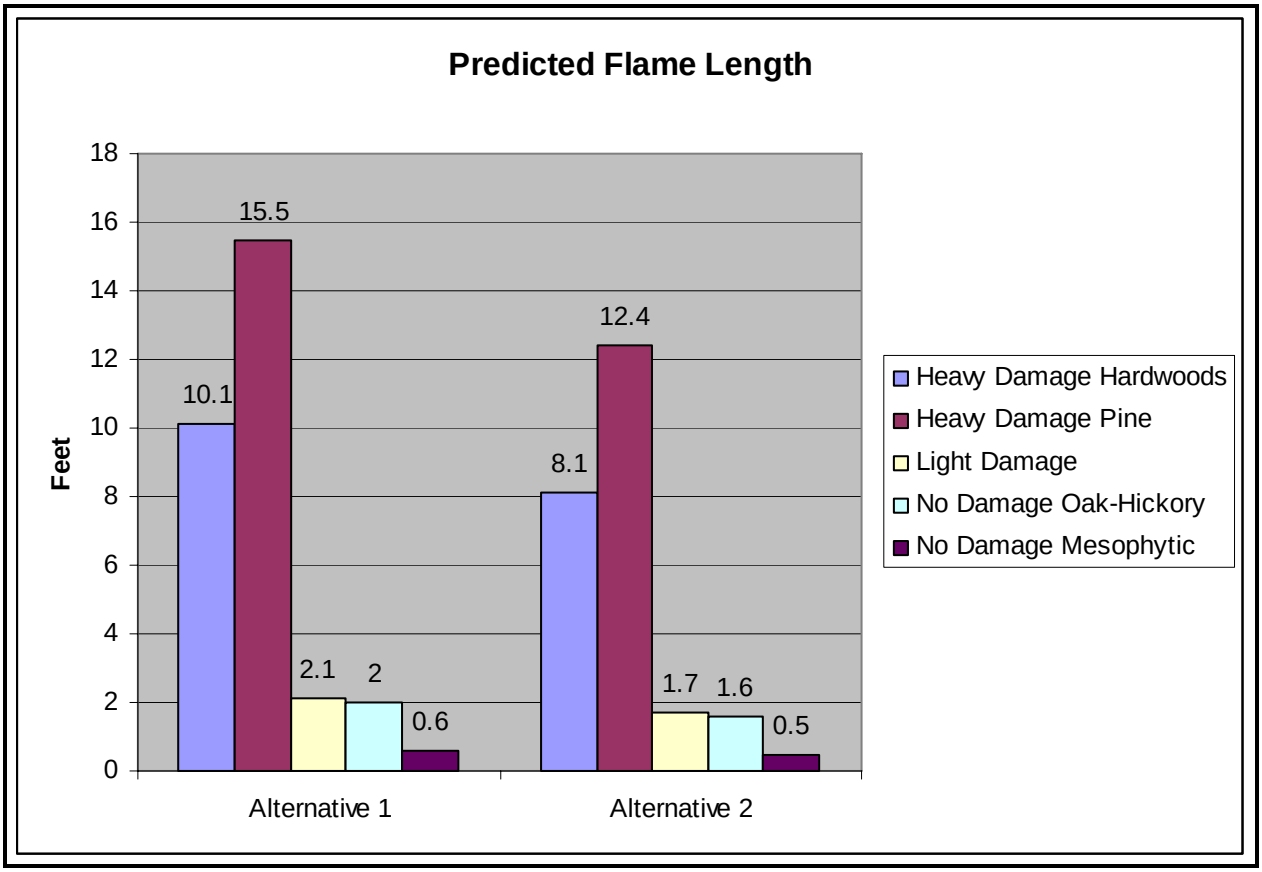



**Figure 18. Predicted Flame Length for each blowdown project area fuel bed.**

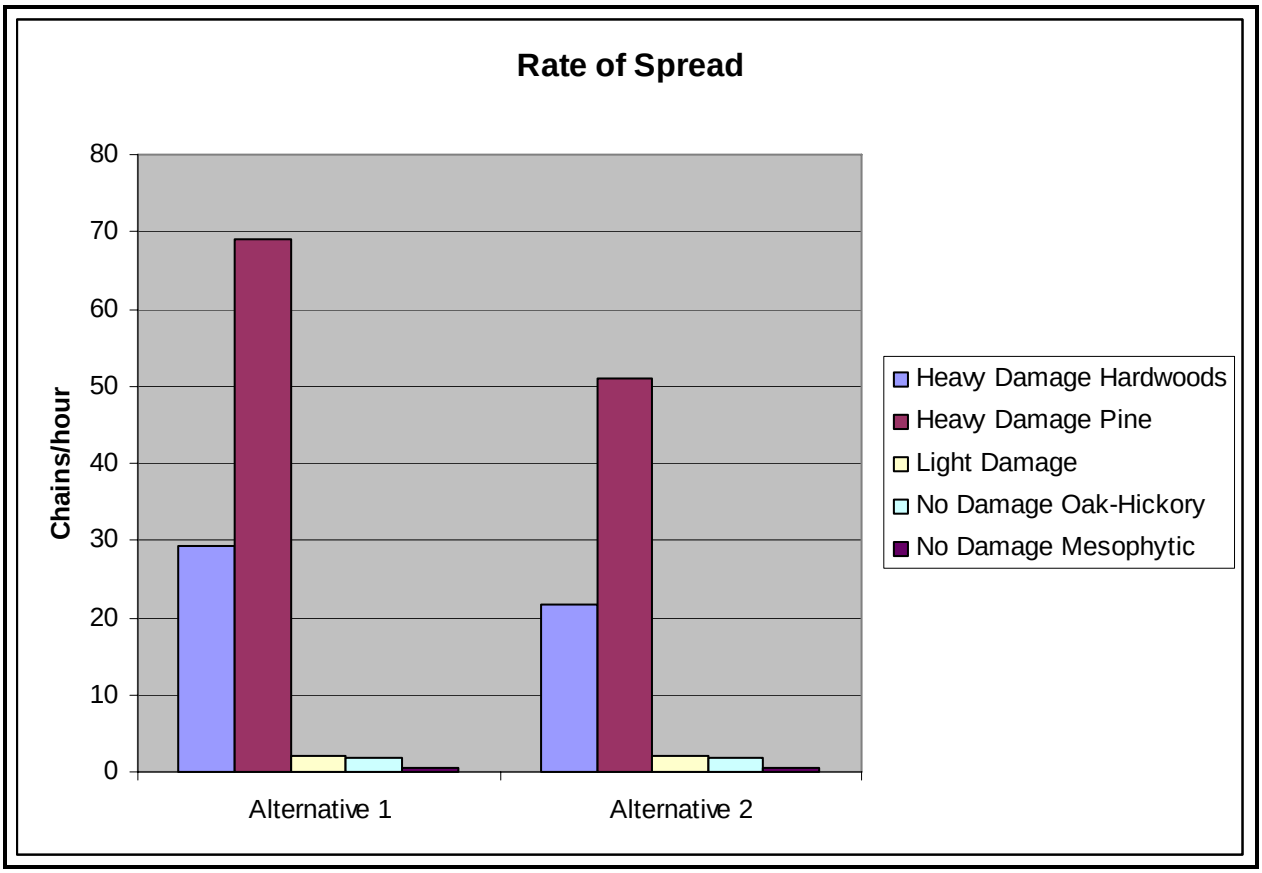


**Figure 19. Predicted Rate of Spread for each blowdown project area fuel bed.**

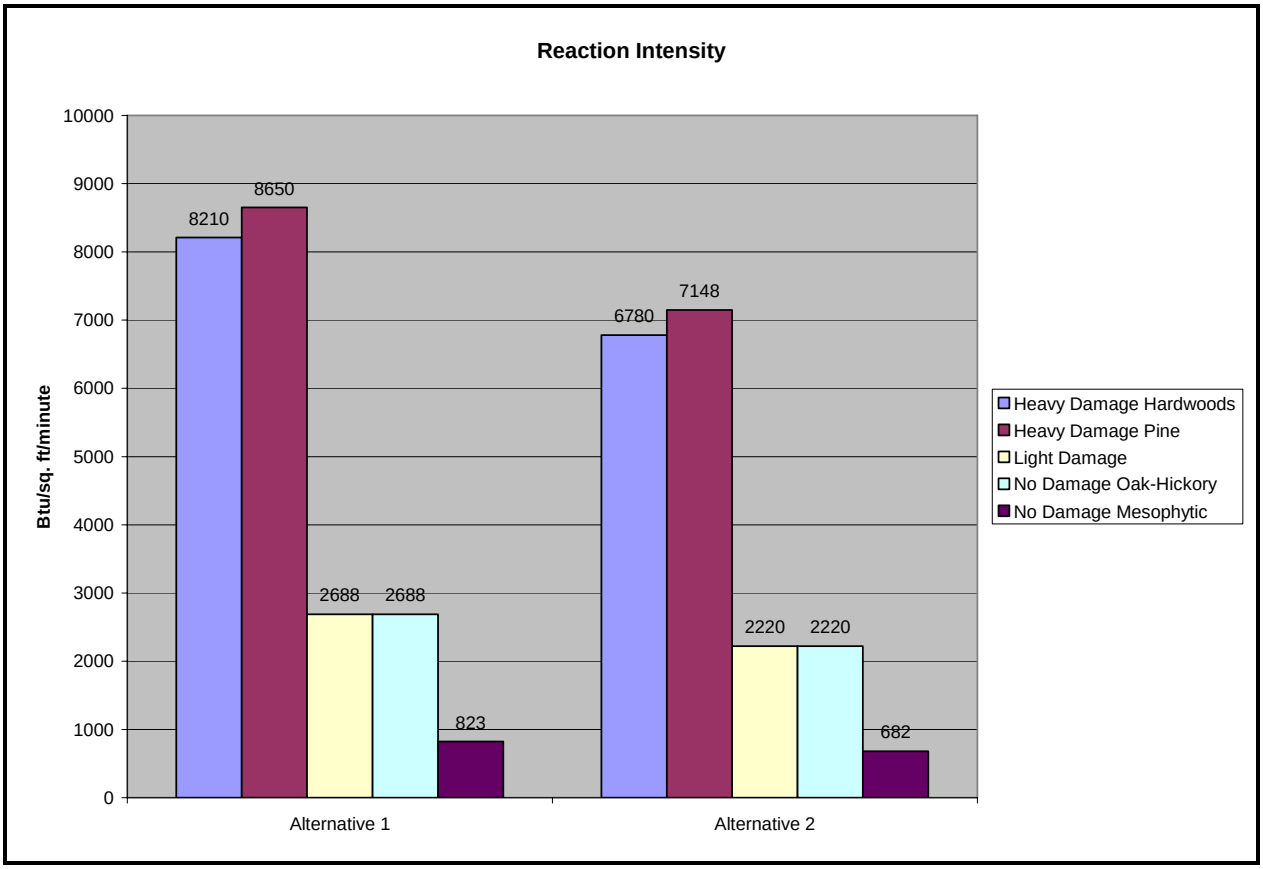



**Figure 20. Predicted Reaction Intensity for each blowdown project area fuel bed.**

***Cumulative Effects*** – Several other activities are likely to take place within the project area during the timeframe of project implementation. Only a few of these are likely to influence fuels or burning conditions. Row crop agriculture and pasturing tend to keep the vegetation in these areas as wither non-burnable or in a state where combustion is unlikely and fuel loading is very light anyway. As stated earlier, personal use firewood will likely have a negligible impact on project area fuels. Wildfires have been rare in the project areas in the last 21 years. The fuel situation following the tornado increases the likelihood of a wildfire in the project area, but to an unknown degree. Therefore the project has possible overlaps in time and space with these activities, but it is unlikely. There are definite cumulative overlaps with power line right-of-way (R-O-W) maintenance, garlic mustard torching, and private land timber harvest. Approximately 28 acres of R-O-W will be maintained every three years within the project area by Ameren CIPS. They will use aerial trimming, hydro-axing, and herbicide to keep fuels under and adjacent to the power lines reduced. This will reduce live fuel loads in the R-O-W and change the arrangement to horizontal, but may increase dead fuel load. This should serve as a benefit to project implementation since it will reduce risk of fire damage or electrical arcing as a result of the burn. A growing population of garlic mustard may be torched, pulled, or sprayed in the Buttermilk Hill Rd area. Death to garlic mustard and non-target plants may slightly increase the fuel load in the immediate area, but the small size of the outbreak means it will have a negligible effect on project area fuels. Approximately 76 acres of timber is known to be planned for harvest in the next 10 years on private property (more is possible). Fuel loads in this area will dramatically increase as harvest residue is left on site. Little has been documented on post-harvest fuel loadings in the Central Hardwoods, but Kolaks et al (2003) found that commercial thinning

increased total fuel loading about 300%, though litter weight, depth, and fine fuel all decreased. The authors attributed this reduction to the ground effects of mechanized harvesting. This increased fuel loading may even approach that of the tornado-damaged areas. Fire behavior would be elevated if fire got into these areas. Interestingly, there were significant differences based upon topographic location. Fuel loads in many classes were higher on protected slopes and ridges than exposed slopes. Decomposition rates and fire behavior are known to be affected by aspect and topographic position, and this might explain the difference. Since the landowner has not agreed to allow burning on their property, fuel loads in this parcel will remain elevated Overall, fuels in the project area would be significantly reduced in burn and burn/chip areas, but will slightly decrease in areas outside of the burn or thinning units, except on private land where timber harvests are planned, which will increase.

The planned harvest is outside the perimeter of the planned burn areas, so it would not affect prescribed burning operations unless there was an escape. An escape in the harvest areas would grow more rapidly, burn with greater intensity, and be more difficult to control. Though normally non-combustible, with limited grazing and low herbaceous moisture pastureland can burn. Fuel loading from pasture is light, but has a high surface area to volume ratio and is vertically arranged so it can experience rapid rates of spread. This is normally accounted for in prescribed fire preparation and implementation.

| **Fuel Bed Property** | **Alternative 1 – No Action** | **Alternative 2 – Proposed Action** |
|---|---|---|
| Heavy Damage Hardwood Fuel Load Total (Tons/Acre) | 27 | 11-14 |
| • 1 hr<br>• 10 hr<br>• 100 hr<br>• 1000 hr | 1.5<br>1.4<br>4.7<br>13.0 | 0.0<br>0.0<br>0.1<br>9.4-11.3 |
| Heavy Damage Pine Fuel Load Total (Tons/Acre) | 78 | 32-44 |
| • 1 hr<br>• 10 hr<br>• 100 hr<br>• 1000 hr | 1.4<br>1.7<br>10.0<br>56.7 | 0.0<br>0.0<br>0.0<br>15.3-26.9 |
| Arrangement and Continuity | Horizontally arranged continuous litter and heavy fuels in places in damaged areas, discontinuous mesophytic leaf litter in undamaged areas | Horizontally arranged litter, lightly interspersed with vertically arranged herbaceous fuels. Discontinuous heavy fuels. |
| Litter Compaction/Bulk Density | Very compact litter | Moderately fluffy, moderate bulk density of heavy fuels |

**Table 8. Fuel Bed Properties under each alternative for the Heavy Damage areas.**

## Fire Regime Condition Class

## Alternative 1 – No Action

***Direct and Indirect Effects -*** No immediate change (direct effects) would be noted to fire regime or condition class. That is not to say that this alternative would have no effect. Over time, vegetative composition and structure would be further departed from reference conditions. As woody and fire-intolerant plants further take hold of the project areas, key ecosystem components may be irrevocably lost. Numerous studies have shown herbaceous strata coverage decrease as canopy closure and resultant shade increases. Though many grassland species may persist for some time in the seed bank, certain prairie and woodland–affiliated plants may disappear, even if management is resumed in the future (Anderson et al 2000). In the dry and dry-mesic forests, stand structure and composition would change. Without oak recruitment, this keystone family group may be lost from future forest stands once the dominant overstory dies, with cascading effects throughout the ecosystem (Fralish 2004). Projections of future forest stand composition put this change as complete as early as 2045 (McArdle 1991, Fralish et al 2002), though other estimates are longer (USDA FS 2006). The resulting stand would be closed-canopied, multistoried, and composed of shade-tolerant species. Herbaceous fuels would largely disappear. Table 8 shows current average and predicted fuel bed properties for heavy damage stands, and Table 9 shows predictions for undamaged stands. Where site-specific data did not exist, I used default data as found in *Standard Fire Behavior Fuel Models: A Comprehensive Set for use with Rothermel's Surface Fire Spread Model* (Scott and Burgan 2005) for Surface Area/ Volume Ratio and Packing Ratio, and the *Fuel Characteristic Classification System* (Ottmar 2007) for fuel load values. Fuel Model classification follow Scott and Burgan. Though there would be a gradual transition, at some point in the future fuel beds would have changed such that they are more appropriately modeled as mesophytic stands (Fuel Model TL2). Note that packing ratio is almost twice as high as in Fuel Model TL6.

The Yellow Poplar-White Oak-Northern Red Oak stand type is used here to illustrate the "mesophication" of oak-dominated forests and woodlands, since it could be thought of as a stand intermediate in transition. On the Mississippi Bluffs Ranger District this is typically found on ridge sites that were clearcut, and then planted with Yellow Poplar with oaks interplanted. The fuel bed under these stands is a mixture of oak leaves and mesophytic poplar leaves, and burns less intensely than a pure oak stand, but not as low as a maple-beech stand. Fuel properties could change even more, but that will be outside the 10 year analysis period for most locations.

This would effectively change the fire regime from Fire Regime I (frequent, low-intensity fires) to Fire Regime III (infrequent, mixed-severity fires). Fire Behavior would be mostly diminished as fires are further excluded from the landscape and mesophytes change the understory microclimate. However, other scenarios are possible. The mesophytes growing on drier sites would be more susceptible to drought and other stressors. When fires would occur, they could be more intense due to higher mortality-induced fuel loadings, and the fact that to burn at all these stands must be experiencing very dry conditions and/or extreme burning conditions. They would also have more severe effects, as even low-intensity fires can cause high mortality among these fire-sensitive species.

Currently 97.5% of the project area not in agricultural, urban, wetland, or water classes is in Condition Class 3 (Map 3). One and a half percent of the area is in Condition Class 1. This corresponds to the mesic coves found in the deeper valleys and is considered to be in Fire

Regime III. These acres will not change Condition Class within the next 10 years. There are approximately 85 acres in Condition Class 2. These are drier, thin-soiled slopes where maples have not encroached as readily. The understory microclimate has changed enough that maples are now seeding in and growing in the understory. In 10 years these stands may at least partially convert to Condition Class 3 as maple seedlings enter the sapling and midstory strata. The remaining project area acreage (already Condition Class 3) will become even more dominated by mesophytes and even harder or impossible to restore to Condition Class 1. Since the Condition Class 2 areas are the only ones likely to change Classes and these areas are very small, a map of Condition Class in 15 years would probably look very similar to current conditions (Map 3).

| Fuel Bed | | | Fuel Loading (Tons/Acre) | | | | | | | | | Fuel Particle | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Litter | | Duff | | | | |
| Stand Type (Fuel Model) | Carrying Fuel | Continuity | 1 hr | 10 hr | 100 hr | 1000 hr | Depth (ft) | Load (T/A) | Depth (in) | Load (T/A) | **Total (T/A)** | Surface Area/ Volume Ratio | Packing Ratio |
| Oak-Hickory (TL6) | Oak leaves, some herbaceous | >90%, variable over distance | 0.60 | 0.33 | 1.24 | 4.47 | 0.2 | 4.31 | 0.4 | 4.37 | 15.32 | 1936 | .02296 |
| Y Poplar-N Red Oak (TL2) | Mesophytic leaves | 50-90%, variable, patchy | 1.0 | 1.0 | 2.0 | 8.3 | .17 | 3.0 | 1 | 7.2 | 39.87 | 1806 | .04232 |

**Table 9. Fuel characteristics for the undamaged dry forest and dry-mesic forest communities in the project areas.**

## Alternative 2 – Proposed Action

***Direct and Indirect Effects*** – Many of the vegetative composition and structure changes currently underway in natural area communities would be halted, and potentially stopped. In forest communities, the transition towards a climax beech-maple forest would slow. Even low intensity fires would effectively top-kill seedlings and some saplings of mesophytic species, though most of the larger stems would survive. The larger the stem, the more fire resistant it is because of thicker bark and a wider "sphere of influence" on the fuel bed (especially leaf litter) characteristics. Even so, more intense burning can kill larger stems. As a few stems die, the canopy becomes more open and more subject to the drying effects of sun and wind, and fuel loading increases as the tree dies and eventually falls. Studies have shown mixed results with periodic burning at various intervals (Huddle and Pallardy 1996, Barnes and Van Lear 1998, but see also Alexander et al 2008). In general, stem density of all species declines after multiple burns, but relative abundance of oak stems increases (Brose 2006). Periodic burning yields

slightly higher mortality than annual burning, likely due to the increased buildup of fuels between burns (Huddle and Pallardy 1996).

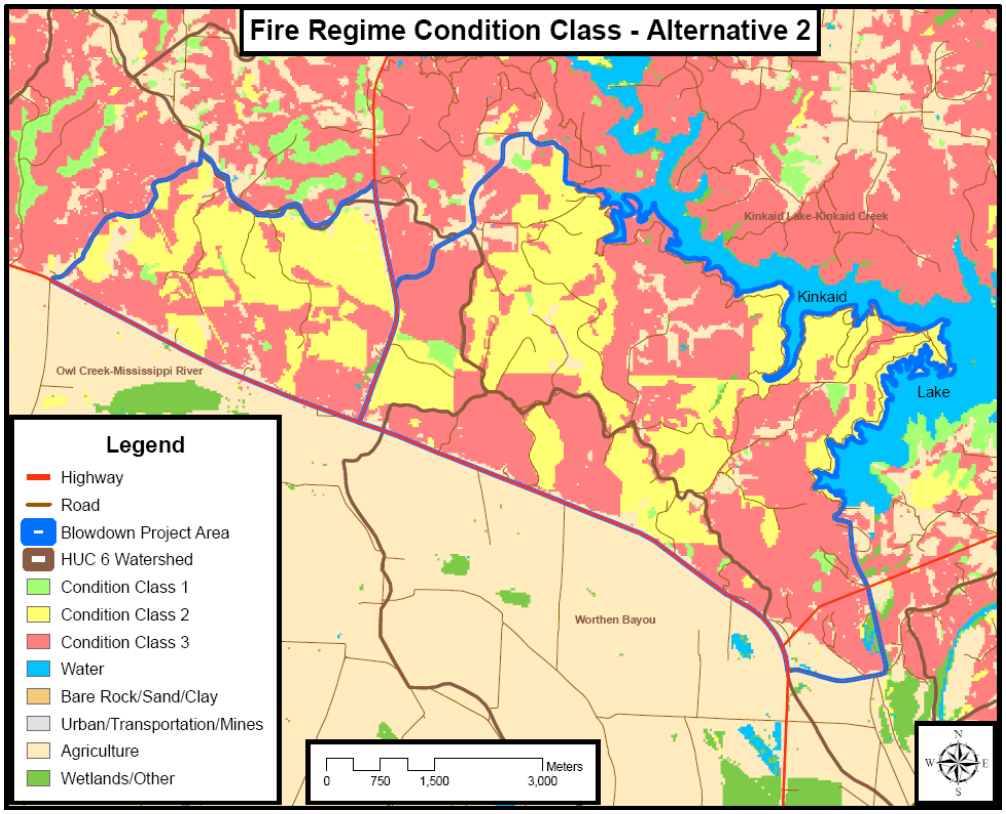
Many studies have documented the rapid reduction of mesophytic midstory and understory under any kind of burning regime, often in conjunction with an increase in herbaceous cover (Abrams 2006, Barnes and Van Lear 1998, Hutchinson et al 2005, Franklin et al 2003), though results have been mixed. Hutchinson (2006) reported that 5 burns in 15 years were sufficient to create a park-like appearance in a southern Ohio mixed oak forest. Other authors have shown that in some stands, particularly mature or closed canopy stands, or those burned under very low-intensity fires, oak regeneration and mesophyte reduction are not universally achieved (Brose et al 2006, Hutchinson et al 2005). In these instances light is still insufficient to regenerate oaks or herbaceous species, even though they will resprout. In a recent study with oak stands of similar structure and composition (average canopy cover 90-94 percent), one prescribed burn reduced canopy cover three to ten percent, though much of the canopy cover rebounded in subsequent growing seasons. Three burns reduced it five to seven percent above this. This increased light availability led to augmented seedling growth of some species, but was not considered enough to meet regeneration requirements or release oaks into the advanced regeneration pool (Alexander et al 2008). In these cases thinning or some canopy removal in conjunction with burning is often suggested in the literature to simulate the self-replacement regime that oaks had enjoyed for thousands of years. On higher-quality sites especially, burning alone may not be enough to regenerate oak and eliminate mesophytic species, though it would likely slow or halt the conversion to mesophytic dominance. Each burn would move the landscape incrementally towards a healthier Condition Class through reduction of seedling/sapling/shrub layers (especially of mesophytic species) and some overstory mortality, but it would likely take 15-30 years to restore the structure of the various natural communities, and longer if mesophytic species have reached a size where their bark is thick enough to provide some protection (Abrams 2005). It is not clear if composition can ever be totally restored (Anderson et al 2000, Nelson 2007, Abrams 2005) through burning alone. In short, Alternative 2 may be effective in reaching its stated restoration goals, such as restoring historic fire regimes and vegetative structure, but it is likely that at the 15 year mark the overall landscape may not be completely restored. The project areas under this alternative would likely end up partially in Condition Class 1 and Condition Class 2. It may take decades of restoration to recreate the reference conditions for vegetative structure, composition, fuel properties, and fire regime that developed over decades or even centuries in the past.

***Cumulative Effects -*** The spatial boundary used to evaluate cumulative effects was the project area. All activities that may affect the vegetation and fuel loading are confined to the project area. Activities occurring in the last ten years are analyzed for cumulative effects. Actions occurring earlier than this become more obscure and are harder to differentiate from other influencing factors. Future activities will be analyzed looking forward 15 years. The proposed action would be completed and the resulting effects would be complete. Thus, analysis for cumulative effects will examine from 1998 to 2023.

Few acres have been harvested in the past 10 years in areas proposed for burning. Harvested areas have more light reaching the forest floor, resulting in better germination and accelerated growth of residual trees. Prescribed fire should top kill those trees less than about 3 inches in diameter. Most trees would resprout, but oak sprouts would be more vigorous than other species. Subsequent burns would reinforce these changes as fewer shade-tolerant species resprout. Residual overstory and mid-story trees already large enough to withstand fire would mostly

survive, though a few trees may be killed. The areas receiving both harvest and prescribed burning should see better oak regeneration and growth.

Wildfires in the past 10 years have been very few and very small and have had a negligible effect to forest resources. Depending on size, severity, and timing, a wildfire could affect forest resources in the project area. The proposed burns would reduce the intensity and severity of wildfire and allow suppression at smaller sizes. Wildfires prior to burn implementation (in the next two to three years) could be severe in places and lead to higher mortality of forest resources, including overstory trees as in the no action alternative. They could also have effects to vegetation composition and structure similar to prescribed burns if they occurred under more moderate burning conditions.




**Map 5. Projected Fire Regime Condition Class under Alternative 2, the Proposed Action.**

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## Appendix B: Cumulative Effects Checklist

# Cumulative Effects Checklist

### Resource Area: Fuels / Fire Risk

### Date: May 28, 2008

The beginning of Chapter 3 of the Environmental Assessment for the Buttermilk Hill – Talbott Hollow Blowdown Project presents a list (Table 6) of the past, present and future actions with the potential to produce cumulative effects. This comprehensive list provides the basis for the cumulative effects analysis for each resource.

One or more of the following reasons should explain why the identified past, present or foreseeable future actions would not have cumulative effects:

1. The proposed action has no direct or indirect effects relative to the action.
2. The identified action has no direct/indirect effect relative to the proposed action.
3. The identified action is not geographically or temporally relevant to the proposed action.
4. There is no difference in effects between the action alternative and the no action alternative.

### Temporal Boundary

The temporal boundary of analysis will be 10 years into the future (2008-2023) for fuel bed properties, since that is the projected life of the project and the projected timing of direct and indirect effects. Past activities completed within the last ten years (1998-2008) will be analyzed for cumulative effects, since any fuel influx prior to this timeframe potentially affecting fire behavior would largely be negated by decay.

### Spatial Boundary

The spatial boundary used to address cumulative impacts (Cumulative Effects Area - CEA) was the project area, totaling 9582 acres. The project area then is bounded by State Highways 3 and 149 on the south, Spillway Rd on the east and Kinkaid Lake on the northeast, Forest Rd 638C, Gum Ridge Rd, and Dry Hill Rd on the north, and Logan Hollow Rd on the west. All activities that might affect project area fuels are confined to the project area. When combined with past, present, and reasonably foreseeable future actions on all lands this area gives a good picture of the cumulative impacts as there are 4136 acres of non-NFS lands in the analysis area.

### Past, Present or Reasonably Foreseeable Future Actions

| Agriculture (row-cropping) | About 1250 acres (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Row crop agriculture keeps and has kept fuel loads light or in a noncombustible state. Row cropping also disrupts the horizontal continuity of fuel beds, acting as a barrier to fire spread. Crop production areas would not be burned under either alternative. | |

| Agriculture (pastureland) | About 500 acres (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |

| | |
|---|---|
| X | Will not have cumulative effects with the proposal |
| Explain: Pastoral agriculture keeps and has kept fuel loads light or in a noncombustible state. These areas are often used for safety zones. Grass fuel load would be light but would have a high surface are-to-volume ratio and vertical arrangement. With limited grazing and low herbaceous moisture, these fuels could experience rapid rates of spread but short-duration burning. Little pastureland is included in burn units in Proposed Action Alternative and is not expected to burn under the conditions in which prescribed fires would be lit (high fuel moisture or recent grazing or mowing), so there would be no effect. | |

| Wildfires | About 10 acres per year (past, present and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: Past wildfire occurrence has been rare in the analysis timeframe. Still, past wildfires consumed fuel, created new snags that became available fuel, changed decay rates of residual fuel and subsequent fuel influxes, and may have altered other fuel conditions. If future wildland fires are similar to historic wildland fires in the project area, the burned areas would have reduced fuels for a few seasons afterward, but this may be offset by the influx of new large fuels from fire-killed trees. This will have little effect on overall fuel conditions if the extent of these fires is similar in the next 15 years than it was in the past 10 years (less than 1% of the area burned by wildfires); however, there is increased potential for large and/or severe wildfires in the future that may affect fuel properties. In these areas wildfires would reduce fuels, especially in smaller size classes. The unburned portions of the analysis area would not be affected. | |

| Prescribed fire | No past prescribed fire and none planned in the CEA. |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: There have been no prescribed fires in the past 10 years in the project area. No prescribed fires other than those proposed are foreseeable in the project area in the analysis period. | |

| Timber harvest | About 100-200 acres (past and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: Timber harvests (hundreds of acres) have occurred in the CEA in the past 10 years on private lands. Future harvests (about 100+ acres in the CEA) would add fuel and increase sunlight and wind to the fuel bed. Where harvests occur, the residual fuel would be similar to the moderate load blowdown. Increases in large fuels and fine fuels would be expected, though increased sun exposure may change decay rates so that leaf litter diminishes a couple seasons after an increase post harvest. Since no future harvests are within proposed burn units, fire behavior would not change expect in the case of an escape, which may be more likely with harvesting. Burn plans should take increased loading adjacent to burn units into consideration. | |

| Timber Stand Improvement | About 80 acres per year (future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: All reasonably foreseeable timber stand improvement is outside the analysis area. | |

| ATV use | Variable use in the watershed (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: ATV use has no effect on fuel properties and has not been shown to increase ignition potential. | |

| Road Maintenance | About 20 miles maintained per year (past, present and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: Though fire ignition points on the Shawnee NF are frequently along roads, past road maintenance has not been correlated to higher levels of ignitions and should have no affect on fuel conditions. Road and right of way maintenance may serve as firebreaks, limiting fire spread and the fuel reduction potential of wildfires. Also, maintained roads provide better, quicker access for fire vehicles and equipment. This would likely result in a negligible effect to fuel loads but decreases the fire risk. | |

| Road right of way maintenance | About 10 acres maintained per year (past, present and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: Road right-of-way maintenance may reduce fuels in a narrow corridor and prevent any ignitions from spreading into surrounding natural fuel beds. Ignition potential has not been linked to road maintenance. Road and right of way maintenance may serve as firebreaks, limiting fire spread and the fuel reduction potential of wildfires. This would likely result in a small decrease in fuel loads and decreases the fire risk. | |

| Tree planting | About 10 acres per year (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: In the analysis timeframe planted trees will not have grown enough to significantly add to fuel loading or shade existing surface fuels. | |

| Invasive species control | About 10 acres manual treatments per year (past and present). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Death to garlic mustard and non-target plants may temporarily cause an infinitesimally slight increase the fuel load in the immediate area, but the small size of the treatment and the exceedingly low amount of vegetation killed means it has a negligible effect on project area fuels. | |

| Brush pile creation for wildlife | About 120 acres (past). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Brush pile creation has largely been outside the spatial boundary of analysis for fuels. One project area landowner has created a few piles within burn unit 3, but these are extremely limited in area and contribute a negligible amount to the fuel loading as a whole. | |

| Utility right of way maintenance | About 25 miles maintained (past, present and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: This will reduce live fuel loads in the R-O-W and change the arrangement to horizontal, but may increase dead fuel load. Fire behavior should be much lower under the powerlines after maintenance. Since maintenance affects only 28 acres within the project area, the overall effect would be small but very important to minimize risk to power poles. | |

| Trail maintenance | About 10 miles maintained per year (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Past and present trail maintenance has not resulted in higher levels of ignitions and has no affect on fuel conditions or fire regime condition class. Future trail maintenance is expected to have similar non-effects. | |

| Horseback riding | Variable use in the watershed (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Past recreation activities including horseback riding have occurred and not affected fuel conditions or FRCC. Future activities will also not affect fuel properties. | |

| Non-system trails | Estimate less than 25 miles of trail (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Past recreation activities include hiking, horseback riding, rock climbing, hunting and other dispersed recreational activities. These activities have occurred and not affected fuel conditions or FRCC. Future activities will also not affect fuel properties. | |

| Special-Use Permits (telephone lines, electric lines, water lines, and driveways | Estimate less than 2 acres per year (past, present and future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: These activities are very limited in size and hence have no effect on fuel properties. | |

| Openlands management | Disking and planting of food plots on about 230 acres (future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: All openlands management is outside the spatial boundary of analysis. | |

| Trail construction | About 0.5 miles of trail construction to reroute an existing trail (future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Past trail construction has not resulted in higher levels of ignitions and has had no affect on fuel conditions or fire regime condition class. Future trail construction will similarly not affect fuel conditions. | |

| Shoreline stabilization - Kinkaid Lake | About 6 miles of shoreline (future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: Shoreline stabilization occurs on the shoreline of Kinkaid Lake and has no effect on terrestrial fuels. Aquatic vegetation that does develop will not burn or contribute to fire risk. | |

| Gully stabilization - Kinkaid Lake | About 900 feet (future). |
|---|---|
| | May have cumulative effects with the proposal |
| X | Will not have cumulative effects with the proposal |
| Explain: This activity will not modify fuel loading, fuel type, or arrangement and has no spatial overlap with project activities. | |

| Residential Development | About 200 homes/decade (past, present, and future). |
|---|---|
| X | May have cumulative effects with the proposal |
| | Will not have cumulative effects with the proposal |
| Explain: Residential development will reduce the horizontal continuity of wildland fuels, helping to minimize wildfire spread. Lawns effectively protect most residential structures. Development also places higher protection importance on an area, increasing the necessity of a quick suppression response. It increases complexity and cost of prescribed burning and hence fuels reduction in adjacent areas. Higher populations have been linked to increased ignition frequency. Wildland-urban interface areas have unique hazards for wildland firefighters. There would still be no cumulative effect with prescribed fire to fuel loads, however, since these activities would not overlap spatially. There could be a minor cumulative effect with fire risk. There could be increased ignition potential but reduced continuity of fuels, potentially cancelling each other out. | |

## Appendix C – Other Information

Other supporting documentation such as fuels data records, spatial data analysis, and computer modeling outputs are not possible or practical to attach electronically. Paper copies of relevant data are included in the project record.