Appendix E: Missouri Department of Conservation HCP Requirements

Over the next 50 years, forest and woodland management activities are expected to promote a diversity of forest types and ages and thus promote a diversity of suitable Indiana bat foraging and roosting habitat across the state. A lack of forest management in some areas of Missouri has led to homogeneous forests composed of dense stands lacking species and structural diversity that provide high-quality bat habitat. Most tree removal conducted by the department is aimed at directing the long-term growth, forest health, and development of a stand as it relates to the surrounding landscape. Different management techniques result in optimal conditions (e.g., low subcanopy clutter, diversity of snag-decay classes/sizes, higher solar exposure for roost trees, enhanced herbaceous vegetation promoting insect abundance and diversity) for the Indiana bat. Management techniques implemented by the department promote heterogeneity in forests across Missouri, providing appropriate species composition and forest structure necessary to maintain long-term viability of bat populations. Forests with greater diversity are more capable of coping with fluctuations in environmental conditions. Such resilience can improve forest health and its potential effects on Missouri's forests. Contemporary management of forests enhances future habitat quality, improving survival rates for the Indiana bat.

Unlike many HCPs, the department's bat HCP permits activities that **maintain** and **enhance** a landscape suitable for use by covered bats. Maintaining forest and other preferred habitats on the landscape is critical to the conservation of covered bat species. The department promotes silvicultural practices that maintain forests regionally and enhance woodlands and other habitat.

Working forests and woodlands maintain bat habitat on the landscape by reducing the chance for land conversion (i.e., natural to developed land) and provide opportunities for the department to apply conservation measures described in the HCP to avoid and minimize impacts and to enhance preferred habitats of covered bat species. Collectively, these programs help ensure that forested lands in Missouri remain forested.

The department has formulated several biological goals designed to help restore and maintain our forests and woodlands as high-quality bat habitat.

Biological Goal: Maintain a mosaic of contiguous or semi-contiguous natural lands to provide foundational habitat for covered bats.

While millions of acres of forest are publicly and privately owned in Missouri, certain forest types (e.g., shortleaf pine [*Pinus echinata*]) and conditions (e.g., disturbance regimes), have been significantly altered or even lost since the state was settled by Europeans in the early to mid-1800s. As a result, to achieve desired future conditions that are meaningful for species in the short term, it is often necessary to adjust successional pathways. Management actions will improve roosting and foraging habitat by targeting specific factors that would limit use by covered bats (e.g., overcrowding of available roost trees). Active forest management (e.g., harvesting timber and selective tree removal) is a proven and objective-based way to accelerate or redirect forest successional development. By maintaining a diversity of seral stages, overstory species, stand ages, and

harvest types, forest managers can create a shifting mosaic of conditions that is resilient to potential impacts associated with a variety of disturbances and environmental stressors. This shifting mosaic of habitat will ensure an ample supply of roosting and foraging habitat throughout the term of the HCP.

The department owns, manages, or administers more than 1 million acres of natural lands across Missouri and is committed to protecting and maintaining vital ecosystem services supported by this significant area. This is accomplished through the department's approach to sustainable forestry and habitat management. The department is also enrolled (roughly 650,000 acres) in the Sustainable Forestry Initiative, the largest forest certification body in North America and one of the only true measures of sustainability.

From a landscape perspective down to a site level perspective our HCP has it covered.

Site-Level Conservation

While the maintenance of working forests across the landscape is a primary benefit of the department's forest management programs, site-specific management similarly protects and enhances habitat for covered bats and minimizes impacts on tree-roosting bats during the spring, summer, and fall.

It is standard practice to retain certain live and dead trees during the course of timber harvest for their wildlife and environmental benefits. A retained tree, or leave tree, contributes to the next stand of trees and provides an element of structural complexity. At the site or stand level, snags, cavity, legacy, and mast-producing trees, as well as trees with loose bark or cracks or open seams, all provide important roosting elements for covered bat species. The department's tree-retention guidelines provide a mechanism for perpetuating these critical features within and across stands. The department applies tree retention guidelines to all department-administered lands, including private lands receiving coverage through the HCP under the department's authority. Collectively, tree-retention guidelines focus on retaining snags (dead standing trees), trees with cavities (could include snags), hollow trees, and healthy trees that are representative of the forest stand subject to harvest. Depending upon stand conditions and species composition, recruitment of live trees may be required to increase the pool of future snags and mast producers.

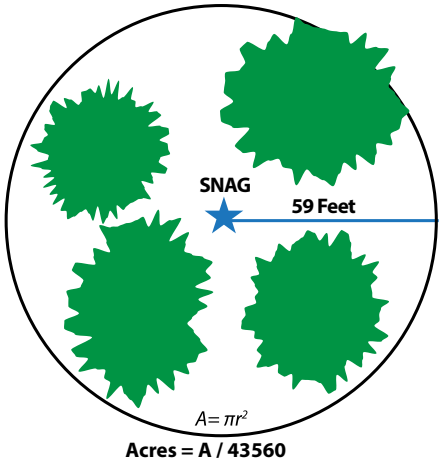
In addition, retention guidelines are aimed at fostering future roost trees. Forestry and wildlife professionals face a challenge when managing species such as Indiana, little brown, and northern long-eared bats that make extensive use of older trees associated with early to mid-successional tree species. If undisturbed, stands dominated by tree species such as oaks, hickories, cottonwoods, ashes, and elms will eventually succeed to more shade-tolerant species (such as maple). Growing a viable roost tree takes 50 to 100 years or more, and a viable snag may only remain on the landscape for a few years. The same principle applies to cavity trees, although they may remain viable for much longer periods since they may be used when alive. Potential roost trees have a short period of viability and take many years to replace. The only way to replace these aging trees is to begin growing new trees, and these are species that need substantial solar exposure to grow. As a result, providing future roost trees requires a decision to implement targeted retention guidelines and to manage existing forest (through harvest) to promote the growth of the new trees that will replace today's crop of viable roosts. As such, a key goal of the HCP is to allow the forestry and wildlife practices that will promote access to existing snags and ensure that new trees begin growing so that future generations of bats will continue to have access to viable roost trees. Additional detail on tree retention is provided within the department's HCP in Objective 3.1.

Biological Goal: Enhance, maintain, and restore roosting and foraging habitat for covered bats.

All of the covered bats make extensive use of forested habitats for foraging, and all but the gray bat roost in trees during the active season. However, not all forests provide habitat of equal value for bats. For example, intermediate forests of dense trees are close together, high in canopy coverage, and low in understory diversity and abundance. Because of these characteristics, foraging or roosting bats are less likely to use intermediate-age forests. Newly harvested stands provide large open areas that have a greater abundance of understory plant species and a greater diversity and density of insect prey. In some cases, older stands may also be more open as a result of competition; not all trees will survive to maturity, resulting in more snags that provide roosting habitat, less canopy coverage, greater light penetration, increased understory complexity, and more insects. With proper management, intermediate forests can become the high-quality roosting habitat bats require. The following best management practices (BMPs) are aimed at ensuring Missouri's forests provide areas of high-quality habitat throughout the 50-year permit term.

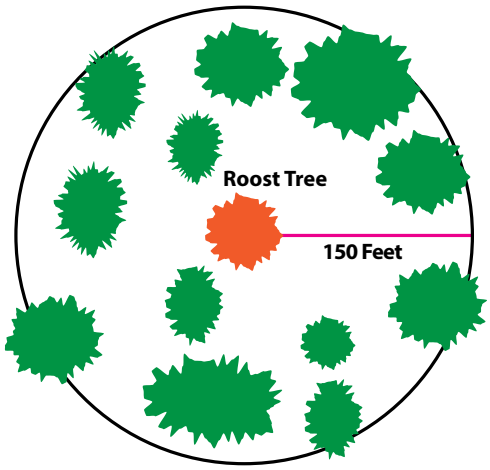
The department follows the following BMPs:

Retain all snags except where public or worker safety concerns or disease/insect outbreaks in a stand constitute a threat to the health of the surrounding forest.



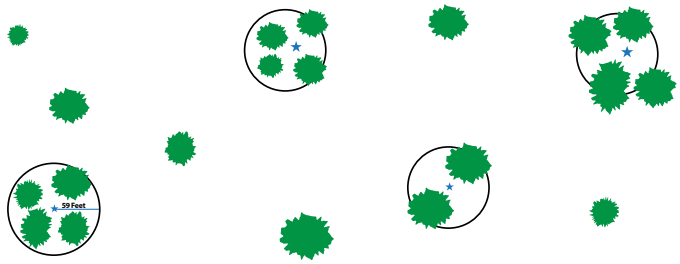
In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre, create leave-tree patches that are variable in size (but a minimum of 0.25 acre) and located throughout the harvest unit.

Retain all known maternity roosts for covered bats. Known maternity roosts are those within the Natural Heritage Database with documented use by multiple (>1) reproductive females over multiple nights (>1).



All known roost trees must be buffered by a 1.62-acre patch.

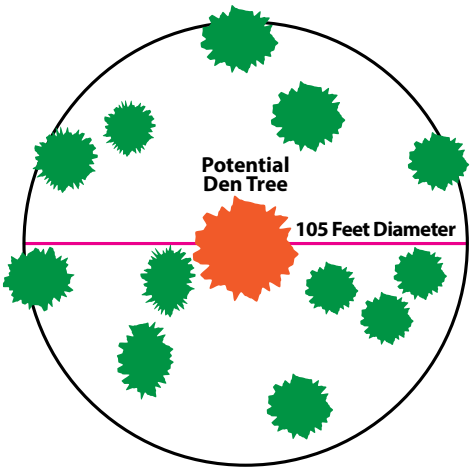
Retain patches or aggregations of trees, which are generally preferred over a scattered distribution of trees. The maintenance of both snags and live trees is important because snags are ephemeral (i.e., they fall down or lose their bark). Retaining snags and live trees with the potential to become roosts helps to provide a continuing supply of roost trees for covered bats. Retain patches of varying size distributed in clumps throughout the harvest unit. All known roost trees will be buffered by a 1.62 acre patch. Additional information on patch sizes for even- versus uneven-aged stand management is provided in the table below.



In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre, create leave-tree patches that are variable in size (but a minimum of 0.25 acre) and located throughout the harvest unit.

Retain multiple den trees, unless none are found. Although den trees can be long-lived, they are prone to developing additional roosting habitat, such as exfoliating bark, sooner than live trees without cavities. To facilitate den tree retention and development, the department and landowners participating in the HCP will use the following practices:

- **Retain** a minimum of three den trees (optimum of seven) per acre in heavily forested areas.
- **Retain** up to 25 den trees per acre in riparian forests.
- **Prioritize** den trees with cavities higher than 20 feet above the ground.



When den trees are not present, retain a 0.2-acre (105-foot-diameter) group of trees around at least one large-diameter tree that may potentially serve as a den tree.

When den trees are not present, retain a 0.2-acre (105-foot-diameter) group of trees around at least one large-diameter tree that may potentially serve as a den tree. Although den trees provide preferred roosting structures (e.g., cavities and foliage), for some species, such as the northern long-eared, little brown, and tricolored bats, they do not necessarily provide habitat for the bark-roosting Indiana bat. For this reason, when available, den trees with multiple types of roosting structures (e.g., cavities, crevices, exfoliating bark) will be used. Species such as shagbark and shellbark hickory (*Carya ovata* and *C. laciniosa*) can exhibit these characteristics.

On average, retain two to four super-canopy trees (trees that are taller than the surrounding trees), or those with potential to become such trees, per acre in riparian areas and bottomland forests to promote structural diversity and provide large leafy surfaces for foraging activities. Sunlight reaching the bark of trees is important for roosting bats. Often portions of boles or branches of these trees receive greater solar exposure than trees beneath the canopy. When super-canopy trees grow old or are exposed to storm damage, the tree can become damaged or die and develop suitable roosting structures. Some tree species, such as shagbark or shellbark hickory, develop and maintain suitable roost structures when alive and can provide long-term potential roosting habitat for covered bats.

Create snags if insufficient snags exist, based on average per-acre targets. Concentrate on creating large diameter (greater than 16-inch) snags with exfoliating bark for bat maternity habitat. When creating snags, hickory will be used when it is present on the landscape. When selecting snags to retain, physical structures that provide roosting opportunities are considered more important than tree species. However, some tree species, such as shagbark and shellbark hickory, tend to develop preferred roosting structures more than others. When creating snags, the department and landowners participating in the HCP will leave, if present:

- One existing, potential, or future snag greater than 20 inches diameter at breast height per acre.
- Four existing, potential, or future snags between 10 and 20 inches diameter at breast height per acre.

Recommended snag/den tree creation and retention targets are greater for certain forest habitats (i.e., riparian corridors and bottomland hardwoods). When prioritizing snag creation, larger-diameter trees are preferred. Smaller-diameter snags are used as secondary roosts by Indiana and little brown bats but can be used as primary roosts by northern long-eared and tricolored bats. Secondary roost trees occur in greater numbers on the landscape than primary roosts and serve as important ancillary roost sites for bats.

Use the following table to ensure compliance.

Even-Aged Stand Management Conservation Measures	Uneven-Aged Stand Management Conservation Measures
Snag Retention	
Retain all snags except where public or worker safety concerns exist or where catastrophic weather events or disease or insect outbreaks in a stand constitute a threat to the health of the surrounding forest.	Retain all snags except where public or worker safety concerns exist or where catastrophic weather events or disease or insect outbreaks in a stand constitute a threat to the health of the surrounding forest.
Retain Patches/Leave Trees	
In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre harvest reduces basal area below 30 square feet per acre, uncut patches totaling at least 5% of the harvested area will be retained. In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre, create leave-tree patches that are variable in size (but a minimum of 0.25 acre) and located throughout the harvest unit. When working in a riparian corridor, depending on stocking rate, always leave at least one-third of the typical-sized trees and 40 square feet of basal area or greater. One-half to two-thirds of typical-sized trees is recommended. In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre, leave one or more large live trees (retain hickory 16 inches or greater diameter at breast height if available), otherwise retain trees greater than 18 inches diameter at breast height, or as large as available) to provide for a continuous supply of future roost trees. In stands greater than or equal to 20 acres where harvest reduces basal area below 30 square feet per acre, locate leave-tree patches near or adjacent to riparian management zones, wetlands, or seasonal pools. Wildlife openings are encouraged; however, riparian buffers should not be used for all reserve islands because snag and leave-tree patches are also important in upland forest treatments. Locate patches in draws and along protected slopes, near the edge of the stand on ridge-top locations, or just below the ridge, if possible, to reduce the potential for windthrow. Focus patches to coincide with such features as wetland inclusions, ponds, one or more active dens trees or cavity trees, or at least good candidates for potential cavities.	Maintain a minimum basal area of 30 square feet and where possible retain at least 16 live trees greater than 9 inches in diameter at breast height per acre (with at least 6 trees per acre of the largest available trees of species favored by roosting bats, which will vary by bat species and geographic locations) Where insufficient large trees (9 inches in diameter or greater) are available to meet silvicultural management needs while providing the number and size of trees noted above, use the 16 largest trees available per acre, to provide adequate canopy cover and roost-tree availability. When working in a riparian corridor, always leave at least one-third of the typical-sized trees.
Openings	
If openings are created for forest regeneration, those stands will be thinned and/or burned during appropriate seral stages to create and maintain high-quality foraging habitat in the future.	Create relatively small openings (less than 5 acres) where practicable because they may provide the best balance between maintaining foraging and roosting habitat across the landscape. Where practicable, maximize the amount of edge habitat (e.g., through the creation of long and narrow openings) to provide a greater amount of foraging habitat and additional predator protection. When creating openings, consider both the bat species and the amount of sunlight needed for forest regeneration. Larger openings provide more sunlight to regenerate future roost trees. However too large an opening (greater than 45 acres) may affect bat occupancy.

The department is required to adhere to the tree retention guidelines that maintain suitable roost trees on the landscape and retain patches of forest throughout the permit term. Current retention guidelines apply to all individual sites that are harvested. However, for monitoring purposes, results should be assessed at the landscape level (e.g., 320 acres or more) because it's not always feasible to meet the specified requirements at each site. For example, certain sites may not contain snags, or the snags present may present hazards and thus require removal.

Roost Tree BMPs

These restrictions avoid direct mortality and will be extended to all known roosts of the covered bats. For all covered bats, a 1.62-acre buffer will be established around all known maternity roost trees, within which tree cutting and prescribed burning will be restricted to the non-maternity season (September 1 to March 31). For the remainder of the year, this area will be protectively managed and/or enhanced for the species of bat known to be present. If a known roost tree falls or is shown to be abandoned, the protective buffer will be removed.

The department has established priority bat management zones (PBMZ) to protect bats and their pups and promote high-quality bat habitat in areas of known or potential bat activity. The department's PBMZs cover, at a minimum, 28,000 total acres across the state. Seven thousand acres have been delineated for each of the four covered bat species that have summer and maternity roosts in trees (i.e., Indiana bat, little brown bat, northern long-eared bat, tricolored bat). PBMZ locations were selected based on existing survey data and habit quality. Within the PBMZs, removal of trees equal to or greater than 9 inches diameter at breast height will be avoided between April 1 to August 31 and prescribed fires will be avoided between May 1 and July.