

**Coal Mining in Tennessee,
Minimum Guidelines for Development of
Protection and Enhancement Plans
for the Indiana Bat (*Myotis sodalis*)**

March 2006

**Developed by
U.S. Fish and Wildlife Service
and
Office of Surface Mining**

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INTRODUCTION

The Office of Surface Mining (OSM) and U.S. Fish and Wildlife Service (FWS) have coordinated with the Tennessee Wildlife Resources Agency (TWRA) and Tennessee Department of Environment and Conservation (TDEC) to develop this document. Hopefully, these guidelines will aid coal mining applicants in understanding the options and protocol associated with mining in areas containing known or potential Indiana bat habitat. This document was developed using the most current scientific research regarding the Indiana bat, its habitats and behavior. As new research efforts result in additional knowledge about the species, revisions to this document may be necessary. Note that TWRA and TDEC's Division of Natural Heritage should be consulted regarding state-listed species that may be impacted by mining.

BACKGROUND

The scientific name for the Indiana bat is *Myotis sodalis*. *Myotis* is the combination of two Greek words meaning "mouse ear", and *sodalis* refers to the word "companion." This name, *Myotis sodalis*, aptly describes the colonial nature of the Indiana bat. *M. sodalis* received its common name after the first specimen was collected in Indiana and described by Miller and Allen in 1928. The species is also referred to as a social bat because of its tendency to congregate in large groups during winter hibernation.

The Indiana bat is approximately the size of a small mouse (body length of 7.5-9 centimeters), and the wing span is several times the average body length, ranging from 24 to 27 centimeters. Weights range from 4.5 to 9.5 grams, females being larger than males. The range of the Indiana bat extends from Oklahoma, Iowa, and Wisconsin east to Vermont and south to the northwestern part of Florida. Formally listed as endangered throughout its range on March 11, 1967, *Myotis sodalis* is currently protected under the Endangered Species Act of 1973 (Public Law 93-205, as amended).

Indiana bats hibernate during the winter months. By entering a sleep-like state known as torpor, they greatly reduce their metabolic rate. Bats use the body fat accumulated in the fall, "sleeping" through the season when their food source (flying insects) is not available. *M. sodalis* hibernates in limestone caves, sandstone rock shelters and abandoned mines, known as hibernacula (the singular of which is "hibernaculum"). Most Indiana bats hibernate in a few hibernacula in Kentucky, Indiana, and Missouri. They require very specific habitat features in these hibernacula, with cool, stable temperatures (preferably between four and eight degrees Celsius, i.e. between 40 and 48 degrees Fahrenheit) and humidity above 74 percent but below saturation. During hibernation, Indiana bats cluster in groups with densities reaching 300 to 450 bats per square foot.

After hibernation, most females depart from the caves and abandoned mines during April, while males typically remain longer before migrating to summer habitat. A few males

may even occupy hibernacula during the summer months. Females migrate to summer habitats where they will congregate to bear and raise young in groups known as maternity colonies. These colonies are usually found under exfoliating bark of dead or live trees, in cavities of trees, or in snags (i.e., dead trees or dead portions of live trees). Maternity colonies often use several roost trees, depending on weather conditions. The use of manmade structures (e.g., barns, a church, bat boxes, and an electric transformer bracket) for roosting during summer has also been documented. Pregnant females typically give birth to a single young bat in late June, and juveniles are capable of flying within a month.

Females and juveniles return to the hibernacula in early September. As the females return, an activity known as swarming occurs outside the hibernacula or nearby caves. During swarming, the bats fly in and out of the hibernaculum. This is the period when *M. sodalis* mate and forage to build up fat reserves for the winter. By late October or early November, Indiana bats have entered the hibernacula for the winter. Hibernation is driven by ambient temperature and may occur later or earlier depending on weather conditions.

APPLICANT OPTIONS

A mining operation may affect the Indiana bat in a situation where an area of proposed surface disturbance is located within ten miles of a documented Indiana bat hibernaculum or within five miles of a site known to have been occupied by the species during a non-hibernation period. In any case where Indiana bats may be affected within some portion of a proposed mining or mining-related area, the entire permit area will be considered an area of potential impacts. OSM and FWS personnel will coordinate about species protection measures, and the applicant will receive written notification from OSM regarding any deficiencies in the permit application. Under certain circumstances where the Indiana bat is known to use habitat on or adjacent to the proposed permit area, the applicant may be required to assume presence of the species. This will be detailed in a letter to the applicant from OSM or FWS. The applicant must choose one of the four options described below and follow the protocol set forth for that option. The applicant is encouraged to consult with OSM, FWS, TDEC, and TWRA personnel throughout the permit application process.

Option 1. Assume the summer presence of the Indiana bat on a proposed permit area that has no open caves or abandoned mine portals.

This option requires:

- An Indiana Bat Protection and Enhancement Plan (see page 6)

Option 2. Survey to demonstrate presence or probable absence of the Indiana bat in summer habitat on the proposed permit area. This is only applicable for proposed permit areas which do not have any open caves or abandoned mine portals.

This option requires:

- A Summer Habitat Mist Net Survey - Survey Plan and Survey Report (see page 4, Appendix A, and Appendix B)
- An Indiana Bat Protection and Enhancement Plan if the species is found to be present (see page 6)

Option 3. Survey to demonstrate the presence or probable absence of the Indiana bat in both summer and winter habitat on the proposed permit area. This option is for proposed permit areas which have open caves and/or abandoned mine portals that have the potential for winter use by the Indiana bat in addition to potential summer habitat.

This option requires:

- A Summer Habitat Mist Net Survey - Survey Plan and Survey Report (see page 4, Appendix A, and Appendix B)
- A Portal Habitat Assessment (see page 5 and Appendix C)
- A Summer Portal/Cave Survey if there is suitable habitat for bat use of portals or caves - Survey Plan and Survey Report (see page 5, Appendix B, and Appendix D)
- A Fall Portal/Cave Survey if there is suitable habitat for bat use of portals or caves – Survey Plan and Survey Report (see page 5, Appendix B, and Appendix D)
- An Indiana Bat Protection and Enhancement Plan if the species is present (see page 6)
- A Portal Closure Plan if a small number of bats is found (see page 10)

Option 4. Assume presence of the Indiana bat on a proposed permit area that has open caves and/or abandoned mine portals.

This option requires:

- An Indiana Bat Protection and Enhancement Plan (see page 6)
- A Portal Habitat Assessment (see page 5 and Appendix C)
- Fall Portal/Cave Survey if there is suitable habitat for bat use of portals or caves - Survey Plan and Survey Report (see page 5, Appendix B, and Appendix D)
- A Portal Closure Plan if a small number of bats is found (see page 10)

SURVEY REQUIREMENTS

The period during which survey results remain viable for Indiana bats is limited. The potential for impacts to the species must be re-assessed if a mining operation is not completed within three years of the date on which a survey for the species is conducted.

The capture of bats confirms their presence. Although failure to catch bats does not guarantee their absence, negative data acquired during a survey conducted in accordance with approved protocol will be accepted as confirmation of the absence of the Indiana bat. Capture of Indiana bats should be interpreted carefully. Although the capture of a single male or non-lactating female may represent a transient or migratory individual, the bat's presence at a particular location is important. Capture of lactating females or juveniles during the summer likely indicates a nearby maternity colony. Multiple captures at a cave or mine portal during the fall sampling period indicates the probable presence of a hibernaculum.

Summer Habitat Mist Net Surveys

1. Summer surveys must be conducted between May 15 and August 15 and prior to any tree clearing. A minimum of two nights of mist netting is required.
2. Net sites: A net site consists of two net locations no less than 30 meters apart.
 - a. For every square kilometer (247 acres) of forest within the permit area, two net sites for two nights are required.
 - b. In addition, one net site for two nights is required for each kilometer of intermittent or perennial stream corridor located within the proposed permit area.

The sampling period should begin at sunset and last at least five hours, even if Indiana bats are netted early in the evening. If bat activity has not declined after five hours, survey efforts shall continue until activity declines.

Weather Conditions: Severe weather adversely affects the capture of bats. If Indiana bats are caught during weather extremes, it is probably because they are at the site and active despite inclement weather. A lack of bat captures may result from an absence of bats at the site, or they may be inactive in order to avoid weather conditions. Negative results combined with adverse weather conditions during a substantial portion of a sampling period will require additional netting. The time and duration of any of the following adverse conditions are to be documented in the survey report:

Precipitation.

Temperatures below 10°C (50°F).

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Strong Winds. Use your judgment; moving nets are more likely to be detected by bats.

Moonlight. There is some evidence that small myotine bats such as *Myotis sodalis* avoid brightly-lit areas, perhaps as a predator avoidance mechanism. It is typically best to set nets under the canopy where they are out of moonlight, particularly when the moon is half full or greater.

Equipment: Mist nets should be made of the finest, lowest visibility mesh commercially available. Currently, this is two-ply, 50-denier nylon (denoted 50/2). The mesh size should be approximately 1 ½ (1 ¼ - 1 ¾) inch. No specific hardware is required.

Net Placement: Potential travel corridors such as streams or abandoned forest access roads are typically the most effective areas to sample during feeding activity. The presence of water in road ruts, woodland ponds, and streams increases the likelihood of bat use. Nets should be placed approximately perpendicular to the corridor. Nets should fill the corridor from side to side and from stream or ground level up to the tree canopy. A typical net configuration is seven meters high (three nets “stacked” on top of each other) and up to 20 meters across.

IMPORTANT: One or more members of each field survey crew must hold (and have in their possession) valid endangered species collecting permits issued by the FWS and TWRA. Assistants must be designated as agents of the federal permittee and have in their possession a copy of the letter so designating them for the specific survey.

Summer Portal/Cave Surveys:

Summer surveys must be conducted between May 15 and August 15 and prior to any tree clearing. A minimum of two nights of sampling is required.

The applicant must first conduct a Portal Habitat Assessment of all open caves and mine portals on the proposed permit area, and a report with photographs of each portal opening is to be submitted with the survey study plan. This will facilitate determination of the need for a bat survey. See the sample data sheet in Appendix C for more information.

If the minimum external air temperature falls below 10°C (50°F), the survey is to be postponed until acceptable temperatures are attained. Otherwise, sampling period, weather conditions, and equipment should comply with those specified in the above “Summer Habitat Mist Net Surveys” section. In addition, harp traps may be used to survey potential hibernacula where the cave or portal configurations are suitable and where open areas at the sides and top of traps can be enclosed. Entrances to caves or portals are to be entirely enclosed by the survey gear.

In cases where one team of surveyors cannot feasibly sample all caves or portals on the proposed permit area in one night, a modified method may be used. This method may only be used in association with caves and portals that are known to be interconnected. During use of this modified method, half of the interconnected openings are netted on the first night. The other half of the openings are completely blocked using plastic or other material. On the second night, this is reversed. Caves and portals that are completely isolated do not need to be netted simultaneously.

CAUTION: Do not completely block portals unless inter-connection is certain.

Fall Portal/Cave Surveys:

The applicant is to conduct a Portal Habitat Assessment of all open caves and portals on the proposed permit area, and a report with photographs of each portal opening is to be submitted with the survey plan. This will facilitate determination of the need for a bat survey. See Appendix C for a sample data sheet.

Fall portal/cave surveys must be conducted between September 15 and October 31, and prior to any tree clearing. Sampling period, weather conditions, equipment, and modification of the sampling method for multiple cave or portal openings are to comply with those specified in the above “Summer Portal/Cave Surveys” section.

PROTECTION AND ENHANCEMENT PLAN

This plan is to be developed for use in cases where the applicant has elected to assume presence of the Indiana bat, where the species is known to exist based on species records as maintained by the Division of Natural Heritage, Tennessee Department of Environment and Conservation, or where the species is collected during surveys. As long as all the minimum guidelines are fulfilled, the applicant can create a protection and enhancement plan that best fits the circumstances of the proposed mining operation. A checklist is provided in Appendix E for the applicant’s reference in preparing the protection and enhancement plan.

As the applicant creates a protection and enhancement plan for the Indiana bat, certain objectives must be met. The first objective is to acceptably minimize the potential to take (i.e., harm or harass) an Indiana bat. This can be partially accomplished by removing any potential roosting/maternity habitat during a time when the bat is not present. The second objective is the short-term replacement of the habitat that was lost during the mining operation. The final, long-term objective in conserving roosting/maternity habitat is to restore and enhance the Indiana bat habitat that previously existed on the mine site. Hibernation, feeding, and watering needs at mine sites must also be met as appropriate.

Recommendations for fulfilling the required objectives are discussed below. Alternative practices are permitted upon approval by FWS.

Minimizing the Potential Take of an Indiana Bat

Tree Clearing: This involves removal of all potential roost/maternity trees within the area of proposed surface disturbance. An individual with Indiana bat expertise, subject to approval by FWS, is to identify and mark potential maternity and roost trees for felling during the approved clearing dates (i.e., between November 15 and March 31). The FWS office in Cookeville, Tennessee, maintains a list of bat biologists who hold a current Federal collecting permit; this list is available upon request. Mining operations shall begin within 12 months after potential roost/maternity trees have been felled. The individual that identifies and marks trees for felling is to contact OSM personnel if potential roost/maternity trees need to be felled outside of the clearing period. Strict adherence to best management practices for erosion control during the felling of trees is strongly recommended.

Mining applicants are encouraged to fell the minimum number of trees necessary during winter. However, an alternative to selective felling of potential roost/maternity habitat is to fell all trees during the approved clearing dates. This option will not require the services of a biologist.

Stream Protection: Bats rely on streams and other water bodies as drinking water sources. Aquatic habitats are also valuable areas for production of invertebrates that can be a primary component of Indiana bats' diets. Therefore, the maintenance of high quality surface waters is important to this species. A standard stream protective measure during coal mining involves the maintenance of a minimum 100-foot buffer zone along each side of intermittent and perennial streams.

Mining applicants occasionally request authorization to conduct mining and related activities within the 100-foot buffer zone. These activities have the potential to adversely affect water quantity, quality, or other environmental resources of streams. In-stream impacts are specifically regulated by several Federal and State agencies. To varying degrees, the statutes and regulations require that an applicant prevent, minimize, or compensate for impacts to aquatic resources.

For instance, regulations enforced by TDEC specify that disturbances shall not result in impairment to designated stream uses. Likewise, FWS must find that mining or its associated activities will be consistent with the FWS's 1996

Biological Opinion, and therefore will not jeopardize the continued existence of a threatened or endangered species before consultation with OSM is completed for a permit application. Such findings by FWS will be provided only if the stream use classification does not meet TDEC's specifications for impairment. Site-specific decisions will be coordinated by OSM and FWS with U.S. Army Corps of Engineers, TDEC, and TWRA personnel in determining the appropriateness of any request for a stream buffer zone variance.

Portals and Caves: Assessment and surveys (if needed) of abandoned mine portals are to be conducted prior to closing. If any Indiana bats are found during a survey, coordination with OSM and FWS personnel will be required. Caves are not to be closed unless specifically coordinated with FWS and authorized by OSM. The applicant is to consult with OSM personnel to determine the need for use of gates and required design specifications. For the purposes of these guidelines, an underground void that has not been excavated or otherwise created by people is considered to be a "cave". Some "rock shelters" may be considered caves in cases where enough space is available for sheltering of bats.

Confirmation of Protective Measures: After trees have been removed and caves and mine portals have been assessed by an Indiana bat expert, a request for initiation of mining must be submitted to OSM. Commencement of mining activities will be authorized after adequate implementation of protective measures has been confirmed by the regulatory authority. Subsequent to regrading and revegetation, short-term habitat replacement measures (i.e., tree girdling) are to be implemented.

Short-term Habitat Replacement

Tree Girdling: Girdling trees along the entire perimeter of the permit area or within the undisturbed areas of the permit can create short-term roosting habitat. Trees selected for girdling should be among those species listed in Appendix F. If there are not enough trees from the list of the appropriate size, other species may be substituted. Girdling of trees with tight bark such as American beech and sycamore is not appropriate. Trees are to be selected for girdling by a person with expertise in tree identification. Girdling trees with a dbh (diameter at breast height - i.e., 4.5 ft) of 9 inches or more is sufficient, and these trees shall be spaced no more than 500 feet from each other. The permittee shall use a unique method to mark girdled trees in order to simplify future inspection efforts. This method should not involve a mark that will slough off of trees with bark as the trees die. It is important not to girdle every available large tree. Timing of tree-girdling should coincide with regrading and revegetation. OSM personnel are to be contacted if this timing is not compatible with the mining plan.

Girdling may not be necessary if an adequate number of potential roost/maternity trees exists within one mile of the entire permit area (i.e., no portion of the permit area should be over one mile from suitable habitat) at the time of regrading and revegetation. Roosting/maternity habitat will be considered to be suitable in cases where potential roosting/maternity structures are present at a density of one or more per acre. The permit applicant should demonstrate the adequacy of this habitat through documentation of its critical components including the existing habitat quality (i.e., approximate forest age and size of living trees), acreage extent of the forest, and distance from the permit boundary to the nearest forest edge.

In cases where a portion of a permit area is 500 feet wide or less (e.g., some contour mines), it may be appropriate to girdle trees along only one edge of the permit boundary. This deviation from the standard girdling guideline should be coordinated with OSM and FWS. The permit boundary to receive the greatest solar exposure is to be used for girdling in order to maximize the heating of potential bat roosting/maternity habitat.

Bat Houses: Bat houses may be used as an optional practice in addition to (i.e., not instead of) the girdling of trees. Note that Indiana bats appear to more readily occupy “rocket box” style houses with double walls.

Long-term Habitat Replacement

Watering Areas: High quality, accessible water is very important to the Indiana bat. Watering areas need to be created in the form of shallow water depressions designed to provide water during October. Depending on soil conditions, ponds with depths of eighteen inches to three feet in mid-June will generally meet this specification. One depression is to be placed per half mile of narrow contour cuts or one per 50 acres of flatter mining area. These depressions should be placed immediately adjacent to existing trees (e.g., usually along permit boundaries) in order to take advantage of habitat used by bats as escape cover. The retention of sediment basins may be appropriate in cases where they are linked to forested areas, contain high quality water year-round, do not have an unstable embankment, and are not overly entrenched. For example, an eight-foot distance between water surface and top of the original pond banks may generally be considered overly entrenched where the mean width of a water source is less than forty feet. In cases where permanent water sources are located one-half mile or less from all points within a permit boundary, creation of watering areas is not necessary.

Tree Plantings: In addition to the language normally incorporated into the applicant’s discussion of revegetation success standards as per 30 CFR 816/817.116, this discussion must also indicate the following. All permitted acreage that

encompasses disturbed ground, minus areas occupied by permanent roads, ponds, and structures existing at the time of final bond release, must be planted with a minimum of four different tree species from the list in Appendix F. Species selection will be determined by site-specific characteristics (e.g., soil type, drainage, and sun exposure) with approval by OSM prior to planting. The species list will be a primary consideration of the FWS in determining its concurrence (or lack thereof) with the fish and wildlife protection and enhancement plan. Stocking success at the time of final bond release will be a minimum of 250 stems per acre. A minimum of three species identified as 'Exfoliating Bark Species' on the Appendix F list must be planted and maintained at the rate of 150 stems combined total or more per acre. One or more of these must be an oak or hickory. The remaining 100 stems per acre may be selected from any of the categories in the species list or may be volunteers (i.e., present as a result of natural succession). No more than 50 stems per acre may be black locust. Trees should be planted at approximately equal rates in a pattern that assures compatibility with microhabitat features (i.e., soil moisture and fertility and solar exposure) and reasonably equal distribution of all species across the permit area.

Minimum Compaction: OSM, FWS, TWRA, and TDEC personnel strongly encourage coal operators to utilize the Forestry Reclamation Approach (FRA) during reclamation, which includes minimizing compaction of the growth medium during the final grading of a mine site. Reduced compaction greatly improves tree survival and growth, and enhances wildlife habitat. For further information about the FRA, contact OSM.

PORTAL CLOSURE PLAN

This plan details the approved exclusion methodology for the complete and permanent closing of a mine portal that does not act as a hibernaculum for Indiana bats. It must be submitted as part of the protection and enhancement plan. Exclusion activities are limited to the periods of May 1-15 and August 1 - November 5 and require two nights of observation. Closure shall not occur until a fall portal survey has been conducted and approval of the survey report has been provided by FWS and OSM. Note that portal closure will be authorized only in cases where five or fewer bats of any species are caught during a portal survey.

Be aware that entry of abandoned mine portals can be dangerous because of the potential for ceiling collapse and presence of toxic gases. Safety or health problems may occur during or after entry of abandoned mines. OSM, FWS, TWRA, and TDEC do not authorize or regulate this activity.

Exclusion Methodology

Night 1 of closure includes:

Portals will be observed during the standard emergence period (typically within two hours after dusk). Night vision equipment may be used to assist in this task. The approximate end time for emergence will be noted.

After emergence is complete, chicken wire with one-inch mesh will be placed securely and completely over the openings to deter bats from re-entering.

Night 2 of closure includes:

Prior to dusk (and emergence) the chicken wire will be removed to allow any trapped bats to exit. Emergence will be observed during the standard time period as noted previously. The one-inch mesh chicken wire will be secured over the openings until permanent closure is completed.

This wire closure will remain intact and functional over the opening. If at any point this covering is disturbed to the point that it no longer serves its function, the process will begin again.

AGENCY COORDINATION

Six copies of each survey plan, survey report and/or protection and enhancement plan are to be submitted to OSM; four for incorporation into the proposed permit application and two for distribution to FWS and TWRA for expeditious review. The applicant will receive notification from OSM regarding the acceptability of the submissions after receipt of comments from the reviewing agencies.

The applicant is encouraged to consult with OSM, FWS, TDEC, and TWRA personnel throughout the permit process. The applicant will receive final notification from OSM regarding acceptability of the Protection and Enhancement Plan.

APPENDIX A

SURVEY PLAN FORMAT

1. Introduction
 - a. Why and for whom the survey is being conducted.
 - b. Objectives of the survey.
2. Description of Study Area
 - a. General physiographic description.
 - b. Detailed description based on site-specific reconnaissance and existing data (e.g., county, USGS quadrangle, location, elevation, watershed, stream(s), land use history, proposed mining operation methods, acreage, major vegetative cover types, etc.).
 - c. Map showing proposed permit area and netting locations (1:24,000 scale is sufficient). Include cave/portal locations if appropriate.
3. Materials and Methods
 - a. Number of mist net locations: based on two mist net sites per square kilometer (247 acres), one per kilometer of intermittent or perennial stream, and one per cave or mine portal.
 - b. Description of mist nets (e.g., mist nets to be used have a mesh size of three centimeters, 50 denier/two-ply nylon, a length of six to nine meters, and will be stacked seven meters high).
 - c. Description of proposed mist net locations.
 - d. Proposed mist netting dates: If mist netting between May 15 and June 1 or between October 15 and 31, minimum temperature data for the site must be recorded for the week preceding the proposed survey dates. If the minimum temperature falls below 10°C (50°F), the survey should be postponed until acceptable temperatures are attained.
 - e. Approximate time and duration of mist-netting activities.
 - f. State that the survey will only be conducted during appropriate weather conditions (i.e., not during precipitation event, strong winds, or temperatures below 10°C).
4. Literature Cited
5. Personnel - include resumes of all personnel to be participating in the survey and copies of all applicable collecting permits and agent designations (as an Appendix). Indicate which biologists will be identifying bats.

APPENDIX B

SURVEY REPORT FORMAT

1. Introduction
 - a. Why and for whom the survey was conducted.
 - b. Objectives of the survey.
2. Description of Study Area
 - a. General physiographic description.
 - b. Detailed description based on site-specific reconnaissance and existing data (e.g., county, USGS quadrangle, location, elevation, watershed, stream(s), land use history, proposed mining operation methods, acreage, major vegetative cover types, etc.)
 - c. Revised maps, if necessary, as described in Appendix A, item 2c.
3. Materials and Methods
 - a. Describe net locations, net set-up (include net height), survey dates, duration of survey, weather conditions, anything that is different from the study plan.
 - b. Include copies of data sheets (as an appendix).
 - c. Map identifying mist net locations.
4. Results
 - a. Table with information on all bats captured during the survey including: capture site, date of capture, time of capture, sex, reproductive condition of females, age, weight, direction of flight (if a cave or mine portal survey). A sample data sheet is shown in Appendix D.
 - b. Include photographs of the net locations and all Indiana bats captured.
5. Discussion of Results
 - a. Description of weather conditions that occurred during the survey and effects they might have had on the survey.
 - b. Description of bat habitat at each site and on the overall permit area (presence of water, tree canopy density, understory and travel corridors).
 - c. General description of bat findings relative to site conditions, habitat adjacent to proposed permit area, and regional expectations.
 - d. Conclusion to be drawn from findings regarding potential impacts to the Indiana bat.
 - e. If Indiana bats are to be impacted during the proposed mining, include protective and enhancement measures to be taken during the active mining phase and reclamation/post-mining phase.

APPENDIX C

PORTAL HABITAT ASSESSMENT DATA SHEET

Location: _____

Observers: _____

Latitude/Longitude: _____

Date: _____ Time: _____ Temperature (external): _____

Photos of all portals included: _____

Portal #1 Portal #2 Portal #3 Portal #4

Opening (vertical or horizontal)
Opening size: height x width (or
diameter)
Internal dimensions: height x width
Slope (up or down from entrance)
Entrance stable?
Direction of airflow (in or out of portal)
Amount of airflow (slight, heavy)
Internal air warmer or cooler than
external temperature?
Evidence of collapse ?
Ceiling condition
Amount of water in portal
Evidence of past flooding?
Observed length of portal
Distance to nearest water source
Percent obstruction of portal entrance by
trees, slide, etc.
Foraging signs (e.g., moth wings)?
Are any portals suspected or known to
be connected? Which ones?
Any observable side passages present?

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APPENDIX D

SAMPLE DATA SHEET FOR PORTAL SURVEYS

Date: _____ Temperature: Start _____ End _____
Precipitation: _____ Wind: _____
Moonlight: _____ Time: Start _____ End _____
Personnel: _____

Mist net number/name

Location

Time of capture

Species

Sex

Weight (grams)

Age

Reproductive condition of females

Flight direction if portal survey (in or out)

Band # (if applicable)

APPENDIX E

PROTECTION AND ENHANCEMENT PLAN CHECKLIST

This list is provided to assist the applicant in the development of Indiana bat protection and enhancement plans.

Minimizing the Potential Take of an Indiana Bat

- Appropriate dates for removal of potential roosting/maternity habitat
- Portals and caves addressed
- 100-foot stream buffer zone around intermittent and perennial streams addressed

Short-term Habitat Replacement

- Tree girdling, if applicable
- Bat boxes (optional practice)

Long-term Habitat Replacement

- Watering areas
- Loosely compacted growth medium
- Entire disturbed area minus permanent structures (e.g., ponds and roads) planted in trees
- Minimum of four different tree species
- Three exfoliating bark species @ 150 stems combined total per acre
- One oak or hickory species - must also be an exfoliating bark species
- A minimum of 250 stems per acre at time of final bond release
- Post-mining land use map indicating locations of tree plantings

APPENDIX F

TREE SPECIES LIST

Exfoliating Bark Species

<i>Acer saccharinum</i>	silver maple
<i>Acer saccharum</i>	sugar maple
<i>Carya cordiformis</i>	bitternut hickory
<i>Carya glabra</i>	pignut hickory
<i>Carya laciniosa</i>	shellbark hickory
<i>Carya ovata</i>	shagbark hickory
<i>Carya tomentosa</i>	mockernut hickory
<i>Fraxinus americana</i>	white ash
<i>Fraxinus pennsylvanica</i>	green ash
<i>Quercus alba</i>	white oak
<i>Quercus coccinea</i>	scarlet oak
<i>Quercus falcata</i>	southern red oak
<i>Quercus prinus</i>	chestnut oak
<i>Quercus rubra</i>	northern red oak
<i>Quercus stellata</i>	post oak
<i>Quercus velutina</i>	black oak
<i>Sassafras albidum</i>	sassafras
<i>Ulmus americana</i>	American elm
<i>Ulmus rubra</i>	slippery elm

Nitrogen-fixing Trees

<i>Cercis canadensis</i>	redbud
<i>Robinia pseudoacacia</i>	black locust

Other Trees

<i>Diospyros virginiana</i>	persimmon
<i>Morus rubra</i>	red mulberry
<i>Prunus serotina</i>	wild black cherry