FIELD SURVEY FOR INDIANA BAT (*MYOTIS SODALIS*) HIBERNACULA FOR PROPOSED SECTION 202 FLOOD DAMAGE REDUCTION ACTIVITIES PIKE COUNTY, KENTUCKY

PREPARED FOR:
AMEC EARTH & ENVIRONMENTAL, INCORPORATED
LOUISVILLE, KENTUCKY

DECEMBER 2003

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DECEMBER 2003

I. INTRODUCTION

Eco-Tech, Incorporated, was contracted to conduct a search for hibernacula for the federally endangered Indiana bat (*Myotis sodalis*) at two areas (North Pikeville and Coal Run Village) in Pike County, Kentucky, where floodwalls and levees are proposed for flood damage reduction (see attached project location maps). Potential hibernacula for Indiana bats may include caves or mine portals.

II. SPECIES STATUS, DISTRIBUTION, AND NATURAL HISTORY

A. Species Status

The Indiana bat was listed as an endangered species on March 11, 1967 by the United States Fish and Wildlife Service (USFWS). As with all federally endangered species, it is protected by the Endangered Species Act (ESA) of 1973 (Public Law 93-205) (United States Congress 1973), as amended. Several years following its listing, an Indiana bat recovery plan was developed by biologists (i.e., the recovery team) and reviewed by the USFWS. Since that time the recovery plan has been revised to reflect recent studies and surveys. The Indiana Bat Recovery Plan outlines criteria for protecting and recovering the species (Brady *et al.* 1983, USFWS 1999).

Although most of the hibernacula have been protected, the Indiana bat still appears to continue a 5% decline in range-wide population every two years. Currently, researchers are focusing studies on summer habitat, heavy metals, the influence of pesticides, and genetic variability within the species in attempts to find causes for the continuous declines in populations.

B. Distribution

The range of the Indiana bat includes most of the eastern United States. It occurs from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida (Barbour and Davis 1969). The majority (85%) of the range-wide population hibernates in nine Priority 1 hibernacula (sites that currently and/or historically contained more than 30,000 individuals), which are located in Indiana (three sites), Kentucky (three sites), and Missouri (three sites) (USFWS 1999).

Some Indiana bats migrate long distances from their hibernacula to find suitable summer habitat to raise offspring. Until recently it was thought that the entire species, with the exception of some males, migrated north and west from their hibernacula to forested areas in Missouri, Indiana, Kentucky, Iowa, Ohio, and Michigan during the summer (Barbour and Davis 1969). Currently, reproductive Indiana bats have been documented from the following states Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

C. Natural History

Winter Habitat

During the short days of autumn (late August through early October), Indiana bats roost under sloughing bark and in cracks of dead, partially dead, and live trees (Humphrey *et al.* 1977, Gardner *et al.* 1991, J. MacGregor *et al.* 1999). Roost trees used by Indiana bats during the autumn range

from 4.7 to 26.4 inches in dbh (diameter at breast height) and occur in forested, semi-forested and open habitats within 1.4 miles of the hibernacula (Kiser and Elliott 1996). Depending on local weather conditions, Indiana bats normally enter the hibernaculum in October and remain there through April (Hall 1962, LaVal and LaVal 1980). An abandoned iron mine in Missouri historically contained 139,000 Indiana bats. Most of the hibernacula with large colonies are located in Arkansas, Illinois, Indiana, Kentucky, Missouri, New York and Tennessee (USFWS 1999). Smaller hibernacula are located in Alabama, Connecticut, Florida, Georgia, Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Vermont, Virginia, and West Virginia (ibid., Bryan *et al.* 1994).

According to Barbour and Davis (1969), temperature and relative humidity are important factors in the selection of hibernation sites. During the early fall Indiana bats roost in warm sections of caves and move down a temperature gradient as temperatures decrease. In midwinter Indiana bats tend to roost in portions of the cave where temperatures are cool (37° to 43° F). Relative humidity in Indiana bat hibernacula tends to be high, ranging from 66% to 95% (Barbour and Davis 1969). Prior to entering the hibernacula swarming occurs at the entrances (Cope and Humphrey 1977), or sometimes at other caves located near the hibernacula (LaVal *et al.* 1977, J. MacGregor *et al.* 1999). Swarming usually lasts for several weeks (August - September) and mating occurs toward the end of this period. After mating, females usually enter directly into hibernation, whereas males may remain active through the end of November. Adult females store sperm through the winter thus delaying fertilization until early May. During April and May the majority of the Indiana bat population will leave the cave areas and find suitable summer habitat. Females usually start grouping into larger maternity colonies by mid-May and give birth to a single young between late June and early July (Easterla and Watkins 1969, Humphrey *et al.* 1977).

Summer Habitat

Maternity colonies have been found under sloughing bark of dead and partially dead trees in upland and lowland forest (Cope *et al.* 1974, Humphrey *et al.* 1977, Gardner *et al.* 1991). These colonies are usually located in large-diameter, standing dead trees with direct exposure to sunlight (Callahan *et al.* 1997). A maternity roost may contain more than 100 adult females. During Callahan *et al.*'s (1997) study, he arranged roost trees into two groups depending on the intensity of use and size of the colony that used each tree. Callahan (1993) classified any tree that was used more than once by greater than 30 bats each time as a primary roost tree, and any tree with less than 30 bats or used only once as an alternate roost tree. The primary roost trees had an average diameter at breast height (dbh) of 22.4 inches, while alternate roost trees had an average dbh of 20.9 inches (Callahan *et al.* 1997). For unknown reasons, Indiana bats require many roost trees to fulfill their needs during the summer (Callahan *et al.* 1997). In Michigan, Kurta and Williams (1992) found that Indiana bats used two to four different roost trees during the course of one season. Although Indiana bats have been found roosting in several different species of trees, it appears that Indiana bats choose roost trees based on their structural composition. Therefore, it is difficult to determine if one particular species of tree is more important than others. However, twelve tree species have been listed in the Habitat Suitability Index Model (Romme *et al.* 1995) as primary species (class 1 trees). The trees listed by Romme *et al.* (1995) include silver maple (*Acer saccharinum*), shagbark hickory (*Carya ovata*), shellbark hickory (*C. laciniosa*), bitternut hickory (*C. cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*F. americana*), eastern cottonwood (*Populus deltoides*), red oak (*Quercus rubra*), post oak (*Q. stellata*), white oak (*Q. alba*) slippery elm (*Ulmus rubra*), and

American elm (*Ulmus americana*). In addition to these species Romme *et al.* (1995) listed sugar maple (*A. saccharum*), shingle oak (*Q. imbricaria*), and sassafras (*Sassafras albidum*) as class 2 trees. The class 2 trees are those species believed to be less important, but still have the necessary characteristics to be used as roosts. Trees normally used as primary roosts are typically dead and have a dbh greater than 12 inches (Romme *et al.* 1995). However, in some rare cases primary roosts have been found in large hollow live trees. Kurta *et al.* (1993) found a primary roost in a 22 inch dbh hollow sycamore (*Platanus occidentalis*) in Michigan. Roost trees often provide suitable habitat as maternity roost for only a short period of time. However, bats will use them in consecutive years, if they remain standing and have sloughing bark (Gardner *et al.* 1991, Callahan *et al.* 1997).

Food Habits

Historically, the Indiana bat was thought to prey primarily on moths (Lepidoptera), beetles (Coleoptera), true flies (Diptera), and caddisflies (Trichoptera) (Belwood 1979, Brack 1983, Brack and LaVal 1985). During a study by Belwood (1979), the primary insects consumed by females and juveniles in southern Indiana were Lepidoptera (57%), Diptera (18%), and Coleoptera (9%). Belwood's information was very similar to a three year study conducted by Brack (1983) throughout Indiana. Brack (1983) found that Indiana bats also consumed Lepidoptera (48%), Coleoptera (24%), and Diptera (8.5%). However, he also found Trichoptera (9.8%) to be an important food source. Recent studies by Lee (1993) and Kurta and Whitaker (1998) found the same four insect orders were consumed by Indiana bats in central/northern Indiana and in Michigan. However, these studies showed that Indiana bats preyed much more on caddisflies in central/northern Indiana and in Michigan. The female Indiana bats in central and northern Indiana consumed 40% Lepidoptera, 29% Trichoptera, 13% Coleoptera, and 9% Diptera (Lee 1993). The most recent Indiana bat food habits study was conducted in Michigan at the northern limits of the species range. These bats consumed primarily Trichoptera (55.1%) and Diptera (25.5%) which have aquatic larva (Kurta and Whitaker 1998). These authors hypothesized that Indiana bats in northern portions of their range feed more on aquatic insects than southern populations because they foraged primarily over streams and wetlands.

Indiana bats forage primarily in upland, bottomland, and riparian forests (Cope *et al.* 1974, Humphrey *et al.* 1977, LaVal *et al.* 1977, Belwood 1979), but they will also use forest and cropland edges, fallow fields, and areas of impounded water (Gardner *et al.* 1991). It has been documented that Indiana bats may travel up to three miles from their summer roosts to summer foraging areas and will visit these same areas each night. A pregnant female captured near Morehead, Kentucky maintained a very systematic travel pattern to reach an upland wildlife pond and woods that had been shelterwood cut (J. MacGregor, unpublished data). This bat arrived at the pond and adjacent woods within a couple of minutes each night that it was tracked. Reproductively active females traveled a maximum mean distance of 1.5 miles from their roost trees to foraging areas in Illinois (Gardner *et al.* 1991). During a recent study by Pruitt *et al.* (1995) at the Jefferson Proving Ground (JPG), Jefferson County, Indiana, reproductive female bats were found to travel a mean distance of 1.7 miles from their original capture sites to their roost trees. Also, at JPG, a male traveled 0.4 miles from the capture site to its roost; this distance is less, but similar to the distance of 0.7 miles found by Gardner *et al.* (1991) for males in Illinois.

III. METHODS

Prior to the field survey, a thorough search of existing cave and mine portal information for the project area and adjacent area was conducted. The field survey for hibernacula was done on December 2, 2003. The study area was walked to locate potential hibernacula for the Indiana bat. This included searching for caves and mine portals. If these were present, further evaluation would be provided. Cave-like dwellings (culverts, cisterns, storm sewers) were also searched for within the project area. These features were evaluated for bat use.

Other Indiana bat habitat characteristics that were rated include summer roosting habitat, food and water availability and quality, and interspersion of habitat components. A bat habitat assessment form was completed during the field survey. Although this form is for all bat species, it was filled out with emphasis on the habitat requirements of the Indiana bat. Notes and photographs of existing land cover were taken. As required by the Endangered Species Act, the best scientific methods were used to evaluate habitat for the species.

IV. RESULTS AND DISCUSSION

The study area is mostly riparian forest and fields in a floodplain terrace of Levisa Fork (see attached photographs). No caves or mine portals were found in the study area. However, a few concrete culverts and drain pipes were inspected for bat use. No evidence of use was found in any of these structures. No hibernacula or winter habitat are present within the study area. According to geology maps of the area (Alvord 1965, Alvord and Holbrook 1965), the study areas are underlain entirely by alluvium (Quaternary). The Breathitt Formation (lower and middle Pennsylvanian) is situated at slightly higher elevations outside the study areas and has numerous coal zones, some of which contain mine portals. Numerous mine portals and a few caves are known within a five-mile radius; however, the Indiana bat has not been documented from this area or Pike County. Records are from a cave in Letcher County.

The study area provides medium quality potential summer roosting and foraging habitat for the Indiana bat. It was estimated from transect counts that approximately 10 trees per acre have structural attributes similar to known summer roost trees. These include sycamore, silver maple, box elder, river birch, and red elm snags and cavity trees, as well as live trees of the same species.

If proposed project is constructed during the winter (November 15 through March 31), this project is not likely to affect the Indiana bat. However, if tree removal is proposed outside of this time frame then additional surveys (mist netting and echolocation detection recording and analysis) should be conducted in the study area according to USFWS guidelines (USFWS 1999) to determine whether or not Indiana bats are present.

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Bat Habitat Requirements Summary Table. North Pikeville Floodwall / Levee Pike County KY 12-2-03

Habitat Component	Habitat Requirements
Food - Young	• Milk from mother, insects, usually within two weeks of birth.
Food - Adult	• Night-flying insects such as moths, beetles, fruit flies, mosquitoes, mayflies, caddis flies, midges, grasshoppers, cicadas, and many others. Insect types may vary by bat species. • Fish, frogs, lizards, small rodents, birds, other bats. United States and Canadian bats are primarily insectivorous, but tropical bats have adapted to many other food sources. • Fruit, pollen, and nectar from plants and flowers such as banana, mango, date, fig, peach, cashew, guava, avocado, agave, giant saguaro and organ pipe cacti, and many others. Only a few southwestern species feed on nectar and pollen from cacti and agaves.
Roosts -Hibernacula	• Caves and mines, occasionally buildings. Many species migrate, and a few overwinter in the open, such as in trees.
-Maternity roosts	• Loose tree bark, leaves, tree cavities, caves, mines, bridges, and buildings.
-Bachelor roosts	• Loose tree bark, leaves, tree cavities, caves, mines, bridges, and buildings.
-Night roosts	• Bridges, porches, barns, other buildings, trees, caves, mines, bat houses, and other structures.
-Transient roosts	• May include all of those listed above. ✓
Winter habitat	• Caves, mines, tree branches, cavities and bark; cliff and rock crevices; tangled hedgerow thickets; attics and roofs of barns and other structures that provide an overhang in close proximity to open water; mowed fields; desert landscapes; agricultural crop fields and residential areas lit with street and yard lights. Varies by species. Many bats migrate from their summer range.
Water	• Open bodies of fresh water large enough to enable drinking on the wing without disturbance from cattails, bank side trees, or other vegetation.
Interspersion	• Prefer a complex of open water, mowed fields, woodlots, streams, desert landscapes, agricultural crop fields, residential areas, trees, cliff and rock crevices, tangled hedgerow thickets, caves, mines, attics and roofs of barns and other structures that provide an overhang. Interspersion of habitat components varies tremendously by bat species.
Minimum habitat size	• No reasonable estimate of minimum habitat size exists for bats, but probably varies by species.

Limiting Factors

For planning purposes, use the table below to inventory the site to determine the availability of each of the basic habitat components, based on the above narrative habitat requirement descriptions. Habitat components that are absent or rated low are limiting habitat quality for bats.

Habitat Component	Availability/Quality			
	High	Medium	Low	Absent
Food		✓		
Roosts - hibernacula				✓
- maternity roosts		✓		
- bachelor roosts		✓		
- night roosts			✓	
- transient roosts			✓	
Winter habitat				✓
Water		✓		
Interspersion of habitat components		✓		

* See attached photographs.

Bat Habitat Requirements Summary Table.

Coal Run Village Floodwall/ Levee
Pike County, Kentucky. 12-2-03

Habitat Component	Habitat Requirements
Food - Young	• Milk from mother. Insects usually within two weeks of birth.
Food - Adult	• Night-flying insects such as moths, beetles, fruit flies, mosquitoes, mayflies, caddis flies, midges, grasshoppers, cicadas, and many others. Insect types may vary by bat species. • Fish, frogs, lizards, small rodents, birds, other bats. United States and Canadian bats are primarily insectivorous, but tropical bats have adapted to many other food sources. • Fruit, pollen, and nectar from plants and flowers such as banana, mango, date, fig, peach, cashew, guava, avocado, agave, giant saguaro and organ pipe cacti, and many others. Only a few southwestern species feed on nectar and pollen from cacti and agaves.
Roosts -Hibernacula	• Caves and mines, occasionally buildings. Many species migrate, and a few overwinter in the open, such as in trees.
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-Night roosts	• Bridges, porches, barns, other buildings, trees, caves, mines, bat houses, and other structures.
-Transient roosts	• May include all of those listed above. ✓
Winter habitat	• Caves, mines, tree branches, cavities and bark; cliff and rock crevices; tangled hedgerow thickets; attics and roofs of barns and other structures that provide an overhang in close proximity to open water; mowed fields; desert landscapes; agricultural crop fields and residential areas lit with street and yard lights. Varies by species. Many bats migrate from their summer range.
Water	• Open bodies of fresh water large enough to enable drinking on the wing without disturbance from cattails, bank side trees, or other vegetation.
Interspersion	• Prefer a complex of open water, mowed fields, woodlots, streams, desert landscapes, agricultural crop fields, residential areas, trees, cliff and rock crevices, tangled hedgerow thickets, caves, mines, attics and roofs of barns and other structures that provide an overhang. Interspersion of habitat components varies tremendously by bat species.
Minimum habitat size	• No reasonable estimate of minimum habitat size exists for bats, but probably varies by species.

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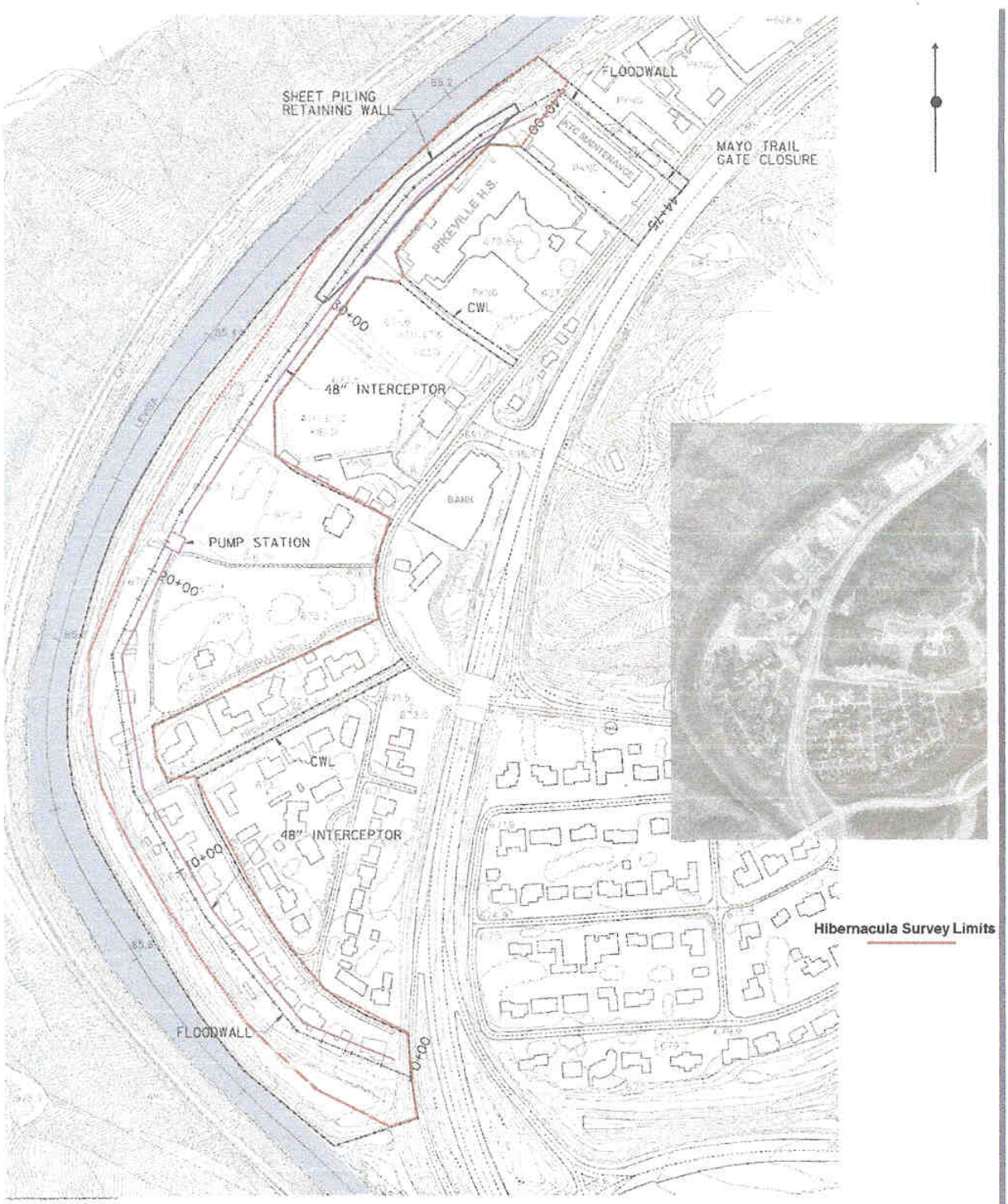
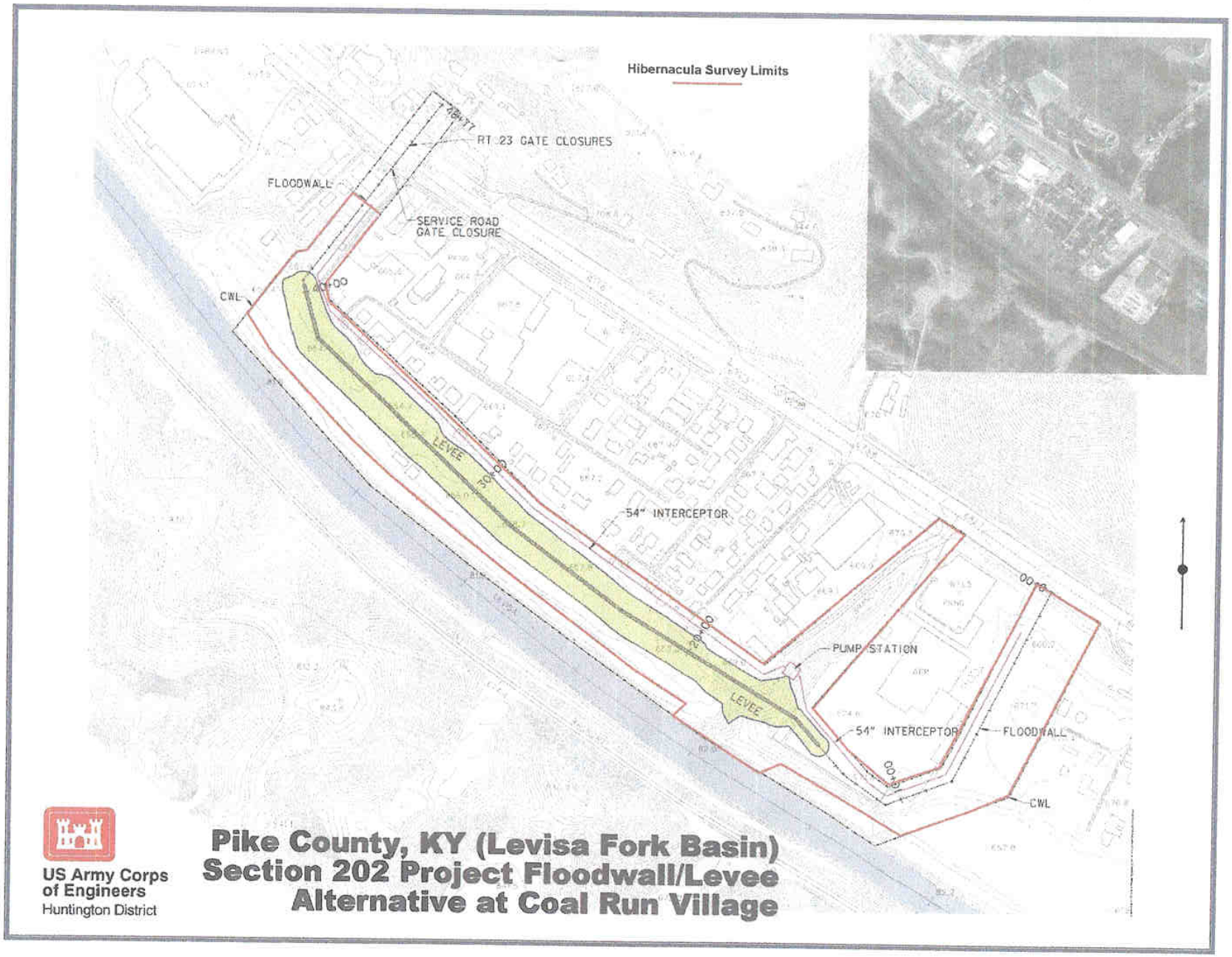
	Availability/Quality			
Habitat Component	High	Medium	Low	Absent
Food		✓		
Roosts - hibernacula				✓
- maternity roosts		✓		
- bachelor roosts		✓		
- night roosts			✓	
- transient roosts			✓	
Winter habitat				✓
Water		✓		
Interspersion of habitat components		✓		

* see attached photographs.



US Army Corps of Engineers
Huntington District

Pike County, KY (Levisa Fork Basin) Section 202 Project Floodwall/Levee Alternative at North Pikeville


Hibernacula Survey Limits
RT 23 GATE CLOSURES
FLOODWALL
SERVICE ROAD
GATE CLOSURE
CWL
LEVEE
54" INTERCEPTOR
PUMP STATION
LEVEE
54" INTERCEPTOR
FLOODWALL
CWL
US Army Corps
of Engineers
Huntington District
Pike County, KY (Levisa Fork Basin)
Section 202 Project Floodwall/Levee
Alternative at Coal Run Village

Proposed North Pikeville Floodwall Area – double box culvert at southern end

Proposed North Pikeville Floodwall Area – riparian forest on lower terrace

PHOTOGRAPHS

FIELD SURVEY FOR INDIANA BAT (*MYOTIS SODALIS*)
HIBERNACULA FOR PROPOSED SECTION 202 FLOOD
DAMAGE REDUCTION ACTIVITIES,
PIKE COUNTY, KENTUCKY

2 DECEMBER 2003

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Proposed North Pikeville Floodwall Area – lower terrace residential area

Proposed North Pikeville Floodwall Area – lower terrace behind high school

PHOTOGRAPHS

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HIBERNACULA FOR PROPOSED SECTION 202 FLOOD
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Proposed Coal Run Village Floodwall Area – lower terrace fields and riparian forest

Proposed Coal Run Village Floodwall Area – lower terrace fields and riparian forest

PHOTOGRAPHS

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