Appendix H

ADDITIONAL STUDIES

Environmental Justice Supporting Documentation | Indiana Bat Mist Netting Survey

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Environmental Justice

Supporting Documentation

Population Characteristics: Poverty Level

Geography	Total Population	Income in 2000 below poverty level	
		#	%
United States	273,882,232	33,899,812	12.38%
Indiana	5,894,295	559,484	9.49%
Jennings County, Indiana	27,200	2,511	9.23%
COMMUNITY OF COMPARISON (COC)			
North Vernon, Indiana	6,345	746	11.76%
AFFECTED COMMUNITY (AC)			
Jennings County			
Census Tract 9603-BG 1	1,476	63	4.27%
Census Tract 9604-BG 1	1,914	376	19.64%
Census Tract 9604-BG 2	1,059	89	8.40%
Census Tract 9604-BG 3	2,031	160	7.88%
Census Tract 9604-BG 4	965	100	10.36%
		COC	**Affected Community (All Block Groups)**
Percent in Poverty		11.76%	10.58%
125% of the COC Threshold		14.70%	
EJ Population			NO

Source: U.S. Census Bureau 2000, Table P87, Census Data Set: Census 2000 Summary File 3 (SF 3)

Highlighted value indicates exceedance of COC threshold.

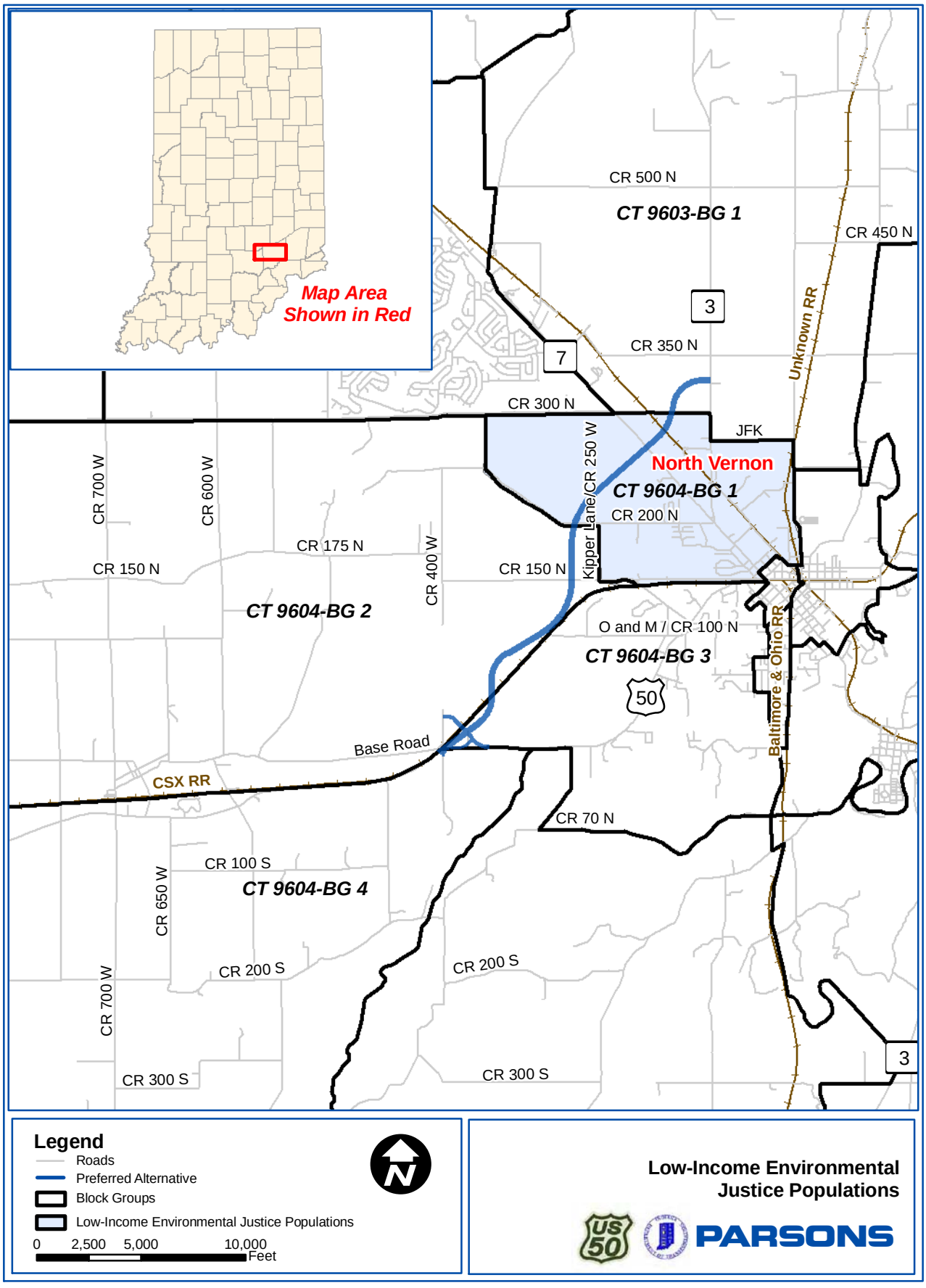
Population Characteristics: Race

Geography	Total population	Minority Population	Total population: White alone		Total population: Black or African American alone		Total population: American Indian and Alaska Native alone		Total population: Asian alone		Total population: Native Hawaiian and Other Pacific		Total population: Some other race alone		Total population: Two or more races		Hispanic	
		%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
United States	281,421,906	24.90%	211,353,725	75.10%	34,361,740	12.21%	2,447,989	0.87%	10,171,820	3.61%	378,782	0.13%	15,436,924	5.49%	7,270,926	2.58%	35,238,481	12.52%
Indiana	6,080,485	12.55%	5,317,334	87.45%	504,449	8.30%	17,168	0.28%	57,193	0.94%	1,762	0.03%	98,092	1.61%	84,487	1.39%	210,538	3.46%
Jennings County, Indiana	27,554	3.03%	26,720	96.97%	191	0.69%	104	0.38%	76	0.28%	0	0.00%	139	0.50%	324	1.18%	249	0.90%
Community of Comparison (COC)																		
North Vernon, Indiana	6,527	3.26%	6,314	96.74%	80	1.23%	38	0.58%	43	0.66%	0	0.00%	5	0.08%	47	0.72%	26	0.40%
Affected Community (AC)																		
Jennings County																		
Census Tract 9603-BG 1	1,489	1.34%	1,469	98.66%	9	0.60%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	11	0.74%	0	0.00%
Census Tract 9604-BG 1	2,061	1.36%	2,033	98.64%	5	0.24%	17	0.82%	6	0.29%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Census Tract 9604-BG 2	1,082	0.00%	1,082	100.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Census Tract 9604-BG 3	2,038	6.28%	1,910	93.72%	48	2.36%	0	0.00%	37	1.82%	0	0.00%	0	0.00%	43	2.11%	0	0.00%
Census Tract 9604-BG 4	965	2.18%	944	96.58%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	9	0.93%	12	1.24%	21	2.18%

		COC	Affected Community (All Block Groups)
Percent Minority		3.26%	2.58%
125% COC Threshold		4.08%	
EJ Population			NO

Source: U.S. Census Bureau 2000, Table P07, Census Data Set: Census 2000 Summary File 3 (SF 3)

Highlighted value indicates exceedance of COC threshold.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Shown in Red
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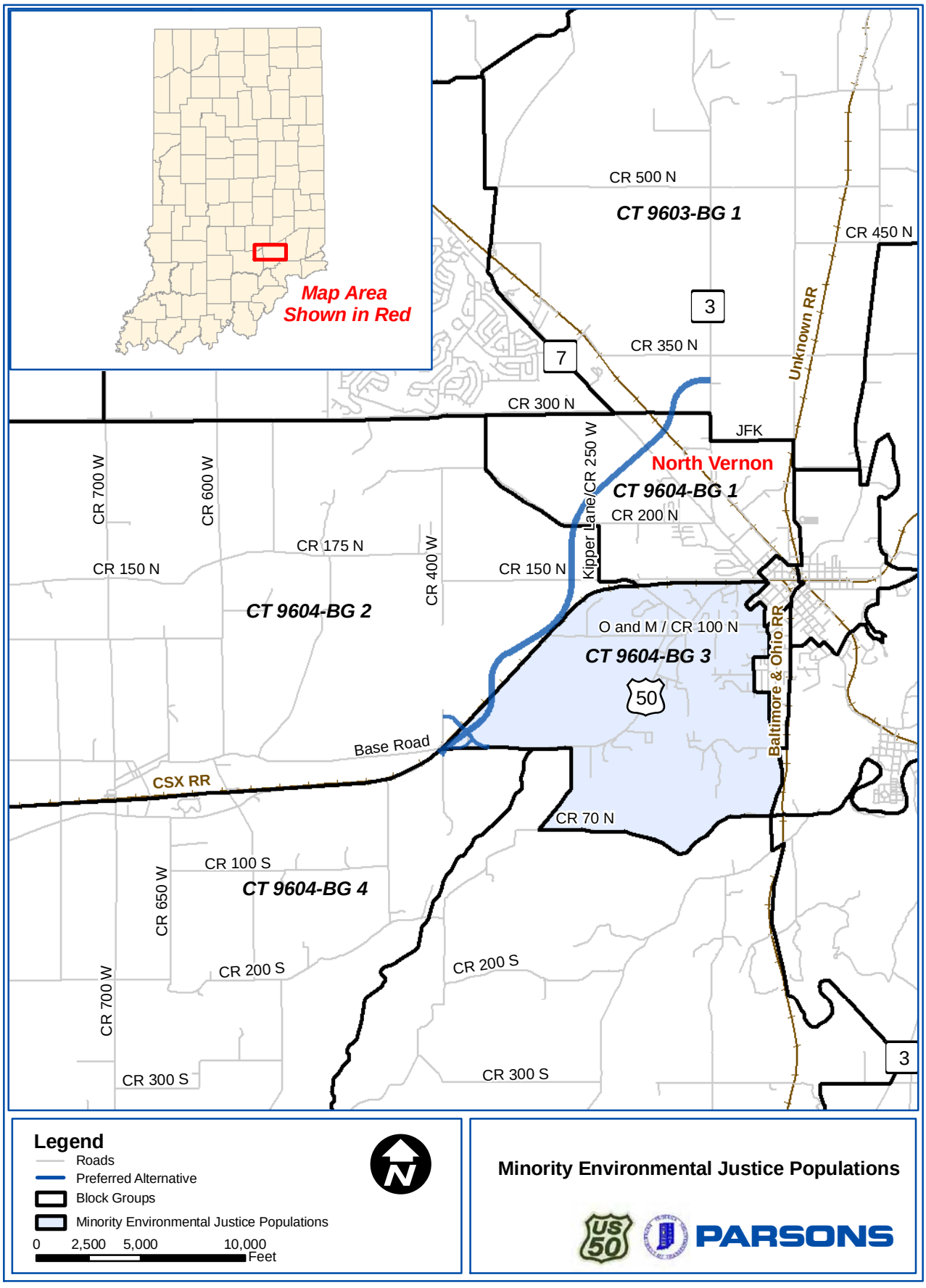
CT 9603-BG 1
CR 450 N
3
Unknown RR
CR 350 N
7
CR 300 N
JFK
North Vernon
CT 9604-BG 1
CR 200 N
Kipper Lane/CR 250 W
CR 700 W
CR 600 W
CR 175 N
CR 400 W
CR 150 N
CR 150 N
CT 9604-BG 2
O and M / CR 100 N
CT 9604-BG 3
Baltimore & Ohio RR
50
Base Road
CSX RR
CR 70 N
CR 100 S
CT 9604-BG 4
CR 650 W
CR 200 S
CR 200 S
CR 700 W
CR 300 S
CR 300 S
3
Legend
Roads
Preferred Alternative
Block Groups
Low-Income Environmental Justice Populations
0 2,500 5,000 10,000
Feet
N
Low-Income Environmental
Justice Populations
US 50
PARSONS


Map Area
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CR 500 N
CT 9603-BG 1
CR 450 N
3
Unknown RR
CR 350 N
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CR 300 N
JFK
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CT 9604-BG 1
CR 200 N
CR 700 W
CR 600 W
CR 175 N
CR 150 N
CR 400 W
CR 150 N
Kipper Lane/CR 250 W
CT 9604-BG 2
O and M / CR 100 N
CT 9604-BG 3
50
Baltimore & Ohio RR
Base Road
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CR 70 N
CR 100 S
CT 9604-BG 4
CR 650 W
CR 200 S
CR 200 S
CR 700 W
CR 300 S
CR 300 S
3
Legend
Roads
Preferred Alternative
Block Groups
Minority Environmental Justice Populations
0 2,500 5,000 10,000
Feet
Minority Environmental Justice Populations
US 50
PARSONS

Bat Surveys

MIST NET SURVEY FOR THE FEDERALLY ENDANGERED INDIANA BAT (*Myotis sodalis*) FOR THE PROPOSED US 50, NORTH VERNON BYPASS JENNINGS COUNTY, INDIANA

Prepared for:
Corradino, LLC
Indianapolis, IN

Prepared by:
Eco-Tech Consultants, Inc.
Jeffersonville, IN

August 2009

ETC ECOLOGICAL
Eco-Tech Consultants, Inc.

MIST NET SURVEY FOR THE FEDERALLY ENDANGERED INDIANA BAT (*Myotis sodalis*) FOR THE PROPOSED US 50, NORTH VERNON BYPASS, JENNINGS COUNTY, INDIANA.

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1.0 INTRODUCTION

Eco-Tech Consultants, Incorporated (ETC) was subcontracted by Corradino, LLC to conduct a mist net survey for the federally endangered Indiana bat (*Myotis sodalis*) for the proposed US 50, North Vernon Bypass, Jennings County, Indiana (Appendix A). Portions of the proposed project may require tree clearing within potential Indiana bat summer roosting habitat.

The proposed North Vernon Bypass is located north of North Vernon, Indiana (Appendix A, Figure 1). The alignment would cross agricultural, residential and forested lands.

The purpose of this survey was to determine presence/absence of the Indiana bat within potential summer roosting habitat located in proposed clearing areas associated with the new road alignment. This survey was performed in accordance with the Agency Draft Indiana Bat Revised Recovery Plan (USFWS 2007).

1.1 Project Area

The proposed project is located in the Pre-Wisconsinan Drift Plains ecoregion of Indiana (Level IV ecoregion; Woods et al. 2007). The soils of this area are deeply-leached and acidic. They consist of pre-Wisconsinan till and thin loess. The region is largely flat with some dissected areas and extensive areas of poorly drained soils. Beech forests and elm-ash swamps were once common here (Woods et al. 2007), and relatively extensive forested areas are still present. Rock outcrops are prominent in the area, especially along the banks of the Vernon Fork of the Muscatatuck River. Karst features are also present in the vicinity of the proposed alignment and at nearby sites such as the Crosley Fish and Wildlife Area.

1.2 Project Description

The proposed bypass would require clearing of approximately 35 acres of forested habitat, all of which is considered to be potential summer habitat for Indiana bat maternity colonies. The 6.75-mile proposed alignment for Alternative B would cross approximately 4.1 km of forested habitat, including one bridge crossing of the Vernon Fork of the Muscatatuck River.

2.0 INDIANA BAT NATURAL HISTORY

2.1 Species Status

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and abandoned mines during winter and spends the summer season in forested areas. It was listed as an endangered species on March 11, 1967 by the USFWS. However, the Indiana bat did not receive protection until enactment of the Endangered Species Act (ESA) in 1973 (Public Law 93-205), as amended. Critical habitat for the species was designated on September 24, 1976; it consisted of 11 caves and two mines in six states. Several years following its listing, an Indiana bat recovery plan was developed by biologists (i.e., the recovery team), which outlines habitat requirements, critical habitat, potential causes for declines, and recovery objectives. The recovery plan was reviewed and published by the USFWS in 1983 (Brady et al. 1983). An agency draft of a revised plan was published in 1999, but it was never finalized. The Indiana bat recovery team is currently utilizing new information and making revisions to the recovery plan (USFWS 2007).

Indiana bat estimated population numbers have consistently declined from 1965 to 2001. This steady overall decline can be attributed to several causes including human modifications to hibernacula and surrounding areas, disturbance and vandalism of hibernacula, natural catastrophes, and threats to summer habitat and migration pathways, including loss and degradation of forested habitat (USFWS 2007). Even with the discovery of many new, large hibernacula, the range wide population estimate dropped approximately 57 percent from 1965 to 2001. However, estimates of range wide Indiana bat population totals from surveys conducted post-2001 have actually increased. In 2005, a 15% population increase was found, yielding an approximate total of 457,000 Indiana bats (USFWS 2007). The USFWS views the apparent upward population trend as viable because the same surveyors have been consistently conducting the winter surveys at all large hibernacula over the past 20 years. In addition, large increases in local populations at 34 known high-priority hibernacula in recent years have been observed. The USFWS (2007) anticipates that planned improvements in hibernacula survey methodology will soon provide an even greater confidence level in the overall population trend.

2.2 Distribution

The Indiana bat's range includes most of the eastern United States. It is known to occur from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida (Barbour and Davis 1969, Gardner and Cook 2002). The species' range is generally consistent with the presence of limestone caves that serve as hibernacula in the winter (Menzel et al. 2001). According to the USFWS (2007) winter survey results from 2005 indicated that there were a total of 23 Priority 1 hibernacula in seven states; including Illinois (one site), Indiana (seven sites), Kentucky (five sites), Missouri (six sites), New York (two sites), Tennessee (one site), and West Virginia (one site). Over 90 percent of the estimated range wide Indiana bat population hibernates in only five states, Indiana (45.2%), Missouri (14.2%), Kentucky (13.6%), Illinois (9.7%), and New York (9.1%).

Indiana bats are known to migrate up to 360 miles from their hibernacula to find suitable summer habitat to raise offspring (Kurta and Murray 2002, Winhold and Kurta 2006). Although, some migrate much shorter distances as evidenced by banded female Indiana bat recoveries from maternity colonies at Mammoth Cave National Park. Additionally, recent radio-telemetry studies in New York found that of 70 Indiana bats emerging from three hibernacula most migrated to summer habitat only 40 miles away (USFWS 2007). 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). This migration pattern was illustrated by Barbour and Davis (1969), with summer band recoveries near the Wayne National Forest in southern Ohio of both male and female bats banded at Carter Caves State Resort Park, in Carter County, Kentucky. In addition, reproductive Indiana bats have now been documented in the following states: Arkansas, Illinois, Indiana, Iowa, Kentucky, Michigan, Maryland, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Vermont, Virginia, and West Virginia (USFWS 2007).

Although Indiana bat maternity colonies occur throughout much of the mideastern United States (e.g., West Virginia, Virginia, Pennsylvania, New York), they appear to be relatively less abundant in these peripheral portions of their range (USFWS 2007). The regional differences in summer distribution and relative abundance are likely influenced by geographic distribution of important hibernacula and also by regional climate and elevation variation (USFWS 2007, Brack et al. 2002). Therefore, the understanding of how and to what extent these factors influence the distribution and abundance of maternity colonies is still evolving (USFWS 2007).

2.3 Winter Habitat

Indiana bats use sloughing bark and cracks in dead, partially dead, and live trees as day roosts during autumn (Kiser and Elliott 1996, MacGregor et al.1999). Autumn roost trees range from 4.7 to 26.4 inches in diameter at breast height (dbh) and occur in forested, semi-forested, and open habitats (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 et al. 1977, LaVal and LaVal 1980).

Prior to entering the hibernacula in autumn, swarming occurs at the entrances of either the hibernacula (Cope and Humphrey 1977) or other caves located near the hibernacula (LaVal et al. 1977). Swarming usually lasts for several weeks (August - September) and mating occurs toward the end of this period. Mated females usually enter directly into hibernation, whereas males may remain active through the end of November. Reproductive females store sperm through the winter, delaying fertilization until early May. During April and May the majority of the Indiana bat population emerges leaving their cave areas to find suitable summer habitat. However, some male and non-reproductive female Indiana bats will remain near the hibernacula during the summer. Females usually start grouping into larger nursery 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).

Indiana bats hibernate primarily in caves, but they have also have been documented using abandoned mines. As of November 2006, the USFWS (2007) has winter records of 281 distinct hibernacula in 19 states that have been occupied continually since 1995. According to Barbour and Davis (1969), temperature and relative humidity are important factors in the selection of hibernation sites. During the early autumn, Indiana bats roost in warm sections of caves and move to lower temperature areas of the cave as outside temperatures decrease. In mid-winter 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, usually above 74 percent, but not exceeding saturation (Hall 1962, Humphrey 1978, Kurta and Teramino 1994, LaVal et al. 1976).

2.4 Summer Habitat

Selection of roost trees by Indiana bat colonies are based on structural characteristics. Tree diameter, solar exposure, and height in canopy are among the most important (Romme et al. 1995, Kurta and Murray 2002). Male and female Indiana bats inhabit different habitats and choose roost trees with differing characteristics during the summer months (Kurta 2005). Reproductive females tend to choose roosts in mature forests with large trees, scattered gaps in the canopy, and an open understory (Gardner et al. 1991b, Callahan et al. 1997). The number of available roost trees in an area influences the suitability of habitat for female Indiana bats (Kurta 2005). Gardner et al. (1991b) found that of 39 roost trees evaluated, 31% were not suitable the following summer, and that 33% of the remaining trees were unavailable for use after two summers. Thus roost trees are an ephemeral resource.

Maternity colonies have been found under sloughing bark of dead, partially dead and live trees (Carter 2003, Gardner et al. 1991b, Kurta et al. 1993, Kurta et al. 2002, Romme et al. 1995). These colonies have been found in lowland forests (Cope et al. 1974, Humphrey et al. 1977), and more recently in upland forests (Callahan et al. 1997, Clark et al. 1987, Gardner et al. 1991b, Kiser et al. 2002). Such colonies are usually located in large-diameter, standing dead trees, with direct exposure to sunlight (Callahan et al. 1997). Maternity roosts can contain over 350 individual bats during July and August (Kiser et al. 1998). During Callahan's study (1997), 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 dbh of 22.4 inches, while open snags used as alternate roosts had an average dbh of 20.9 inches (Callahan et al. 1997).

Indiana bats require more than one roost tree to fulfill their needs during the summer (Callahan et al. 1997). Barclay and Kurta (2004) found one maternity colony that used 18 roost trees during a single summer. In addition, Indiana bats are known to roost in several different species of trees, selecting roost trees by the structural composition of each tree. Farmer et al. (1997) contends that structure is probably more important than tree species in selection of roost trees.

Twelve tree species are 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*), northern red oak (*Quercus rubra*), post oak (*Q. stellata*), white oak (*Q. alba*), slippery elm (*Ulmus rubra*), and American elm (*U. 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 dead and have a dbh greater than 12 inches (Romme et al. 1995).

At least 33 tree species have been found to be roosts for reproductive female Indiana bats, and 87 percent of them are ashes (13%), elms (13%), hickories (22%), maples (15%), poplars (9%), and oaks (15%; USFWS 2007). It was previously believed that oak and hickory were used more commonly used in the southern portion of the range (Callahan et al. 1997, Gardner et al. 1991b), and elm, ash, maple, and cottonwood were occupied more often in northern areas (Kurta et al. 1996, 2002; Whitaker and Brack 2002). However, more recent research reveals that Indiana bats occupy ash and elm most often in southern Illinois (Carter 2003) and hickories most often in Vermont (Palm 2003). Therefore, it appears that tree species use is more closely related to local availability and suitable structure than to broad regional preferences (USFWS 2007). Nonetheless, some common trees, such as American beech (*Fagus grandifolia*), basswood (*Tilia americana*), wild black cherry (*Prunus serotina*), box elder (*A. negundo*), and willow (*Salix* spp.), are rarely to never used, suggesting that they are typically not acceptable even when suitable structure is present, especially as a primary roost (USFWS 2007).

Most (97%) roost trees of female Indiana bats at maternity sites are deciduous species, except for a few coniferous trees discovered in the Great Smoky Mountains (Harvey 2002, Britzke et al. 2003) and in New England (Palm 2003). This more likely reflects availability rather than a preference for deciduous trees (USFWS 2007).

2.5 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 consumed Lepidoptera (48%), Coleoptera (24%), and Diptera (8.5%). He also found Trichoptera (9.8%) to be an

important food source. Studies by Lee (1993) and Kurta and Whitaker (1998) found that 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 heavily on caddisflies in central/northern Indiana and in Michigan. The female Indiana bats in central and northern Indiana consumed Lepidoptera (40%), Trichoptera (29%), Coleoptera (13%), and Diptera (9%) (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 larvae (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 forage primarily over streams and wetlands.

The only food habit information from Kentucky for Indiana bats is from Jackson County. Kiser and Elliott (1996) conducted a study to determine the food habits of male Indiana bats at a cave entrance. During the autumn of 1994 and 1995, male Indiana bats consumed primarily Lepidoptera (28.5% and 34.0%), Coleoptera (15.9% and 40.2%), Homoptera (15.3% and 4.5%), and Diptera (28.8 % and 18.8%). The increase in consumption of snout beetles (Coleoptera: Curculionidae) during the 1995 samples indicates that Indiana bats are opportunistic foragers (Kiser and Elliott 1996).

Indiana bats forage primarily in forested habitats (Cope et al. 1974, Humphrey et al. 1977, LaVal et al. 1977, Belwood 1979), but they will also forage in edges of forests and croplands, fallow fields, and areas of impounded water (Gardner et al. 1991a). Indiana bats may utilize as many as four different foraging areas during nightly foraging (Murray 1998), using the same travel corridor each night to move from the roost tree to the foraging areas. 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. Reproductively active females traveled a maximum mean distance of 1.5 miles from their roost trees to foraging areas in Illinois (Gardner et al. 1991a). During a 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 mile from the capture site to its roost; this distance is less, but similar to the distance of 0.7 mile found by Gardner et al. (1991a) for males in Illinois.

2.6 White-Nose Syndrome (WNS)

White-nose syndrome (WNS) has been characterized as a condition affecting hibernating bats and was named for the white fungal growth located on hairless areas of the body such as the muzzle, ears, and/or wing/tail membranes (Blehert et al. 2008). Behavioral responses to WNS include movement to entrances of hibernacula, day flight during mid-winter, cluster formation on the ground, and other uncharacteristic winter/hibernating behavior. Bats affected with WNS are thought to leave their hibernacula early in search of food and, subsequently, starve or freeze to death.

WNS was first documented by a photograph taken at Howes Cave, approximately 32 miles west of Albany, New York in February 2006 (Blehert et al. 2008). A caver photographed hibernating bats with an unusual white substance on their muzzles and observed several dead bats (USFWS 2009a). The following winter, New York Department of Environmental Conservation biologists documented WNS after observing bats exhibiting abnormal behavior, white, powdery substance on the muzzle, and a few hundred dead bats in several caves in the Albany, NY area (USFWS 2009). Since then sick, dying and dead bats have been found in unprecedented numbers in and around caves and mines from Vermont to Virginia.

WNS has killed hundreds of thousands of bats across the northeast and east during the past three years and continues unchecked (USFWS, 2009b). It has rapidly spread to over 65 sites and has been associated with the deaths of over 400,000 bats in the United States (USFWS 2009). In some hibernaculum, 90 to 100 percent of infected bats are dying (USFWS 2009). Since the 2006-2007 winters, WNS has spread to nine states including: Connecticut, Massachusetts, New Hampshire, New York, New Jersey, Pennsylvania, Vermont, West Virginia and most recently Virginia (USFWS 2009). WNS threatens to spread to the Midwest and Southeast, which are home to many federally endangered bat species as well as some the largest known bat populations in the country (USFWS 2009).

Researchers associate WNS with a newly identified fungus (*Geomyces* sp.) that thrives in the cold and humid conditions characteristic of the caves and mines used by bats (USFWS 2009c). It is not yet known if the fungus is the cause of the mortality occurring in these hibernating bats or if it is a symptom of something else. Affected bats do not always have the white fungus but do leave their hibernacula during the winter and typically die. The fungus isn't always visible to the naked eye -- and usually is not seen on bats found flying or dead outside of their hibernacula or at their summer roosts.

Biologists believe that affected bats may be waking up more often throughout hibernation to groom themselves thus burning fat reserves needed for winter hibernation. Bats with obvious WNS have shown excessive grooming and noticeable agitation. It is thought the fungus causes enough irritation that the bat arouses from torpor to clean itself. Once clean, the bat will re-enter torpor allowing the fungus to re-establish. The fungus may not be readily visible on the bats, especially after they leave their hibernacula and groom themselves. Bat species currently known to be affected by the fungus are little brown bat (*Myotis lucifugus*), Indiana bat, small-footed bat (*M. leibii*), northern long-eared bat (*M. septentrionalis*), eastern pipistrelle bat (*Perimyotis subflavus*) and big brown bat (*Eptesicus fuscus*).

Transmission of WNS is unclear at this time however; biologists believe that WNS is transmitted primarily from bat-to-bat. Evidence collected to date indicates that human activity in caves and mines may be assisting in the spread of WNS since some caves used by people have WNS affected bats, while other, nearby caves not used by people do not seem to be affected. It is likely that the fungus can be transported inadvertently from site-to-site on gear and boots of cave visitors (USFWS 2009a).

Human health implications are not known and there is no information indicating that people or other animals have been affected after exposure to the white fungus.

Biologists with state and federal agencies and organizations across the country are still trying to find the answer to this deadly mystery. Despite the continuing search to find the source of this condition the cause of the bat deaths remains unknown.

3.0 MATERIALS AND METHODS

3.1 Mist Net Site Selection

The survey was conducted according to the guidelines of Appendix 5 of the “Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision” (USFWS 2007). These guidelines call for one net site to be mist netted for two calendar nights per one kilometer (km) of forested habitat to be cleared. A thorough office review of the proposed project area was conducted by ETC biologists in order to identify forest impacts. Office review of current aerial photography and

topographic maps found that approximately 4.1 km of forested habitat will be affected by this project, yielding four proposed mist net sites. Because the proposed project will cross a major river, an additional net site was added in order to ensure that sufficient sample effort was employed.

Potential sites were chosen based on factors such as the potential for presence of travel corridors and water, in addition to a relatively closed canopy cover. Topographic maps and current aerial photographs were utilized to determine the extent of tree clearing, as well as the presence or absence of these important factors. If any of the potential mist net sites were found to not be suitable upon site visit, then another was chosen. Mist net sites (five total) were located as close as possible to the actual alignment of Alternative B; however, some sites were located a short distance (<0.4 miles) from the alignment in order to sample important Indiana bat habitat features such as streams, ponds and forested corridors. Mist net sites are depicted on the attached topographic and aerial maps (Appendix A, Figure 1 and 2).

3.2 Mist Net Survey

Each mist net site consisted of two net sets where one net set consisted of two mist nets hung between two poles. Poles were at least 20 feet high and had ropes affixed to them to raise and lower the nets. The mist nets used in this survey were constructed of 50 denier/2-ply nylon, with a mesh size of 1.5 inches, and a length of 20 to 60 feet, depending on width of corridor (Table 1). Net sets were located so that the entire open portion of the flyway was covered by the nets. Nets were tended from dusk (approximately 21:00 EDT) until 02:00 (EDT). Mist nets were checked for bats every 10 minutes.

Upon capture, bats were removed from mist nets, identified to species, measured, and released unharmed at the capture site. Data recorded for each bat captured included species, age, gender, reproductive condition, right forearm length (RFA), and body weight. Bats were identified to species based upon distinctive morphological characteristics (e.g., body size, hair color, ear length, tragus length and shape, presence/absence of a keeled calcar). Adult female bats were classified as reproductive if they were pregnant (determined by palpation of abdomen) or lactating (i.e., teats conspicuous and enlarged, lack of hair around teats). Male bats with testicles descended into the scrotum were considered reproductive. Juveniles were distinguished from adults by examining ossification (bone growth) in phalangeal joints. All bats were released unharmed at the point of capture.

Weather conditions were documented each night to confirm that netting was conducted in accordance with Indiana Bat Recovery Team Guidance (USFWS 2007). The air temperature, wind speed, cloud cover, precipitation, and visibility of the moon were recorded at the beginning and end of each night of the survey. A digital or mercury thermometer was used to record temperature. Wind speed, percent cloud cover, and moon phase were estimated (Appendix C). All sites were photographed and their location recorded using a handheld GPS unit.

All netting was conducted in accordance to bat handling/disinfection protocols for summer bat field studies, as dictated by state and federal agencies to help prevent the spread of WNS.

4.0 RESULTS

A total of five sites were surveyed using mist nets on July 16-23, 2009. Detailed descriptions and sketches of each net site are included in Appendix B and Table 1. Bat Capture Datasheets are included in Appendix C. Photographs of net sites and representative bats captured during this survey are included in Appendix D. Additional wildlife observed and general comments

about each net site are included on net site descriptions and bat capture data forms in Appendices B and C. Brief synopses of mist net site characteristics and capture results are listed below.

4.1 Mist Net Sites and Cave Reconnaissance

Five mist net sites were located in suitable Indiana bat habitat as close to the proposed alignment as possible. Sample sites were located on the eastern and western sides of the alignment due to the fact that little wooded habitat was available in the middle of the project area. The Vernon Fork of the Muscatatuck River is impounded downstream of the alignment crossing; therefore, the river channel in the project area is very wide with little canopy cover. Due to the fact that most of this section of the Vernon Fork is not conducive to mist netting, only one site (site 2) could be located on the river.

A variety of bat corridor types were sampled for this project. Overall, four net sets were placed over road/trail corridors, three were placed over ponds, two were placed over rivers or streams and one was placed over a sandbar. The dominant canopy tree species varied by site, but sugar maple (*Acer saccharum*), Shagbark hickory (*Carya ovata*), American sycamore (*Platanus occidentalis*) and black walnut (*Juglans nigra*) were each dominant trees at more than one site. Canopy trees averaged 11-20 inches in dbh, and canopy coverage varied from 25 to 100 percent. Dominant understory species included sassafras (*Sassafras albidum*), red elm (*Ulmus rubra*) sugar maple, boxelder (*Acer negundo*) and many other species. Average understory dbh varied from two to six inches. Water was present at four of the five net sites (Appendix B).

Sites 1, 4 and 5 were netted for three nights because of a rainout event that occurred on the night of July 21, 2009. At approximately 23:30 rain began and became increasingly steady for more than 30 minutes. Bats were captured; however, weather conditions did not meet USFWS Indiana bat survey guidelines. Therefore, mist nets were taken down, and netting was resumed during the following two nights.

During mist net site scouting, a landowner indicated the presence of a small cave downstream of site 2. On July 19, 2009 ETC ecologists assessed the cave for bat activity. Approximately eight inches of water was present in the bottom of the cave. The entrance was two to three feet in diameter and lacked air flow and bat guano. Preliminary scouting of this cave indicates that it is not being used by any bat species (see Appendix D).

Table 1. Configuration and location summary for mist net sites during the survey for the federally endangered Indiana bat (*Myotis sodalis*) for the proposed North Vernon Bypass, Jennings County, Indiana.

SITE	SURVEY DATES	# OF NETS	NET CONFIGURATION (h x w)	BATS CAPTURED	Notes
1	July 21-23, 2009	2	A) 20' x 30' B) 30' x 20'	4	Rainout July 21
2	July 19-20, 2009	2	A) 20' x 60' B) 30' x 42'	4	
3	July 16-17, 2009	2	A) 20' x 20' B) 20' x 18'	5	
4	July 21-23, 2009	2	A) 20' x 20' B) 20' x 20'	9	Rainout July 21
5	July 21-23, 2009	2	A) 20' x 20' B) 20' x 20'	7	Rainout July 21

4.2 Capture Results

A total of 29 individuals of six chiropteran species were captured during this mist-net survey. No Indiana bats were captured. Figure 1 depicts the abundance of the six species at each sample

site. The following four species were captured with equal frequency (6 individuals of each species): eastern pipistrelle (*Perimyotis subflavus*), little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*) and eastern red bat (*Lasiurus borealis*). The next most common species was the northern long-eared bat (*Myotis septentrionalis*) (n=4), and a single evening bat (*Nycticeius humeralis*) was captured. Slightly more than half of captures (52%) were non-reproductive males. The remaining captures were of females of several species. Several of these females were, or recently had been, reproductively active (Table 2).

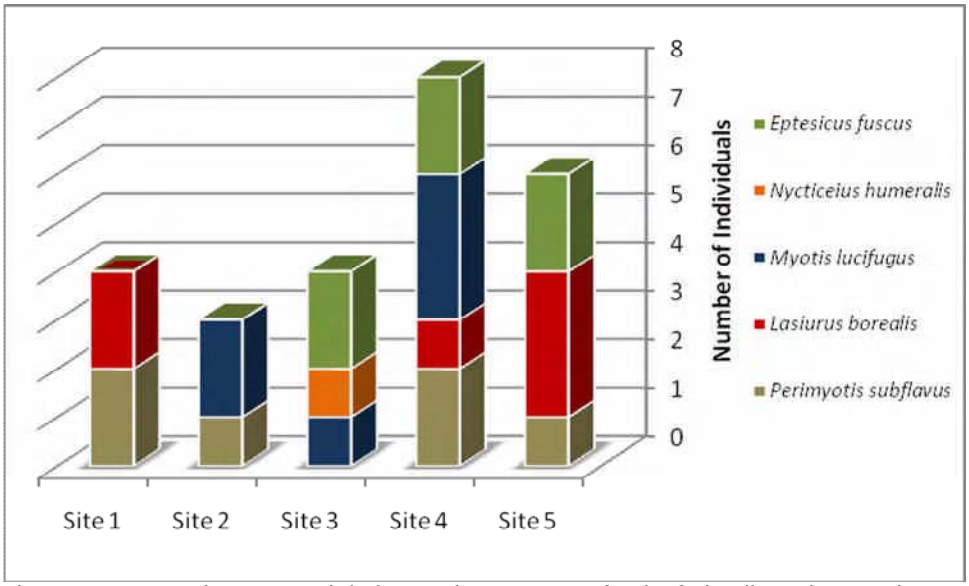

Figure 1. Bat species captured during a mist net survey for the federally endangered Indiana bat (*Myotis sodalis*) for the proposed North Vernon Bypass, Jennings County, Indiana (7/16/09 thru 7/23/09).

5.0 SUMMARY AND DISCUSSION

This mist net survey was conducted with the appropriate level of effort (20 net nights over 2 nights at 5 sites) and under the appropriate conditions to investigate presence/absence of Indiana bats during the maternity season in the vicinity of the proposed North Vernon Bypass in Jennings County, Indiana. A total of 29 bats from six species were captured during this survey. No federally-listed bat species were captured. One bat species listed as endangered by the state of Indiana, the evening bat, was captured at site 3.

Habitat for Indiana bats is present in woodlots throughout the project area. Dead snags and tree species with sloughing bark, such as white oak (*Quercus alba*), were noted. However, the results of this survey indicate that Indiana bats are not likely to be present, or are present in low numbers, within forested portions of the project area.

Table 2. Date, site, time of capture, net, species, sex, age, reproductive condition, forearm length, weight, and band number for all bats captured during the mist net survey for the federally endangered Indiana bat (*Myotis sodalis*) for the proposed North Vernon Bypass, Jennings County, Indiana (7/16/09 thru 7/23/09).

SITE	DATE	NET	TIME	SPECIES	SEX	AGE	REPRODUCTIVE CONDITION	RIGHT FOREARM LGTH (mm)	WEIGHT (g)	WING SCAR SCORE	BAND #
		A	21:18	*Perimyotis subflavus*	M	J	Non-reproductive	33.5	5.0	0	-
	7/21/2009	B	21:30	*Lasiurus borealis*	M	J	Non-reproductive	40.8	9.0	0	-
	7/22/2009	B	22:30	*Lasiurus borealis*	M	J	Non-reproductive	38.9	10.0	0	-
1	7/23/2009	B	23:56	*Perimyotis subflavus*	F	A	Post-lactating	35.2	7.2	0	-
		A	22:20	*Perimyotis subflavus*	F	A	Lactating	33.0	7.4	0	-
		A	22:20	*Myotis lucifugus*	M	A	Non-reproductive	35.0	7.0	1	-
	7/19/2009	A	22:40	*Myotis lucifugus*	F	A	Post-lactating	38.0	9.0	0	-
2	7/20/2009	B	23:20	*Myotis septentrionalis*	M	A	Non-reproductive	35.0	6.5	1	-
		A	23:30	*Nycticeius humeralis*	M	J	Non-reproductive	37.0	10.0	1	-
	7/16/2009	B	2:00	*Eptesicus fuscus*	M	A	Non-reproductive	49.0	19.8	0	-
		B	22:15	*Myotis septentrionalis*	F	J	Non-reproductive	38.0	5.5	0	-
		A	23:40	*Eptesicus fuscus*	F	A	Post-lactating	48.0	19.0	0	-
3	7/17/2009	B	2:00	*Myotis lucifugus*	M	A	Non-reproductive	38.0	7.5	0	-
		A	21:00	*Lasiurus borealis*	F	J	Non-reproductive	42.0	10.0	0	-
	7/21/2009	A	0:00	*Eptesicus fuscus*	M	A	Non-reproductive	49.0	18.5	0	-
		B	23:40	*Perimyotis subflavus*	F	A	Post-lactating	35.0	7.0	0	-
	7/22/2009	B	0:30	*Myotis lucifugus*	F	A	Non-reproductive	38.0	9.0	0	-
		A	22:20	*Myotis lucifugus*	F	A	Post-lactating	40.0	8.5	0	-
		A	22:20	*Perimyotis subflavus*	M	J	Non-reproductive	34.0	5.0	0	-
		A	22:20	*Myotis septentrionalis*	F	A	Non-reproductive	36.0	7.5	0	-
		A	0:40	*Myotis lucifugus*	F	A	Post-lactating	39.0	7.0	0	-
4	7/23/2009	A	1:30	*Eptesicus fuscus*	M	A	Non-reproductive	50.0	17.0	0	-

SITE	DATE	NET	TIME	SPECIES	SEX	AGE	REPRODUCTIVE CONDITION	RIGHT FOREARM LGTH (mm)	WEIGHT (g)	WING SCAR SCORE	BAND #
		A	21:20	*Eptesicus fuscus*	M	A	Non-reproductive	47.0	15.2	1	-
		A	21:20	*Myotis septentrionalis*	M	J	Non-reproductive	34.0	5.4	0	-
		A	21:40	*Lasiurus borealis*	M	--Escaped From Net--					
		A	21:40	*Perimyotis subflavus*	F	A	Lactating	35.0	7.4	1	-
		A	22:30	*Lasiurus borealis*	F	J	Non-reproductive	40.0	8.6	0	-
	7/21/2009	A	22:40	*Eptesicus fuscus*	M	A	Non-reproductive	45.0	17.0	1	-
	7/22/2009	--No Bats Captured--									
5	7/23/2009	A	22:20	*Lasiurus borealis*	F	A	Post-lactating	42.0	14.1	1	-

Total Number of Individuals	29
Species Richness	6
Mean Catch per Site	5.8
Mean Catch per Night	2.2
% Female	48

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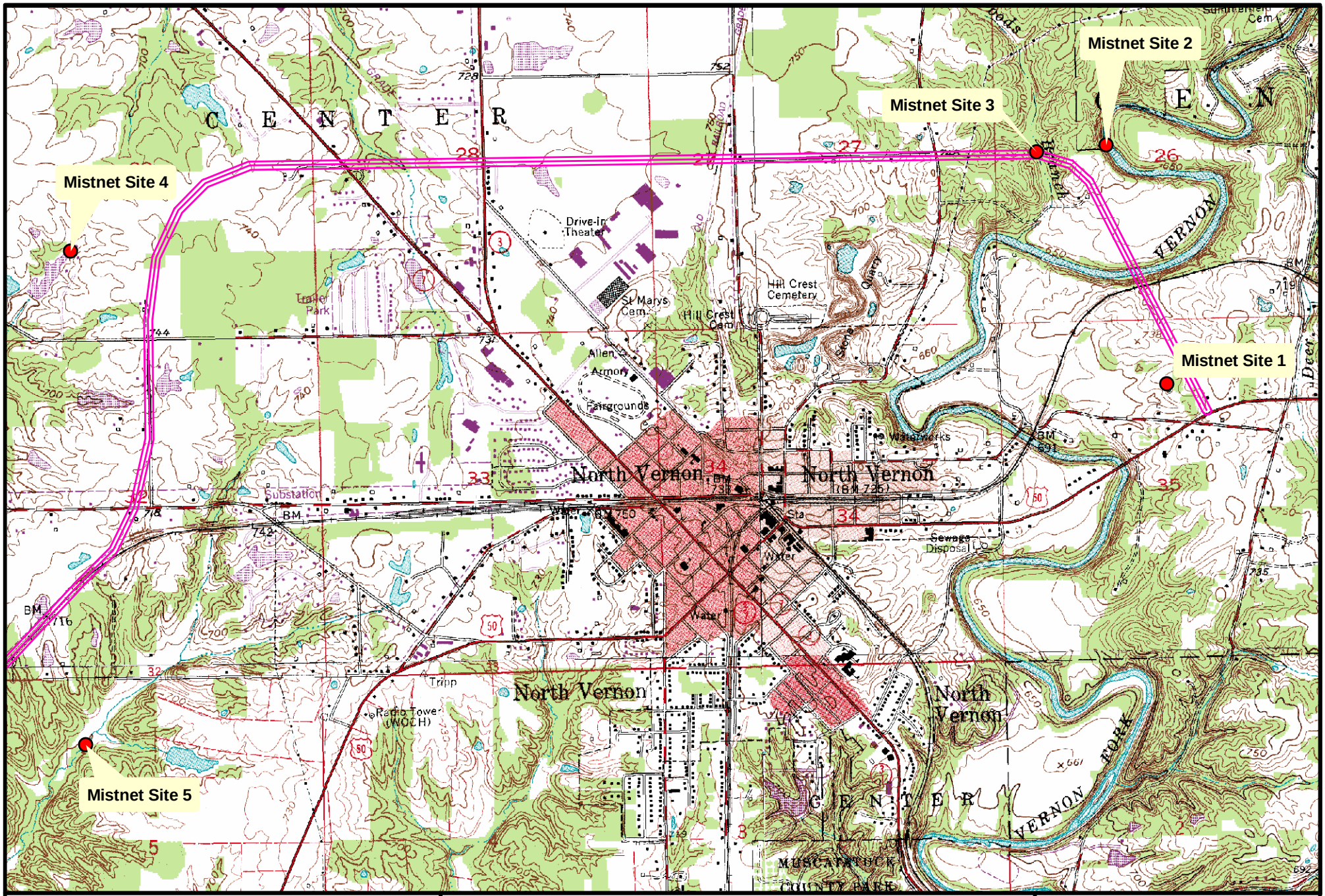
APPENDIX A MAPS



Corradino, LLC
Proposed U.S. 50, North Vernon Bypass
Jennings County, Indiana

0 700 1,400 2,800 4,200 5,600 Feet

Imagery Source:
USGS Topographic Map

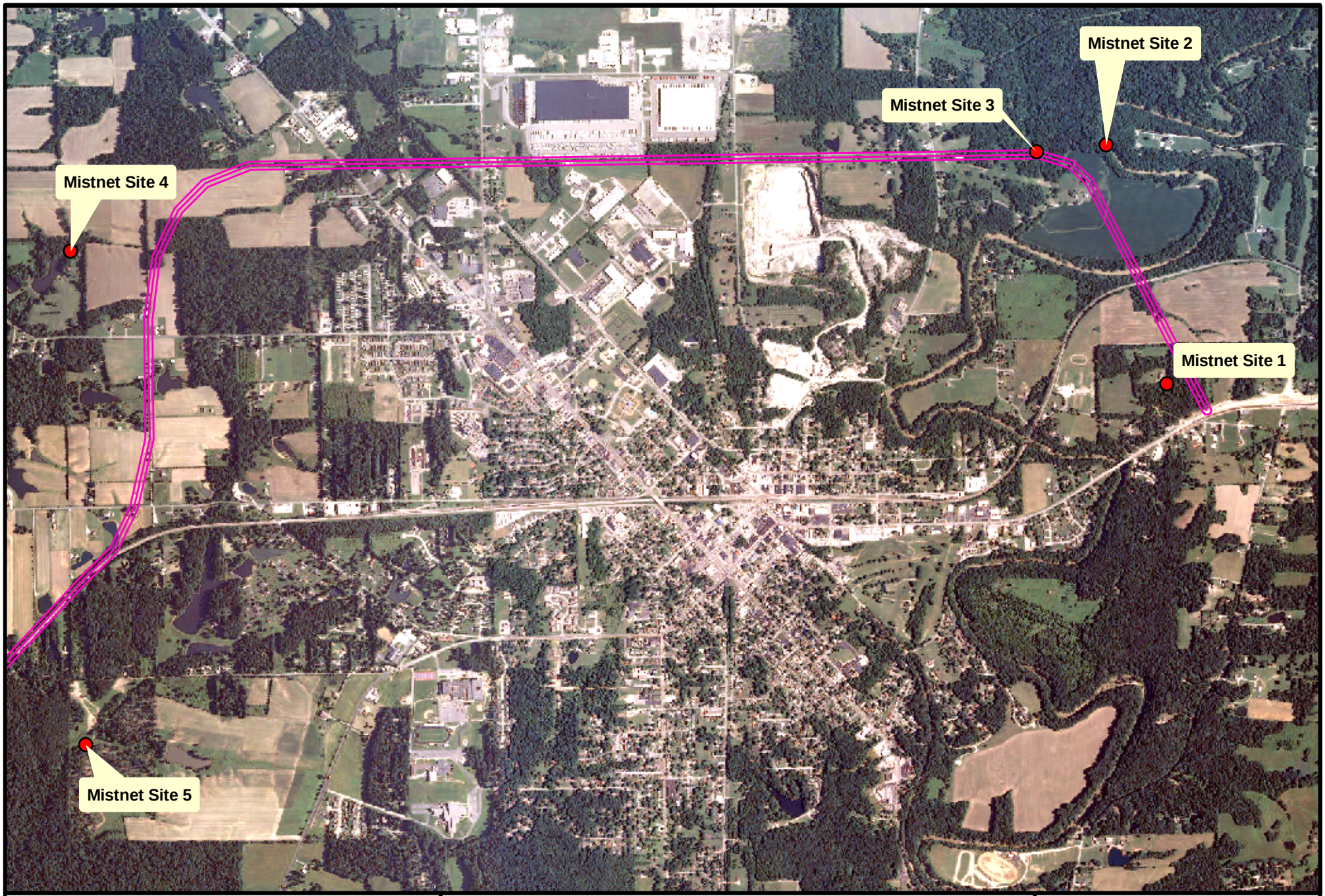
FIGURE 1
Project Location Map

Legend

- Mistnet Sites
- Alternative B

ETC ECOLOGICAL

Drawn by: TTB	Print Date: 08/17/09
Prepared for: Corradino, LLC	
ETC File: JV2009003	



Corradino, LLC
Proposed U.S. 50, North Vernon Bypass
Jennings County, Indiana

0 700 1,400 2,800 4,200 5,600 Feet

Imagery Source:
USGS Topographic Map

FIGURE 2
2008 Aerial Photograph

Legend

- Mistnet Sites
- Alternative B

ETC ECOLOGICAL

Drawn by: TTB | Print Date: 08/17/09
Prepared for: Corradino, LLC
ETC File: JV2009003

APPENDIX B SITE DESCRIPTIONS

Eco-Tech Consultants

NET SITE DESCRIPTION

Site: 1 **Project:** Proposed US 50 North Vernon Bypass **Dates:** July 21-23, 2009

ID by: Robert Carey, S. Roberts **Quad:** Butlerville **County:** Jennings **State:** IN

Net A	**Width (ft):** 30	**Height (ft):** 20	**Lat/Lon:**	39.01159°N, -85.10216°W
Net B	**Width (ft):** 20	**Height (ft):** 30	**Lat/Lon:**	39.01143°N, -85.60234°W

Vegetation

Dominant Canopy Species:
1) Sugar Maple
2) White Oak
3) Shellbark Hickory

Percent Canopy Closure:
Net A 65
Net B 75

Average Canopy DBH (in): 11-14 inches

Dominant Understory Species:
1) Sassafras
2) Shellbark hickory (sapling)
3) Sugar maple (Saplings)

Understory Density:

Very Dense	X
Moderate	
Clear	

Average Understory DBH (in): ~2

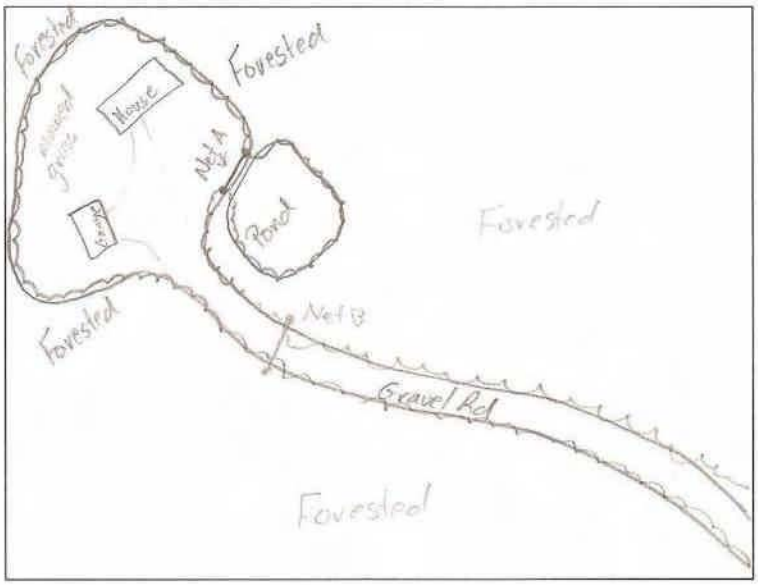
Stream

Bank Height (ft):	N/A	**Average Water Depth (ft):**	N/A
Channel Width (ft):	N/A	**Dominant Substrate:**	N/A
Water Width (ft):	N/A	**Turbidity (clear/cloudy):**	N/A

Comments/Descriptions

- Net A placed over gap in tree line between pond and mowed grass
- Net B placed over gravel drive leading to property owners house.
- Conversation w/ landowner about sinkhole on property + nesting pair of Broad-winged Hawks
- Green herons observed @ pond
- Green frogs and bullfrogs observed at pond.

Site Drawing



Eco-Tech Consultants

NET SITE DESCRIPTION

Site: 2 Project: NORTH VERNON BYPASS Dates: 7/19 – 7/20/09

ID by: L. DROPPELMAN Quad: Butlerville County: JENNINGS State: INDIANA

Net A	Width (ft): 60	Height (ft): 20	Lat/Lon:	N39.022020 / W-85.605327°
Net B	Width (ft): 42	Height (ft): 30	Lat/Lon:	N39.022161 / W-85.605162°

Vegetation

Dominant Canopy Species:
1) PLATANUS OCCIDENTALIS
2) ACER SACHARUM
3) ULMUS RUBRA

Percent Canopy Closure:
Net A 60
Net B 40

Average Canopy DBH (in): 14

Dominant Understory Species:
1) ULMUS RUBRA
2) ACER NEGUNDO
3) ACER SACHARUM

Understory Density:

Very Dense	
Moderate	
Clear	X

Average Understory DBH (in): 4

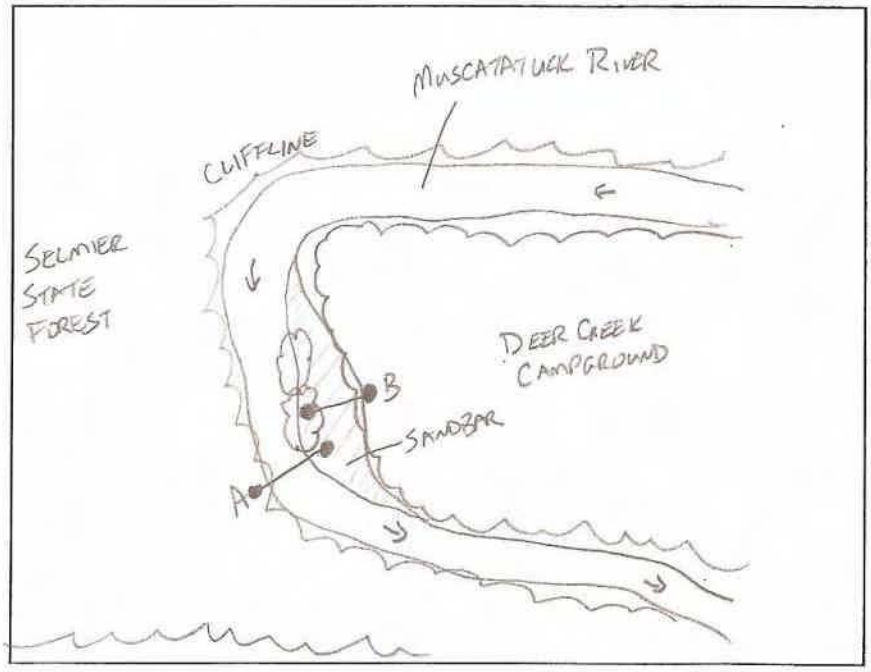
Stream

Bank Height (ft):	4	Average Water Depth (ft):	3.0
Channel Width (ft):	100	Dominant Substrate:	BEDROCK
Water Width (ft):	60	Turbidity (clear/cloudy):	CLOUDY

Comments/Descriptions

SITE IS LOCATED ON A BROAD SANDBAR ON THE INSIDE OF A MEANDER. ACCESS IS THROUGH A CAMPGROUND WITH PERMANENT RVS. SANDBAR HAS INTERMITTENT SYCAMORES. RIVER IS AT LOW FLOW. IT ABUTS A STEEP HILLSIDE/CLIFFLINE THAT HAS MATURE FOREST. RIVER IS BEDROCK WITH SAND/COBBLE MIX. THIS IS THE ONLY NETTABLE SITE ON THE MUSCATATUCK WITHIN ½ MILE OF THE PROPOSED CORRIDOR.

Site Drawing



Eco-Tech Consultants

NET SITE DESCRIPTION

Site: 3 Project: US50 North Vernon Bypass Dates: 7/16/09 - 7/17/09

ID by: L. Droppelman Quad: Butlerville County: Jennings State: Indiana

Net A	Width (ft): 20	Height (ft): 20	Lat/Lon:	N 39.02175°	W -85.60922°
Net B	Width (ft): 18	Height (ft): 20	Lat/Lon:	N 39.02136°	W -85.60899°

Vegetation

Dominant Canopy Species:
1) Juglans nigra
2) Platanus occidentalis
3)

Percent Canopy Closure:
Net A: 80
Net B: 95

Average Canopy DBH (in): 12"

Dominant Understory Species:
1) Lindera benzoin
2) Acer negundo
3) Ulmus rubra

Understory Density:

Very Dense	
Moderate	X
Clear	

Average Understory DBH (in): 2"

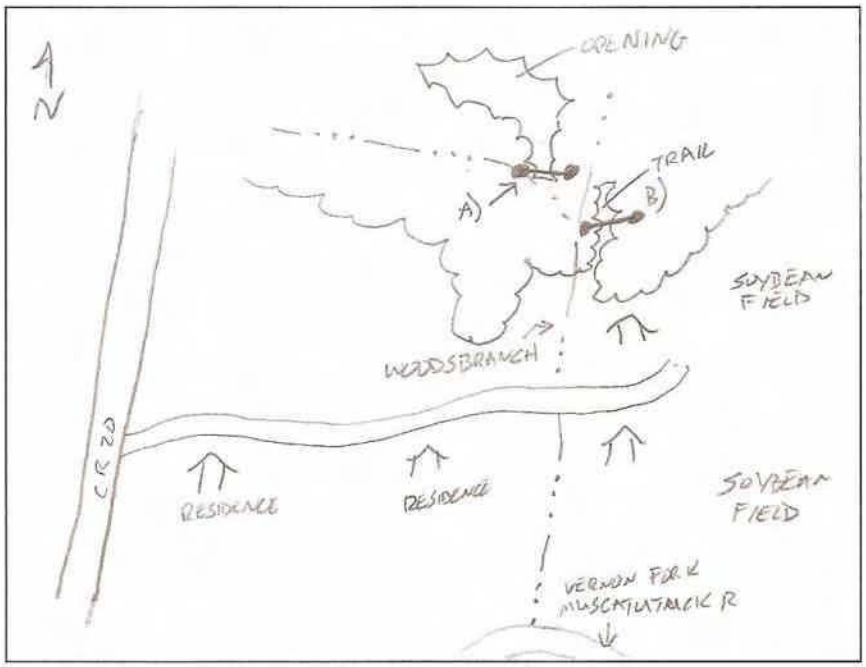
Stream

Bank Height (ft): N/A
Channel Width (ft):
Water Width (ft):
Average Water Depth (ft):
Dominant Substrate:
Turbidity (clear/cloudy):

Comments/Descriptions

Netting a forested stream trail/stream corridor. The site is on an active farm and abuts a state forest. Wildlife openings and cleared trails are abundant. Site is < ½ mile from Muscatatuck River.

Site Drawing



Eco-Tech Consultants

NET SITE DESCRIPTION

Site: 4 Project: North Vernon, IN Bats Dates: 7-21-23-09

ID by: Scott Slankard Quad: North Vernon County: Jennings State: IN

						Wpt.
Net A	Width (ft): 20	Height (ft): 20	Lat/Lon:	39.01809 / -85.66306		108
Net B	Width (ft): 20	Height (ft): 20	Lat/Lon:	39.01827 / -85.66276		107

Garmin 60cx (blue)

Vegetation

Dominant Canopy Species:	Percent Canopy Closure:		Average Canopy DBH (in):
1) C. ovata	Net A	100%	20"
2) A. saccharum	Net B	25%	
3) F. pennsylvanica			

Dominant Understory Species:	Understory Density:		Average Understory DBH (in):
1) A. saccharum	Very Dense		6"
2) C. caroliniana	Moderate	X	
3) T. distichum	Clear		

Stream

Bank Height (ft): X

Channel Width (ft): X

Water Width (ft):

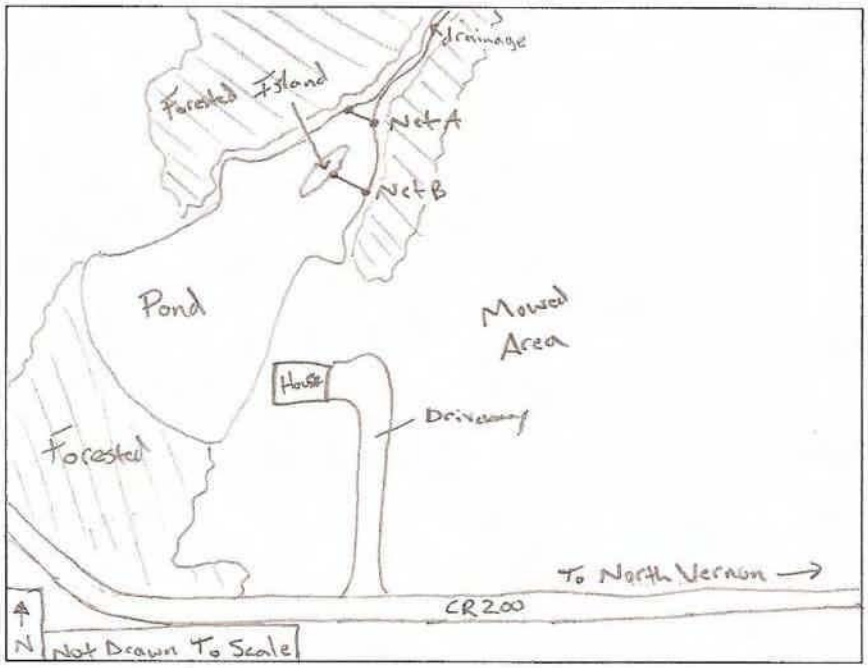
Average Water Depth (ft): X

Dominant Substrate: X

Turbidity (clear/cloudy):

Comments/Descriptions

Site Drawing



Eco-Tech Consultants

NET SITE DESCRIPTION

Site: 5 Project: US50 NORTH VERNON BYPASS Dates: 7/21/09 - 7/23/09

ID by: L. DROPPELMAN Quad: Hayden County: JENNINGS State: INDIANA

Net A	Width (ft): 20	Height (ft): 20	Lat/Lon:	38.99662	-85.66264
Net B	Width (ft): 20	Height (ft): 20	Lat/Lon:	38.99648	-85.66306

Vegetation

Dominant Canopy Species:
1) CARYA LACINIOSA
2) PLATANUS OCCIDENTALIS
3) JUGLANS NIGRA

Percent Canopy Closure:
Net A 100%
Net B 100%

Average Canopy DBH (in): 12

Dominant Understory Species:
1) CARYA OVATA
2) CERCIS CANADENSIS
3) PLATANUS OCCIDENTALIS

Understory Density:

Very Dense	
Moderate	X
Clear	

Average Understory DBH (in): 4

Stream

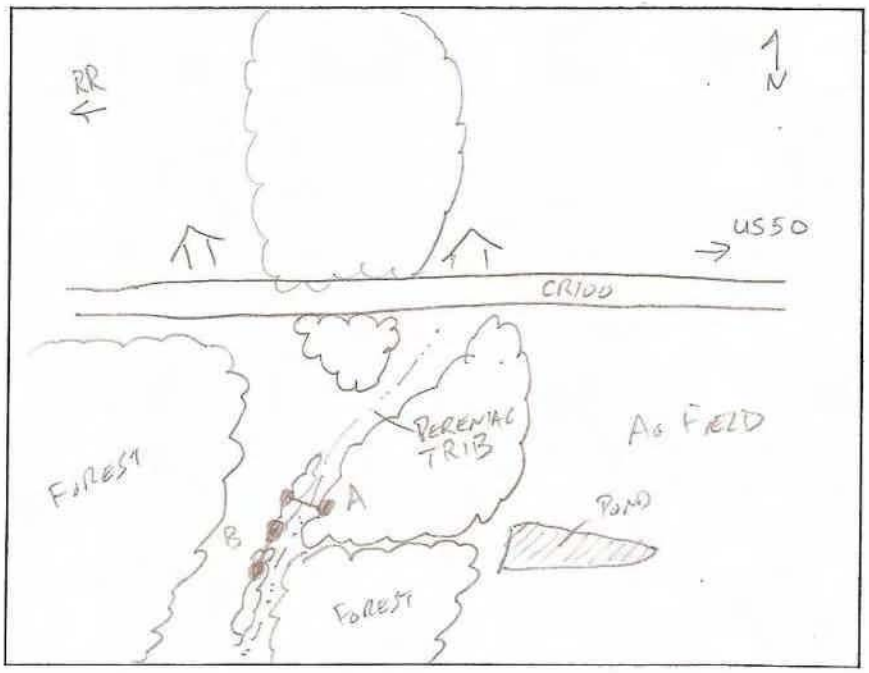
Bank Height (ft): 3
Channel Width (ft): 18
Water Width (ft): 15

Average Water Depth (ft): 1.0
Dominant Substrate: COBBLE
Turbidity (clear/cloudy): CLOUDY

Comments/Descriptions

SITE IS LOCATED ALONG AND ADJACENT TO A PERENIAL TRIBUTARY, SOUTH OF CR 100, WEST OF US50. LARGE BLOCK OF FOREST JUST SOUTH OF SITE. RECENT LOGGING IS EVIDENT. POOLS IN STREAM LOOK IDEAL FOR FISHING/DRINKING.

Site Drawing



APPENDIX C BAT CAPTURE DATA SHEETS

BAT CAPTURE DATA FORM

Site: 1 Investigator(s): Robert Oney, Shane Roberts Date: July 21, 2009

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	71.0	79%	100 clouds	0	0	new moon
Mistnet End	02:00	67.3	89%	100 clouds	0	0	

Comments and Other Wildlife Noted: Green frog, Bullfrog. Rain started @ 11:32 pm (light)

Rain out

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
Perimyotis subflavus	A	21:18	3m	J	M	NR	5.0	33.5	0	—
Lasiurus borealis	B	21:30	5m	J	M	NR	9.0	40.8	0	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 1 Investigator(s): Robert Oney Shane Roberts Date: July 22, 2009

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	67.6°F	95%	100%	0	0	New moon
Mistnet End	02:00	64.9°F	95%	100%	0	light	

Comments and Other Wildlife Noted: Steady rain throughout the day; heavy at times, stopped around 20:00.

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
Lasiurus borealis	B	22:30	4	J	M	N R	10	38.9	0	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 1 Investigator(s): Robert C. Oney, Shane Roberts Date: July 23, 2009

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	71.2°F	73%	Clear	0	0	New Moon
Mistnet End	02.00	61.8°F	92%	Clear	0	0	

Comments and Other Wildlife Noted:

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
Perimyotis subflavus	B	23:56	5m	A	F	PL	7.2	35.2	0	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 2 Investigator(s): L. DROPPELMAN, T. BROWN Date: 7/19/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	71.2	58	CLEAR	NONE	SLIGHT	3/4
Mistnet End	02:00	57.8	76	CLEAR	NONE	NONE	

Comments and Other Wildlife Noted:

RACOON, W.T. DEER, N. LEOPARD FROG, BULLFROG

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
PERIMYOTIS SUBFLAVUS	A	22:20	4.0	A	F	L	7.4	33	0	
MYOTIS LUCIFUGUS	A	22:20	4.0	A	M	N	7.0	35	1	
M. LUCIFUGUS	A	22:40	2.5	A	F	PL	9.0	38	0	

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 2 Investigator(s): L. DROPPELMAN, T. BROWN Date: 7/20/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	69.5	59	CLEAR	NONE	SLIGHT	3/4
Mistnet End	02:00	61.0	81	CLEAR	SLIGHT	SLIGHT	

Comments and Other Wildlife Noted: MANY BEETLES FLYING
FEW BATS OBSERVED FLYING

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
MYOTIS SEPTENTRIONALIS	B	23:20	3.0	A	M	NON	6.5	35	1	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 3 Investigator(s): L. DROPPELMAN / T. BROWN Date: 7/16/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	69.0	59	OVERCAST	NONE	NONE	3/4
Mistnet End	02:00	67.8	76	CLOUDY	NONE	NONE	

Comments and Other Wildlife Noted:

W.T. DEER, GREEN FROG, NO. WATER SNAKE

QUIET. VERY LITTLE BAT ACTIVITY OBSERVED

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
MYOTIS LEUCODUS	A	23:30	3.0	J	M	N	10.0	37	1	
EPTESICUS FUSCUS	B	02:00	4.0	A	M	N	19.8	49	0	

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 3 Investigator(s): L. DRODDELMAN, T. BROWN Date: 7/17/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	60.3	59	50% CLOUDY	NONE	SLIGHT	3/4
Mistnet End	02:00	55.8	78	CLEAR	NONE	NONE	

Comments and Other Wildlife Noted:

W.T. DEER, WILD TURKEY, SCREECH OWL

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
MYOTIS SEPTENTRIONALIS	B	22:15	3.0	J	F	N	5.5	38	0	
EPTESICUS FUSCUS	A	23:40	3.0	A	F	PL	19.0	48	0	
M. LUCIFUGUS	B	02:00	3.5	A	M	N	7.5	38	0	

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 4 **Investigator(s):** Scott Slankard, Travis Brown **Date:** 7-21-09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	72°	NA	100% clouds	Ø	Ø	New Moon
Mistnet End	00:00	67°	NA	Rain	Ø	1-3 mph	

Comments and Other Wildlife Noted: Rana sylvatica (sight)

Closed site due to rain @ 00:00 (midnight)

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
L. borealis	A	21:10	3	J	F	NR	10.0	42	Ø	—
E. fuscus	A	00:00	6	A	M	TND	18.5	49	Ø	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 4 **Investigator(s):** Scott Slankard, Travis Brown **Date:** 7-22-09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	68°	NA	100% Clouds	Ø	1-3	New Moon
Mistnet End	02:00	65°	NA	100% Clouds	Ø	1-3	

Comments and Other Wildlife Noted: Rana Catesbiana (heard & sighted)
Bufo fowleri (sight)

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
P. subflavus	B	23:40	5	A	F	PL	7.0	35	Ø	—
M. lucifugus	B	00:30	2	A	F	NR	9.0	38	Ø	0-3005

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 4 Investigator(s): Scott Slankard, Travis Brown Date: 7-23-09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	68°	NA	Clear	Ø	Ø	New
Mistnet End	02:00	63°	NA	Clear	Ø	Ø	Moon

Comments and Other Wildlife Noted: Green Heron (sight)
Rana catesbiana (sight & sound)
Eastern Screech owl (sound)
whip-poor-will (sound)
~~canis~~ latrans (sound)

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
M. lucifugus	A	22:20	3	A	F	PL	8.5	40	Ø	0-3006
P. subflavus	A	22:20	2	J	M	TND	5.0	34	Ø	—
M. septentrionalis	A	22:20	2	A	F	NR	7.5	36	Ø	0-3007
M. lucifugus	A	00:40	2.5	A	F	PL	7.0	39	Ø	0-3008
E. fuscus	A	01:30	4.5	A	M	TND	17.0	50	Ø	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 5 Investigator(s): L. DROPPELMAN Date: 7/21/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	73.8	56	CLOUDY	NONE	NONE	1/2
Mistnet End	23:30	67.8	100	RAIN	NONE	SLIGHT	

Comments and Other Wildlife Noted:

GRAY TREE FROG, BULL FROG, N. LEOPARD FROG

LA. WATER THRUSH IN NET AT 21:20

RAINED OUT AT 23:30

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
EPTESICUS FUSCUS	A	21:20	4.0	A	M	N	15.2	47	1	
MYOTIS SEPTENTRIONALIS	A	21:20	4.0	J	M	N	5.4	34	0	
LASIURUS BOREALIS	A	21:40	1.0		M	—	EFN	—	—	
PERIMYOTIS SUBFLAVUS	A	21:40	2.0	A	F	L	7.4	35	1	
LASIURUS BOREALIS	A	22:30	3.0	J	F	N	8.6	40	0	
E. FUSCUS	A	22:40	1.5	A	M	N	17.0	45	1	

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 5 Investigator(s): L. DROPPELMAN Date: 7/22/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	68.3	90	CLOUDY	NONE	NONE	1/2
Mistnet End	02:00	65.1	91	CLOUDY	SLIGHT	SLIGHT	

Comments and Other Wildlife Noted:

RAIN TILL 19:30 VERY LITTLE BAT ACTIVITY OBSERVED

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
NO BATS										

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

BAT CAPTURE DATA FORM

Site: 5 Investigator(s): L. DROPELMAN Date: 7/23/09

	Time	Temp. (F)	Relative Humidity (%)	Sky Conditions	Fog	Wind	Moon Phase
Mistnet Start	21:00	75.7	73	P. CLOUDY	NONE	SLIGHT	1/2
Mistnet End	02:00	60.2	91	CLEAR	MODERATE	NONE	

Comments and Other Wildlife Noted:

GREAT HORNED OWL, N. LEOPARD FROG

RECENT RAINS SEEM TO HAVE DIMINISHED THE USE OF THIS STREAM AS A WATERING AND FORAGING LOCATION

Species	Net	Time	Height in net (m)	Age	Sex	Reprod. Cond.	Weight (g)	RFA (mm)	Wing Scar Score	Band Number
LASIURUS BOREALIS	A	22:20	3.0	A	F	PL	14.1	42	1	—

Reproductive Condition: N: non-reproductive; L: lactating; P: pregnant; PL: post-lactating; TD: testes descended
Age: A: adult; J: juvenile Sex: M: male; F: female

APPENDIX D PHOTOGRAPHS

Mist net Site 1; Net A

Mist net Site 1; Net B

Mist net Site 2; Net A

Mist net Site 2; Net B

Mist net Site 3; Net A

Mist net Site 3; Net B

Mist net Site 4; Net A

Mist net Site 4; Net B

Mist net Site 5; Net A

Mist net Site 5; Net B

Potential cave investigated near mist net site 2.

Big brown bat (*Eptesicus fuscus*) captured at site 3.

Eastern red bat (*Lasiurus borealis*) captured at site 4.

Little brown bat (*Myotis lucifugus*) captured at site 3.

Northern long-eared bat (*Myotis septentrionalis*) captured at site 3.

Eastern pipistrelle (*Perimyotis subflavus*) captured at site 4.

Evening bat (*Nycticeius humeralis*) captured at site 3. This species is listed as endangered by the state of Indiana.

INDIANA BAT (*MYOTIS SODALIS*) MIST NETTING SURVEY
US 50 NORTH VERNON PROJECT
JACKSON/JENNINGS COUNTIES, INDIANA

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Abstract

Bernardin, Lochmueller & Associates, Inc. (BLA) was contracted by the Indiana Department of Transportation (INDOT) to conduct a mist netting survey for the federally endangered Indiana bat (*Myotis sodalis*) for the proposed US 50 North Vernon Project in Jackson/Jennings counties, Indiana. Two sites were mist netted on May 18 and 19, 2011. Five bats representing two species were captured: three eastern red bats (*Lasiurus borealis*) and two big brown bats (*Eptesicus fuscus*). No Indiana bats were captured.

Key words: Bats, Indiana bat, *Myotis sodalis*, Indiana, red bat, *Lasiurus borealis*, big brown bat, *Eptesicus fuscus*, Mist netting.

INTRODUCTION

The US 50 North Vernon Project study limits are from I-65 in Jackson County, Indiana, to east of the Muscatatuck Urban Training Center, east of North Vernon in Jennings County, Indiana. An Environmental Assessment (EA) and Categorical Exclusion (CE) are currently being developed for this project. The EA will examine a new alignment roadway extending from US 50 on the west side of North Vernon to SR 3 on the north side of the city. This approach will address the principal transportation needs and still allow for extension of the roadway east of SR 3 in the future.

The Indiana bat (*Myotis sodalis*) is a federally endangered species. Population declines and vulnerability to human disturbances to winter habitat prompted its listing by the USFWS on March 11, 1967. A Recovery Plan was developed in 1976 and revised in 1983. An Agency Draft of the Plan was published in 1999 (USFWS 1999). A new revision to the Plan is currently in draft form (USFWS 2007). The geographic range of the Indiana bat is 16 states. The most current range-wide estimate of the population is 387,835 in 2009; this total is down 17.2% from 2007.

Earlier coordination between the United States Fish and Wildlife Service (USFWS) and the Indiana Department of Transportation (INDOT) resulted in mist netting of five separate sites in 2009 for the US 50 North Vernon Project (Eco-Tech Consultants, Inc., 2009). Surveys were conducted because portions of the proposed project may require tree clearing within potential Indiana bat summer roosting habitat.

As a result of the 2009 surveys, 29 bats representing six species were captured: six tri-colored bats (*Perimyotis subflavus*), six little brown bats (*Myotis lucifugus*), six big brown bats (*Eptesicus fuscus*), six eastern red bats (*Lasiurus borealis*), four northern long-eared bats (*Myotis septentrionalis*), and one evening bat (*Nycticeius humeralis*). No Indiana bats were captured.

As a result of recent coordination in March 2011, the USFWS Bloomington Field Office (BFO) requested additional Indiana bat mist netting surveys be completed at two separate locations for the alternatives that extend from US 50 to SR 3. Area 1 is a wooded tract between SR 7 and the inactive Indianapolis-Madison Railroad. Area 2 includes two wooded tracts, one north and one south of the proposed alternatives (see attached maps).

The USFWS also requested that radio telemetry be conducted if any Indiana bats were captured. This was requested to determine if Indiana bats are possibly traveling between the pair of woodlots southwest of SR 7 in Area 1. Because the woodlots are separated by less than ¼ mile of open agricultural field (with no roadways to act as a barrier), the USFWS views this as a single habitat. While the proposed alignments in this area would have minimal physical impact on either woodlot, the new roadway could act as a barrier to the free movement of bats between these two habitats. If it was determined that there was a connection between the two woodlots (that is, Indiana bats are traveling between the two), "formal consultation" under Section 7 of the Endangered Species Act (ESA) may be needed.

Bernardin, Lochmueller and Associates, Inc. (BLA), assisted by Indiana State University (ISU) bat biologists, conducted the summer mist netting surveys for the Indiana bat at the two aforementioned sites under Federal Endangered Species Permit TE06845-A-0 and State of Indiana Division of Natural Resources Permit Number 10-0111.

The purpose of this survey (as well as the 2009 survey) was to determine presence/absence of the Indiana bat within potential summer roosting habitat located in proposed tree clearing areas associated with the new road alignment.

The proposed project is located in the Pre-Wisconsinan Drift Plains ecoregion of Indiana (Level IV ecoregion; Woods et al. 2007). The soils of this area are deeply-leached and acidic. They consist of pre-Wisconsinan till and thin loess. The region is largely flat with some dissected areas and extensive areas of poorly drained soils. Beech forests and elm-ash swamps were once common here (Woods et al. 2007), and relatively extensive forested areas are still present. Rock outcrops are prominent in the area, especially along the banks of the Vernon Fork of the Muscatatuck River. Karst features are also present in the vicinity of the proposed alignment and at nearby sites such as the Crosley Fish and Wildlife Area.

MATERIALS AND METHODS

A study plan was submitted to the USFWS (BFO) on April 29, 2011 and Sites 1 and 2 were pre-approved by the USFWS (BFO). The property owners for these sites were contacted by phone or in person. Permission to mist net was approved by all owners and all efforts were made to keep them informed of activities and efforts.

This survey was conducted in accordance with the guidelines of Appendix 5 of the "Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision" (USFWS 2007) (Appendix A). These guidelines call for one net site to be mist netted for two calendar nights. Both mist netting sites were located as close as possible to the actual alignment; however, Site 2 was located approximately 0.2 mile from the proposed alignment in order to sample important Indiana bat habitat features (e.g. pond, forested corridor).

Net placement was based upon best professional judgment following best use of existing flyways and maximizing such coverage.

Poles were at least 18 feet high and had ropes affixed to them to raise and lower the nets. The mist nets used in this survey were constructed of 75 denier/2-ply nylon, with a mesh size of 38 millimeters (mm) and a width of 6-9 meters (m) wide depending on width of the net site. Net sets were located so that the entire open portion of the flyway was covered by the nets. Nets were tended from dusk (approximately 21:00 Eastern Daylight Time [EDT]) until 02:00 (EDT). Mist nets were checked for bats approximately every 10 minutes.

Site 1 was located within a wooded parcel, just east of SR 7. Site 1 (Net A) was located over an inactive railroad bed, approximately 0.30 mile east of SR 7. A two-tiered system utilizing 2.6 m high X 6 m wide mist nets was set up over the railroad bed. Site 1 (Net B) was located within the same wooded parcel over an Unnamed Tributary (UNT) of Sixmile Creek. The site was approximately 0.26 mile east of SR 7 and 0.03 mile south of Site 1 (Net A). The same two-tiered system utilizing 2.6 m high X 6 m wide mist nets was set up over the UNT.

Site 2 was located within a different wooded parcel, just west of SR 7. Site 2 (Net A) was located close to a pond, approximately 0.30 mile west of SR 7. A two-tiered system utilizing 2.6 m high X 9 m wide mist nets was set up next to the pond. Site 2 (Net B) was located within the same wooded parcel. The site was approximately 0.40 mile west of SR 7 and 0.03 mile southwest of Site 2 (Net A). The same two-tiered system utilizing 2.6 m high X 9 m wide mist nets was used.

Decontamination of field equipment was conducted in accordance with the White Nose Syndrome (WNS) protocol in Appendix A. Appendix B includes figures showing the locations of the mist net sites; Appendix C includes tables documenting survey site locations and results; Appendix D includes data sheets; Appendix E includes photos of the net locations.

Habitat and meteorological conditions were documented for each mist netting site. Habitat

assessment at net sites focused on features indicative of suitability for Indiana bats. Temperature, percent cloud cover, wind, and rainfall were monitored and recorded every half hour during the mist netting effort to insure compliance with weather conditions outlined in the netting guidelines. A digital thermometer was used to record temperature. Wind speed and percent cloud cover were estimated. All sites were photographed and their location recorded using a handheld Global Positioning System (GPS) unit.

Upon capture, bats were removed from nets and identified to species using a combination of morphological and meristic characteristics (e.g., ear and tragus, presence/absence of a keeled calcar, pelage, size/weight, length of right forearm, and overall appearance of the animal). The species, sex, reproductive status, age, weight, length of right forearm, wing index, and time and location/net site of capture were recorded for all bats.

Age (adult or juvenile) of bats was determined by examining epiphyseal discs of long bones in the wing. Weight was measured to 0.5 gram (g) using a Pesola® 30 g spring scale. Length of the right forearm of each bat was estimated to the nearest 1.0 mm using either calipers or metric ruler. The reproductive condition of captured bats was classified as non-descended male, descended male, non-reproductive female, pregnant female (based on gentle abdominal palpation), lactating female, or post-lactating female. Bat processing and data collection was typically completed within 30 minutes from the time the bat was removed from the net. All bats were released unharmed at the point of capture.

Bats were not banded as part of this survey. Because no Indiana bats were captured, radio telemetry was not needed.

An Anabat SD 1 (Titley Electronics, PTY, LTD) was used at both sites to passively detect and record high frequency bat calls in the general vicinity of the mist netting sites. Each call is digitally recorded as an individual file that can be analyzed at a later time. The Anabat SD 1 was typically placed away from the mist nets to record activity in adjacent open habitats in the immediate vicinity where mist netting would be ineffective, but where bat activity was expected. Anabat data was collected for approximately five hours each night during the same time frame the mist netting was conducted. All Anabat files will be sorted and sent to USFWS (BFO) for their records.

RESULTS AND DISCUSSION

Two mist netting sites were located in suitable Indiana bat habitat as close to the proposed alignment as possible. Overall, the net sets were placed over/adjacent to an inactive railroad corridor, stream, or pond. Dominant canopy tree species generally consisted of American sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), pin oak (*Quercus palustris*), and sugar maple (*Acer saccharum*). Estimated canopy trees averaged 12-36 centimeters (cm) in diameter at breast height (dbh) and estimated canopy closure was moderate to closed. Dominant sub-canopy species included spicebush (*Lindera benzoin*), sassafras (*Sassafras albidum*), multiflora rose (*Rosa multiflora*), and pawpaw (*Asimina triloba*). Water (in the form of streams or ponds) was present at both sites.

For this study, five bats representing two species were captured: three eastern red bats (*Lasiurus borealis*) and two big brown bats (*Eptesicus fuscus*). All five bats were female and four were determined to be pregnant. No federally listed Indiana bats or gray bats (*Myotis grisescens*) were captured. Tables 3 and 4 of Appendix C include capture data by species and reproductive condition for each net site. The capture of bats averaged 0.63 bats/net night. Species richness was highest at Site 1 with two species. Site 2 did not yield any captures.

Habitat for Indiana bats is present in the woods surrounding the project area. Dead snags and tree species with sloughing bark such as sugar maple, American sycamore, eastern cottonwood (*Populus deltoides*) and black cherry (*Prunus serotina*) were noted. However, the results of this survey, in conjunction with the 2009 survey results, indicate that Indiana bats are not likely to be present within the two wooded areas of concern for the project area.

ACKNOWLEDGMENTS

We would like to thank all property owners for access to their properties. Similarly, we extend our thanks to the USFWS and the Indiana Department of Natural Resources (IDNR) for permitting and supporting such studies along with the INDOT and the Federal Highway Administration (FHWA) for funding these endangered species efforts.

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Appendix A

- USFWS Indiana Bat Mist Netting Protocol
- Disinfection Protocol for Bat Field Studies – USFWS Region 3

APPENDIX 5: Indiana Bat Mist-Netting Guidelines

RATIONALE

A typical mist-net survey is an attempt to determine presence or probable absence of the species; it does not provide sufficient data to determine population size or structure. Following these guidelines will standardize procedures for mist netting. It will help maximize the potential for capture of Indiana bats at a minimum acceptable level of effort. Although capture of bats confirms their presence, failure to catch bats does not absolutely confirm their absence. Netting effort as extensive as outlined below usually is sufficient to capture Indiana bats if they are present. However, there have been instances in which additional effort yielded detection when the standard effort did not.

Some mist-netting projects will require modification (or clarification) of these guidelines; these situations must be resolved through coordination with the Service Field Office responsible for the state in which your project occurs. Consultation with the Field Office is always recommended, particularly for large-scale netting efforts.

The Service accepts the results of these surveys to determine presence for the purposes of Section 7 consultation. Survey results are valid for at least two years.

NETTING SEASON: May 15 - August 15

May 15-August 15 are acceptable limits for documenting the presence of summer populations of Indiana bats, especially maternity colonies. (However, see Kiser and MacGregor 2005 for precautions regarding early-season surveys between May 15 and June 1, as well as late-season surveys between August 1 and August 15). Capture of reproductive adult females (i.e., pregnant, lactating, or post-lactating) and/or young of the year during May 15-August 15 indicates that a nursery colony is active in the area. Outside these dates, data cannot be used to document the presence or probable absence of summer populations.

EQUIPMENT

Mist nets to be used for Indiana bat surveys should be the finest, lowest visibility mesh commercially available: 1) In the past, this was 1 ply, 40 denier monofilament–denoted 40/1; 2) Currently, monofilament is not available, and the finest on the market is 2 ply, 50 denier nylon denoted 50/2; 3). The finest mesh size available is approximately 38 mm (~1 1/2 in).

No specific hardware is required. There are many suitable systems of ropes and/or poles to hold nets. The system of Gardner et al. (1989) has been widely used. See NET PLACEMENT below for minimum net heights, habitats, and other netting requirements that affect the choice of hardware.

NET PLACEMENT

Potential travel corridors such as streams or logging trails typically are the most effective places to net. Place nets approximately perpendicular across the corridor. Nets should fill the corridor from side to side and from stream (or ground) level up to the overhanging canopy. A typical set is 7 m high consisting of three or more nets stacked on top one another and up to 20 m wide. (Nets of different width may be used as the situation dictates).

Occasionally it may be desirable to net where there is no good corridor. Take caution to get nets up into the canopy. The typical equipment described in the section above may be inadequate for these situations, requiring innovation on the part of the researchers.

Exercise safety precautions when placing nets. Poles and nets must be clear of overhead wires.

See Kiser and MacGregor (2005) for additional discussion of net placement.

RECOMMENDED NET SITE SPACING

Stream and other linear corridors – one net site per km (0.6 mi) of stream or corridor.
Non-corridor study areas – two net sites per square km of habitat (equivalent to one net site per 123 acres).

The Service Field Office responsible for the state in which your project occurs should be consulted during survey design to resolve issues related to net site spacing for specific projects.

MINIMUM LEVEL OF EFFORT

Netting at each site should include at least four net nights, consisting of: 1) a minimum of two net locations at each site (at least 30 m apart, especially in linear habitat such as a stream corridor); and 2) a minimum of two nights of netting (i.e., two net locations for two nights = four net nights per site). A "net night" is defined as one net set up for one night. The sample period should begin at sunset and continue for at least 5 hours (longer sample periods may improve success). For purposes of determining presence or probable absence of Indiana bats, four net nights at a site are not required if Indiana bats are caught sooner (i.e., if Indiana bats are caught on the first night of netting, a second night is not required for purposes of documenting presence).

CHECKING NETS

Each net should be checked approximately every 10 minutes. Some researchers prefer continuous monitoring (with or without an electronic bat detector); care must be taken to avoid noise and movement near the nets if this technique is used. When monitoring the site continuously with a bat detector, bats can be detected immediately when they are captured in the net. Prompt removal from the net decreases stress on the bat and potential for the bat to escape (MacCarthy et al. 2006). Monitoring the net with a bat detector also allows the researcher to assess the effectiveness of their net placement (i.e., if bats are active near the nets but avoiding

capture); this may allow for adjustments that will increase netting success on subsequent nights. There should be no disturbance near the nets, other than to check nets and remove bats.

WEATHER AND LIGHT CONDITIONS

Severe weather adversely affects 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. On the other hand, if bats are not caught, it may be that bats are at the site but inactive due to the weather. Negative results combined with any of the following weather conditions throughout all or most of a sampling period are likely to require additional netting: 1) precipitation; 2) temperatures below 10^{o}C; and/or 3) strong winds (use good judgment-- moving nets are more likely to be detected by bats). Further, consider human safety when netting during adverse weather.

It is typically best to set nets under the canopy where they are out of moonlight, particularly when the moon is ½-full or greater. Areas illuminated by artificial light sources should also be avoided.

DOCUMENTATION OF *MYOTIS SODALIS* CAPTURES

Photo documentation of *M. sodalis* captured during mist netting is not required, but is encouraged. Photos taken of a bat's head, calcar, tragus, toe hairs, etc. using a macro lens or a digital camera's macro-mode are often diagnostic and aid in validating the record.

If a bat from the genus *Myotis* is captured during mist netting that cannot be readily identified to the species level, species can be verified through fecal DNA analysis. Collect one or more fecal pellets (i.e., guano) from the bat in question by placing it temporarily in a holding bag (15 minutes is usually sufficient, no more than 30 minutes is recommended). The pellet (or pellets) collected should be placed in a 1.5 ml vial with silica gel desiccant; pellets from each individual bat should be stored in separate vials. Samples should be stored out of direct light. Samples should be shipped to Dr. Jan Zinck, Department of Biology, Portland State University, 630 SW Mill St., Portland, Oregon, 97201 for subsequent fecal DNA analysis to assign or confirm the specimens' identification to the species level. The current cost for sequencing is approximately $50 per individual pellet of guano. Contact Dr. Zinck (e-mail: zinckj@pdx.edu) prior to shipping samples. To our knowledge, this is the only lab that currently provides this service. Any additional information (or additional sources) on this technique will be made available on the Indiana bat webpage on the Service's Region 3 website (www.fws.gov/midwest).

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Disinfection Protocol for Bat Field Studies
U.S. Fish and Wildlife Service – Region 3
July 2009

To minimize the potential for transmission of white-nose syndrome (WNS) while handling bats (both between handler and bats and between bats), these procedures shall be implemented. To date, WNS has been discovered in the northeastern U.S. and mid-Atlantic states.[1] The Midwest Region of the U.S. Fish and Wildlife Service (Service) has implemented these protocols in the interest of preventing WNS from spreading any further. In addition, we recommend that these guidelines be used any time people handle wildlife to minimize potential disease-related impacts to wildlife and people. Please note that individual states may have additional permitting requirements above and beyond these general procedures. In addition, these guidelines may be revised upon review of new information.

Any equipment that comes in contact with bats, with individuals handling bats, or the environments where bats occur, has the potential to be a vector for spread of WNS. Examples include mist nets, harp traps, bat bags, wing biopsy punches, weighing tubes, rulers, clothing, and gloves.

Decontamination requirements target the fungus *Geomyces* sp., which, to date, has been the most consistent pathogen recovered from bats exhibiting signs of WNS. Fortunately, many of the disinfectants and techniques tested for efficacy against the fungus are also suitable to kill other bacterial or viral agents should another causative agent of this disease be identified.

CAUTION: Disinfectant efficacy is based on application to hard, nonporous surfaces and the ability to prevent the regrowth of *Geomyces* sp. on artificial culture media. Tests are currently being conducted on porous fiber materials such as ropes and harnesses to determine disinfectant efficacy to kill the fungus on these substrates and their effects on gear integrity. The repeated use of disinfecting agents may compromise the effective use of vertical equipment; therefore, this equipment should be dedicated to one cave or not used at all.

Although a site may be affected with WNS, it should not be assumed that all individual bats within the site are infected or will become infected, and thus, care should be taken not to cross-contaminate specimens by lax handling methods. This is especially true if samples are to be submitted for diagnostic purposes.

Decontaminate all clothing, footwear, and gear prior to departing for a bat netting or cave outing if you did not decontaminate these items after last netting activity or exiting a cave. In affected and adjacent states, you may not take gear into a cave if that gear cannot be thoroughly decontaminated or disposed of (i.e. if harnesses, ropes, or webbing cannot be decontaminated, we advise that you not enter caves or parts of caves requiring use of this gear). In addition, only bring essential equipment used for bat netting and processing to a site; other non-essential items should be left home as they may contribute to spreading the fungus.

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

PROCEDURES:

Vehicles:

Do not put bats in vehicles. Vehicles used to transport equipment may harbor spores. Do all processing on vehicle hood or on a table away from the vehicle. The tailgate is not preferred since it is likely near netting equipment. A drawstring garbage bag should be placed at each site outside the field vehicle each night so all contaminated bags, gloves, wipes, etc., are contained.

Submersible Gear (i.e. clothing and soft-sided equipment):

- For clothing – Wash all clothing and any appropriate equipment in washing machine using the hottest cycle possible for material and conventional detergents. Laboratory testing has found Woolite® fabric wash the best surfactant for clothing. Rinse and air dry. Then follow by soaking with sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 10 parts water in a tub or plastic container. Soak for 10 minutes. Rinse and air dry.

- For other submersible gear (i.e. bags, gloves, nets, etc.) – Disinfect any equipment that can be submersed in a solution with an appropriate and compatible disinfectant such as sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 10 parts water in a tub or plastic container or ≥ 3% concentration of quaternary ammonium compounds (i.e. Sparquat 256, Lysol® All-purpose Professional Cleaner, or the antibacterial form of Formula 409®). Keep submersed for 10 minutes. Rinse and air dry.

Nets:

- Use separate sets between states affected by WNS[1] and unaffected states.

- Under no circumstances should nets that have been used in an affected site be used in an unaffected site. Contact your state wildlife agency (www.fws.gov/offices/statelinks.html) for county by county listings for WNS affected and unaffected sites.

Bats should be kept in breathable holding bags rather than holding cages. To avoid cross-contamination of samples, it is imperative to keep bats separated using holding bags that are kept as clean as possible. Non-disposable holding bags should be used only once per night of field work and should be washed and decontaminated (following procedures above) and dried between nights of use. Disposable paper bags are also a convenient option for holding bats temporarily. Only one bat should be in a given bag, and that bag should not be reused during the field night. White paper bags are best to avoid misplacing bats in the woods.

Disposable latex gloves should be worn over handling gloves and changed in between handling each bat. Disposable gloves should be one size larger than the handling gloves. Smooth leather gloves may be wiped down with a disinfectant (i.e. Purell®, Lysol® disinfecting wipes or alcohol wipes) in between handling bats. If only using leather gloves, each handler should have several sets of gloves to interchange in between handling bats. This allows time to effectively kill the fungus and for the

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

disinfectant to completely dry. After each night of netting (or prior to the next night of use), remove heavy soil deposits from surface of bags and gloves, soak in an appropriate disinfectant, then dry completely.

For situations when gloves may hinder field work (i.e. transmitter attachment) and bats come in contact with bare hands, apply hand sanitizer with alcohol (i.e. Purell®) after handling each bat. Make sure it dries completely before handling the next bat.

Non-submersible Gear (i.e. hard-sided equipment):

- For non-submersible gear (i.e. bat processing equipment, mist net poles, harp trap frames and legs, folding chairs, etc.) – Disinfect any equipment that cannot be submersed by applying an appropriate and compatible disinfectant to the outside surface by using ≥ 3% concentration of quaternary ammonium compounds such as Sparquat 256, Lysol® All-purpose Professional Cleaner or the antibacterial form of Formula 409®, or use sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 10 parts water. Keep on surface for 10 minutes. Rinse and air dry.

- For boots – Boots need to be fully scrubbed and rinsed so that all soil and organic material is removed. The entire rubber and leather boot, including soles and leather uppers, can then be disinfected with an appropriate disinfectant such as ≥ 3% concentration of quaternary ammonium compounds (i.e. Sparquat 256, Lysol® All-purpose Professional Cleaner or the antibacterial form of Formula 409®) and sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 10 parts water. Keep on surface for 10 minutes. Rinse and air dry.

Use one of the disinfecting agents listed above to sanitize all equipment that comes into contact with a bat's body, including light boxes, banding pliers, rulers, calipers, scale, etc. Any instrument coming into direct contact with bat skin should be rinsed free of chemical disinfectant using clean water or physiologic (0.9%) saline. Clean items after handling each bat. If using containers to weigh bats, separate containers used to weigh tree bats from cave bats, do not place tree bats in the same container previously used for a cave bat. Containers used to weigh bats (film canisters, baggies, cardboard rolls) should be disinfected in between handling each bat. Paper lunch bags can be used for holding and weighing individual bats, and can be immediately discarded after each use. Plastic baggies can also be used to line weighing containers, and bats can even be held in unsealed plastic bags during forearm measurements, reducing contact with wing rulers or calipers. Discard used bags after each bat. Disinfect gloves or discard disposable gloves after handling each bat.

Harp traps:

- Use separate traps between states affected by WNS[1] and unaffected states. Under no circumstances should traps that have been used in an affected site be used in an unaffected site. Contact your state wildlife agency for county by county listings for WNS affected and unaffected sites.

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

- Each night after use in affected states[1], remove any dirt/debris from wires/lines and bags, and spray on one of the above-listed disinfecting agents. Swab the bag with disinfectant and allow to dry completely (preferably in the sun) prior to the next use. Do not use equipment in an unaffected site following use in affected sites.

- Bats should not be allowed to remain in the catch bag for more than 10 minutes. Checking the catch bag more frequently will reduce the amount of time that bats are in contact with each other. Bats collected should then be put in their own bag until processing is complete. Disposable bags should be discarded after handling each bat and reusable bags should be decontaminated using one of the disinfecting agents listed above. To reduce cross-contamination, the catch bag may also be lined with a sheet of plastic and replaced with new plastic after every hour or wiped down with one of the disinfecting agents above.

Cameras, Computers, and Other Electronic Equipment:
If possible, do not bring electronic equipment to a netting site. If practical, cameras and other similar equipment that must be brought to a site may be wrapped in plastic wrap where only the lens is left unwrapped to allow for photos to be taken. The plastic wrap can then be decontaminated by using Lysol® disinfecting wipes and discarded after use. If using plastic wrap is not practical, alcohol wipes or Lysol® disinfecting wipes can be applied directly on surfaces.

Wing Biopsies:

If collecting wing biopsies for any approved research studies on Federally threatened or endangered bats, use a new (unused) punch for each bat. For other bats, punches may be reused, but only if they are still sharp enough to make clean punches. If there is evidence of fungal infection on any individual, use new punches. Be sure to completely sterilize recycled punches between bats by dipping the cutting end in alcohol and flaming until it naturally extinguishes, and then allowing them to cool completely. The cutting board must also be disinfected between processing individual bats using one of the agents detailed above. Disposable, stiff cardboard squares (1 per individual) can be used as an alternate surface for biopsy.

Notification of Signs of WNS
As a reminder, the white fungus is only one of the signs of WNS. We do not expect to find bats with fungus on them during the summer or fall, but bats could still be infected during these seasons. Other possible signs of WNS may be damage to wings and tail membranes in the form of lesions, flakiness or dehydrated skin, discolored spots/scarring, multiple holes, or tears to leading edge of membranes. We encourage the use of Reichard's Wing Damage Index (link below) for assessing bats. Please photograph any damage you observe and report it to the nearest U.S. Fish and Wildlife Service Field Office and the state agency that issued your bat handling permit within 24 hours.
http://www.fws.gov/northeast/PDF/Reichard_Scarring%20index%20bat%20wings.pdf

Important Note: These protocols are posted on the U.S. Fish and Wildlife Service Midwest Region website at: http://www.fws.gov/midwest/Endangered/mammals/BatDisinfectionProtocol.html. Please visit the site at least once every six weeks to ensure that you are using the most recent protocol in your permitted activities.

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

What is known about *Geomyces* sp. viability:

- The fungus survives exposure to mammalian body temperature (38° C/100° F) for at least 3 days, but does not remain viable after 8 days (W. Stone, NYSDEC, pers. communication 4/14/09).

- The fungus survives exposure to temperature (30° C/86° F) for at least 15 days. (W. Stone, NYSDEC, pers. communication 4/14/09).

- Short-term incubation of fungus at higher temperatures reduces the number of conidia present and alters the morphology of the hyphae which may not inhibit growth once returned to colder temperatures (W. Stone, NYSDEC and D. Blehert, USGS NWHC, pers. communication 4/14/09).

- Clothes dryer heat treatment (49° C/ 120° F) alone increases fungal spore germination and does not kill the fungus (H. Barton, NKU, pers. communication 4/22/09).

What kills the *Geomyces* sp. fungus:

Method	Conditions	Kill Time	Source	Cautions*
Disinfectant				
5.25% Chlorine bleach	10% bath solution (1 part bleach: 9 parts water)	10 min	Over the counter	Inactivated by organic material, detergents; corrosive to metals; produces toxic gas if combined with ammonia; skin irritant
Lysol® Professional Antibacterial All Purpose Cleaner	1:128 bath solution (1 oz per 1 gal water)_	10 min	Janitorial supply	Corrosive; skin & eye irritant
	1:64 bath solution (2 oz per 1 gal water)	5 min		
Sparquat 256	½ oz per 1 gal water	10 min	www.chemsearch.com	May require license to obtain; requires special disposal methods
Promicidal™	1:128 bath solution (1 oz per 1 gal water)	10 min	www.chemsearch.com	May require license to obtain; requires special disposal methods
Grenadier™	1:64 bath solution (2 oz per 1 gal water)	10 min	www.chemsearch.com	May require license to obtain; requires hazardous waste disposal methods

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

	1:32 bath solution (4 oz per 1 gal water)	5 min		
Formula 409®	At least 0.3% concentration	10 min	Over the counter	
Woolite®	Refer to product label		Over the counter	
Dawn® antibacterial hand soap	Refer to product label		Over the counter	
Purell®	Refer to product label		Over the counter	
Lysol® disinfecting wipes	Refer to product label		Over the counter	
70%-95% ethanol	Undiluted bath	2 min	Lab supply distributor	Flammable, skin irritant
Temperature				
Dry heat	110° F/ 43°C	12 hr	Oven, incubators	
	165° F/ 74° C	15 min		
	175° F/ 79° C	5 min		
	180° F/ 82° C	5 min		
Sterilization				
Steam autoclave	121 F; 15 psi	15 min	Laboratory or hospital settings	
Gas sterilization	Ethylene oxide	16-18 hr	Only available at hospitals	
Flame sterilization	Alcohol & open flame	15-20 sec		Fire hazard; burn injuries

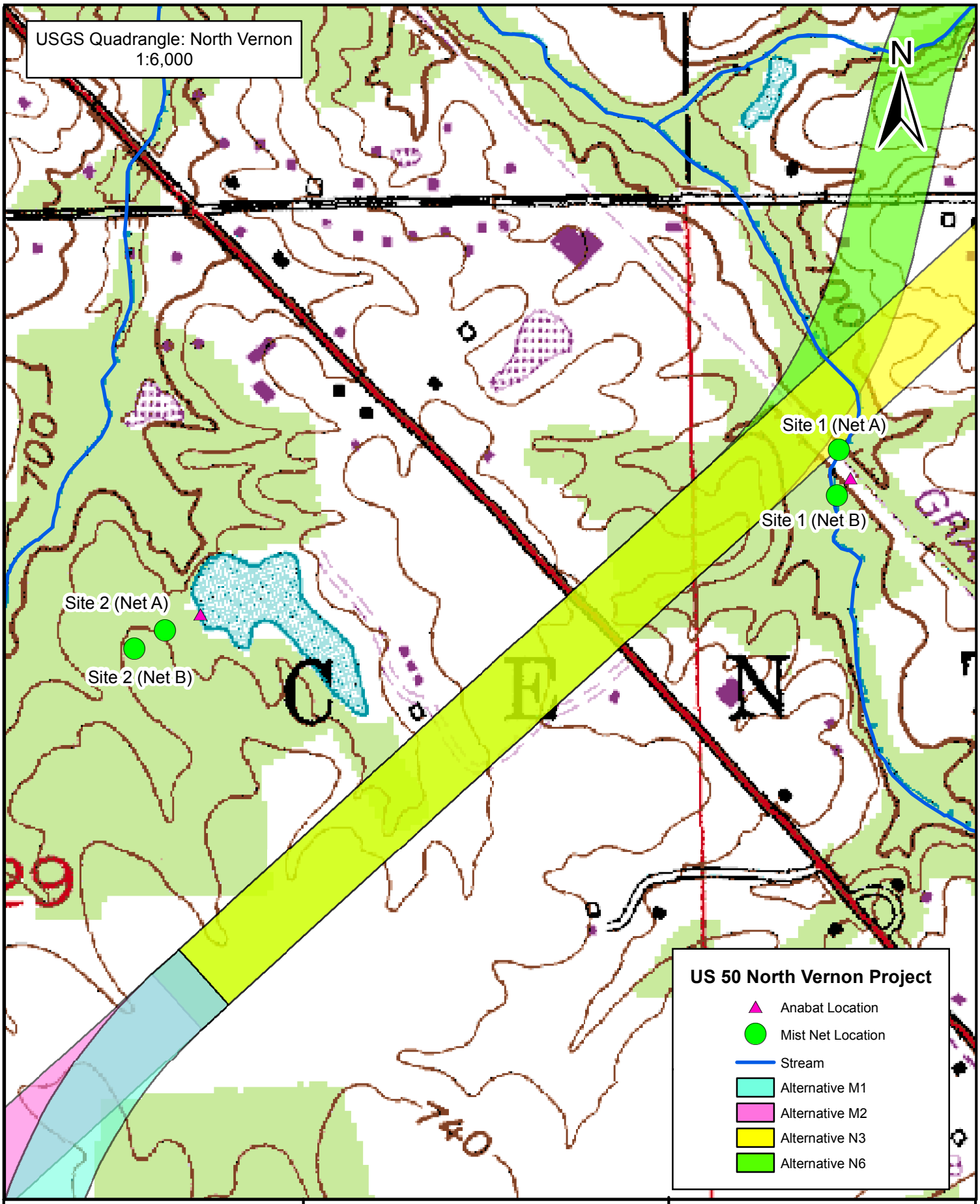
* Effects of different decontamination methods on the integrity of caving equipment are currently being tested.

Important Note: These protocols are posted on the USFWS Midwest Region web site at: http://www.fws.gov/midwest/Endangered/mammals/BatDisinfectionProtocol.html
You are responsible for visiting the site at least once every six weeks to ensure that you are using the most recent protocol in your permitted activities.

[1]WNS Affected States: Connecticut, Massachusetts, New York, New Jersey, New Hampshire, Pennsylvania, Vermont, Virginia and West Virginia

Appendix B

Figures



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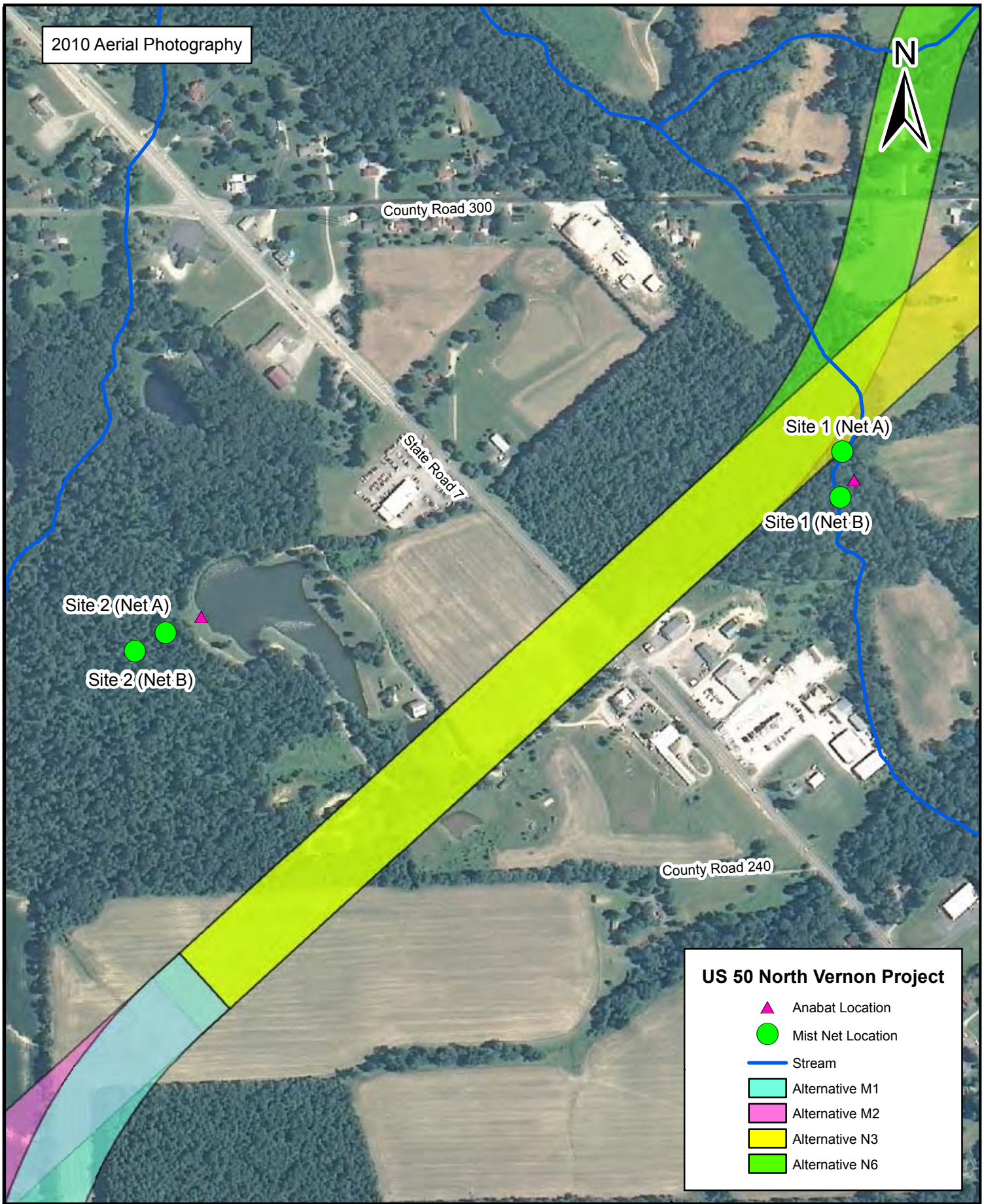
Mist Net/Anabat Locations

0 250 500 1,000 Feet

Location: SR 7
County: Jennings
Township: Center
State: Indiana

Date: 5/27/2011



BERNARDIN LOCHMUELLER & ASSOCIATES, INC.
3502 Woodview Trace, Suite 150
Indianapolis, IN 46268
Phone: (317) 222-3880
Fax: (317) 222-3881

Mist Net/Anabat Locations

0 250 500 1,000 Feet

Location: SR 7
County: Jennings
Township: Center
State: Indiana

Date: 5/27/2011

Appendix C

Tables

Table 1: GPS Coordinates for Mist Netting Survey Sites

Site	County	UTM Coordinates (meters)		
		Northing	Easting	UTM Zone
1	Jennings	4320541	617644	16N
2	Jennings	4320298	616269	16N

Table 2: Maximum and Minimum Recorded Temperatures

Site	Date	Maximum Temp		Minimum Temp	
		°C	°F	°C	°F
1	5/18/2011	14.0	57.2	11.6	52.9
	5/19/2011	19.8	67.6	11.2	52.2
2	5/18/2011	20.3	68.5	12.7	54.9
	5/19/2011	18.0	64.4	11.0	51.8

Table 3: Site/Date Specific Data by Sex and Reproductive Condition

Site Number	Date	Big brown bat (*Eptesicus fuscus*)								Eastern red bat (*Lasiurus borealis*)								Total # of bat per site & night	Total # of bats per site
		Adult female – pregnant	Adult female - lactating	Adult female - post lactating	Adult female - non-reproductive	Juvenile female	Adult male - reproductive	Adult male - non-reproductive	Juvenile male	Adult female - pregnant	Adult female - lactating	Adult female - post lactating	Adult female - non-reproductive	Juvenile female	Adult male - reproductive	Adult male - non-reproductive	Juvenile male		
Site 1	18-May												1					1	5
	19-May	2								2								4	
Site 2	18-May																		0
	19-May																		
Site 1 Totals		2								3								5	
Site 2 Totals		0								0								0	
Study Totals		2								3								5	

Table 4: Bat Capture Summary by Sex and Reproductive Condition

Species	Adult					Juvenile		Total
	Male	Female[1]				Male	Female	
		P	L	PL	NR			
eastern red bat (*Lasiurus borealis*)	-	2	-	-	1	-	-	3
big brown bat (*Eptesicus fuscus*)	-	2	-	-	-	-	-	2
Total	-	4	-	-	1	-	-	5

[1] P = pregnant; L = lactating; PL = post-lactating; NR = non-reproductive

Table 5: Bats Captured by Sex and Capture/Net-night Data

Species	Male		Female		Chi[2]	*P*	Capture/net-night
	Number	Percent	Number	Percent			
eastern red bat (*Lasiurus borealis*)	-	-	3	60	*	*	0.38
big brown bat (*Eptesicus fuscus*)	-	-	2	40	*	*	0.25
Total	-	-	5	100	*	*	0.63

*The use of the Chi-squared test is not appropriate because in each case more than 20% of the expected frequencies are less than 5.

Appendix D

Data Sheets

BERNARDIN · LOCHMUELLER & ASSOCIATES, INC.

Site 1A
Railroad Bed

NET SITE HABITAT DATA

Project Number: 108-0078-0ED-2ED **State:** IN **County:** Jennings
Project Name: US 50 Bypass North Vernon **USGS quad:** North Vernon
Survey Site ID: - Site #1 (Net A) **GPS unit:** Trimble GeoXT
Biologists: JDD & THC **UTM zone:** 16S
Survey date: 5/18/11 **Easting:** 617074 **Northing:** 4320564

Net Site Association with Water Source and Chararcterization

Name of nearest waterway: Trib. to 6 mile CR **Distance to water source** 10 meter
Water source type: Stream
Channel width: 10 meter **Stream width:** 10 meter **Bank height:** 2 meter
Average water depth: 1 meter **Still water present:** Yes **Water clarity** Yes
Substratum: ☒ bedrock ☐ boulder ☒ cobble ☒ gravel ☒ sand ☐ silt/clay

Habitat Vegetation

Dominant Canopy Species (>40 cm / 16 inch dbh)	Subdominant Canopy Species (< 40 cm / 16 inch dbh)	Dominant Subcanopy Species (< 40 cm / 16 inch dbh)
Sycamore	American Elm	Spicebush
Pin Oak	Black Cherry	Sassafras
Black Walnut	Sugar Maple	Multiflora Rose

Est. dbh Range (cm): 36 **Est. dbh Range (cm):** 25

Estimated canopy closure:	☒ Closed	☒ Moderate	☐ Open
Roost tree potential features:	☒ Large tree	☐ Snags	☐ Neither
Roost tree potential probability:	☐ High	☒ Moderate	☐ Low
Subcanopy clutter:	☒ Closed	☒ Moderate	☐ Open
Subcanopy composition:	☐ Low branches of canopy trees	☐ Sapling	☒ Shrubs
Herbaceous cover:	☐ Sparse	☐ Moderate	☒ Dense

Roost potential comments: A few snags in area

Habitat description: Dense Forest with shrubs, creek over abandoned RR at bridge. Set-up Anabat on old RR bed to the south of net ↖ 150 feet

Adjacent Land Use

☐ Mature Upland Forest	☐ Recently Logged Forest	☒ Crop/Pasture Land	☐ Shrub Swamp
☐ Mature Upland Forest	☐ Pine Plantation	☒ Stream/River	☐ Vernal Pool
☐ Mature Lowland Forest	☒ Woodlot/Forest Edge	☐ Emergent Wetland	☐ Deepwater
☐ Young Lowland Forest	☒ Old Field	☐ Forest Swamp	☐ Other

Data structure adopted from Ecological Solutions and Innovations, Inc.

Site 1B Creek

BERNARDIN · LOCHMUELLER & ASSOCIATES, INC.

NET SITE HABITAT DATA

Project Number: 108-0078-0ED-2ED **State:** IN **County:** Jennings
Project Name: US 50 Bypass North Vernon **USGS quad:** North Vernon
Survey Site ID: - Site #1 (Net B) **GPS unit:** Trimble Geo XT
Biologists: JDD & THC **UTM zone:** 16S
Survey date: 5/18/11 **Easting:** 617072 **Northing:** 4320509

Net Site Association with Water Source and Chararcterization

Name of nearest waterway: Trib to 6-Mile Creek **Distance to water source** 0 meter
Water source type: Stream
Channel width: 6 meter **Stream width:** 6 meter **Bank height:** 0.7 meter
Average water depth: 0.25 meter **Still water present:** No **Water clarity** Yes
Substratum: ☒ bedrock ☐ boulder ☐ cobble ☐ gravel ☐ sand ☐ silt/clay

Habitat Vegetation

Dominant Canopy Species (>40 cm / 16 inch dbh)	Subdominant Canopy Species (< 40 cm / 16 inch dbh)	Dominant Subcanopy Species (< 40 cm / 16 inch dbh)
Sycamore	American Elm	Spicebush
Pin Oak	Black Cherry	Sassafras
Black Walnut		Paw Paw

Est. dbh Range (cm): 36 **Est. dbh Range (cm):** 25

Estimated canopy closure:	☒ Closed	☐ Moderate	☐ Open
Roost tree potential features:	☒ Large tree	☐ Snags	☐ Neither
Roost tree potential probability:	☐ High	☒ Moderate	☐ Low
Subcanopy clutter:	☒ Closed	☐ Moderate	☐ Open
Subcanopy composition:	☐ Low branches of canopy trees	☐ Sapling	☒ Shrubs
Herbaceous cover:	☐ Sparse	☐ Moderate	☒ Dense

Roost potential comments: A few snags in the area

Habitat description: Dense forest with shrubs over creek

Adjacent Land Use

☒ Mature Upland Forest	☐ Recently Logged Forest	☒ Crop/Pasture Lan	☐ Shrub Swamp
☐ Mature Upland Forest	☐ Pine Plantation	☒ Stream/River	☐ Vernal Pool
☒ Mature Lowland Forest	☒ Woodlot/Forest Edge	☐ Emergent Wetland	☐ Deepwater
☐ Young Lowland Forest	☒ Old Field	☐ Forest Swamp	☐ Other

Data structure adopted from Ecological Solutions and Innovations, Inc.

BERNARDIN·LOCHMUELLER & ASSOCIATES, INC.

NET SITE HABITAT DATA

Project Number: 108-0078-0ED-2ED **State:** IN **County:** Jennings

Project Name: US 50 By Pass North Vernon **USGS quad:** North Vernon

Survey Site ID: - Site 2 **GPS unit:** ISU

Biologists: Jared Heine Angie Zurcher **UTM zone:** 16S

Survey date: May 18 2011 **Easting:** _____ **Northing:** _____

Net Site Association with Water Source and Chararcterization UTM: 0616269 4320298

Name of nearest waterway: ~~Eagle Creek~~ Private Pond **Distance to water source** 72 meter

Water source type: Pond

Channel width: _____ meter **Stream width:** _____ meter **Bank height:** _____ meter

Average water depth: _____ meter **Still water present:** Yes **Water clarity** _____

Substratum: ☐ bedrock ☐ boulder ☐ cobble ☐ gravel ☐ sand ☐ silt/clay

Habitat Vegetation

Dominant Canopy Species (>40 cm / 16 inch dbh)	Subdominant Canopy Species (< 40 cm / 16 inch dbh)	Dominant Subcanopy Species (< 40 cm / 16 inch dbh)
Maple	Pine	
Walnut	Sycamore	
Ash		

Est. dbh Range (cm): 12-15 **Est. dbh Range (cm):** 5-10

Estimated canopy closure:	☐ Closed	☒ Moderate	☐ Open
Roost tree potential features:	☐ Large tre	☒ Snags	☐ Neither
Roost tree potential probability:	☐ High	☐ Moderate	☒ Low
Subcanopy clutter:	☒ Closed	☐ Moderate	☐ Open
Subcanopy composition:	☒ Low branches of canopy trees	☐ Sapling	☐ Shrubs
Herbaceous cover:	☐ Sparse	☒ Moderate	☐ Dense

Roost potential comments:

Habitat description:

Adjacent Land Use

☐ Mature Upland Forest	☒ Recently Logged Forest	☒ Crop/Pasture Lan	☐ Shrub Swamp
☐ Mature Upland Forest	☐ Pine Plantation	☒ Stream/River	☐ Vernal Pool
☐ Mature Lowland Forest	☒ Woodlot/Forest Edge	☐ Emergent Wetland	☒ Deepwater
☐ Young Lowland Forest	☐ Old Field	☐ Forest Swamp	☐ Other

Data structure adopted from Ecological Solutions and Innovations, Inc.

NARDIN · LOCHMUELLER & ASSOCIATES, INC.
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PHONE (812) 479-6200 · TOLL FREE (800) 423-7411 · FAX (812) 479-6262

BAT CAPTURE DATA

Project Number: 108-0078-0ED-2ED **Survey date:** 5/18/11

Project Name: USSD Bypass N. Vernon **Site name:** - 1

State IN **County:** Jennings **UTM Zone:** 16S

USGS quad: North Vernon **GPS unit:** Trimble GeoXT

Biologists: JDD & TAC

Beaufort Wind Scale

Wind Speed (mph)	Description	Visible Condition
0	Calm	Smoke rises vertically
1-3	Light Air	Direction of wind shown by smoke but not by wind vane
4-7	Light Breeze	Wind felt on face; leaves rustele; ordinary wind vane moved by wind
8-12	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
13-18	Moderate Breeze	Raises dust and loose paper; small branches are moved
19-24	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets on inland water
25-31	Strong Breeze	Large branches in motion; telephone wires whistle; umbrellas used with difficulty
32-38	Moderate Gale	Whole trees in motion; inconvenience in walking against wind
39-46	Fresh Gale	Breaks twigs off trees; generally impedes progress

MOON PHASE

- ☐ New moon
- ☐ Waxing cresent
- ☐ First quarter
- ☐ Waxing gibbous
- ☒ Full moon
- ☐ Waning gibbous
- ☐ Third quarter
- ☐ Waning crescent

METEROLOGICAL DATA

Time (000 h)	Temperature (Celcius)	Wind Speed (Beaufort Scale)	Wind Direction From __ to __	% Cloud Cover	Comments
2100	13.4	0	–	100	Nice
2130	14.0	0	–	100	Nice
2200	12.6	0	–	100	Nice
2230	12.3	0	–	100	Nice
2300	11.9	0	–	100	Nice
2330	12.1	0	–	100	Nice
2400	12.4	0	–	100	Nice
0030	11.9	0	–	100	Nice
0100	11.8	0	–	100	Nice
0130	11.6	0	–	100	Nice
0200	11.6	0	–	100	Nice

Net/Trap/Anabat ID	Net/Trap Type	Easting (m)	Northing (m)	Length (m)	Height (m)	Time Up (0000h)	Time Down (0000h)	Photo Numbers
1A	Net	617074	4320564	6'	6	2100	0200	Photo 1 & 2
1B	Net	617072	4320509	6	6	2100	0200	Photos 3 & 4
1C	Anabat	617089	4320529	–	–	2100	0200	

Capture Number	Net Number	Time (0000h)	Species	Sex (M/F)	Age (A/J)	Repro. Status	Weight (g)	RFA (mm)	Belly F/M/E	Wind Index (0-3)	Comments
1	1A	2115	L. borealis	F	A	NR	12.5	42	M	0	
2											
3											
4											
5											
6											
7											
8											
9											
10											

Age: A = Adult, J = Juvenile

Reproduction: P = pregnant, L = lactating, PL = post lactating, NR = non-reproductive, A = ascended testes, D = descended testes

Belly: F = full, M = medium, E = empty

Data structure adopted from Ecological Solutions and Innovations, Inc.

NARDIN • LOCHMUELLER & ASSOCIATES, INC.

BAT CAPTURE DATA

Project Number: 108-0078-0ED-2ED **Survey date:** 5/19/11

Project Name: US50 ByPass North Vernon **Site name:** - 1

State IN **County:** Jennings **UTM Zone:** 16S

USGS quad: North Vernon **GPS unit:** Trimble Geo XT

Biologists: JDD & THC

Beaufort Wind Scale

Wind Speed (mph)	Description	Visible Condition
0	Calm	Smoke rises vertically
1-3	Light Air	Direction of wind shown by smoke but not by wind vane
4-7	Light Breeze	Wind felt on face; leaves rustele; ordinary wind vane moved by wind
8-12	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
13-18	Moderate Breeze	Raises dust and loose paper; small branches are moved
19-24	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets on inland water
25-31	Strong Breeze	Large branches in motion; telephone wires whistle; umbrellas used with difficulty
32-38	Moderate Gale	Whole trees in motion; inconvenience in walking against wind
39-46	Fresh Gale	Breaks twigs off trees; generally impedes progress

MOON PHASE

- ☐ New moon
- ☐ Waxing cresent
- ☐ First quarter
- ☐ Waxing gibbous
- ☒ Full moon
- ☐ Waning gibbous
- ☐ Third quarter
- ☐ Waning crescent

METEROLOGICAL DATA

Time (000 h)	Temperature (Celcius)	Wind Speed (Beaufort Scale)	Wind Direction From __ to __	% Cloud Cover	Comments
2100	19.8	0	—	10	
2130	18.7	0	—	10	
2200	16.3	0	—	0	
2230	14.6	0	—	0	
2300	13.7	0	—	0	
2330	14.1	0	—	0	
2400	13.2	0	—	0	
0030	12.2	0	—	0	
0100	11.8	0	—	0	
0130	11.8	0	—	0	
0200	11.2	0	—	0	

Net/Trap/Anabat ID	Net/Trap Type	Easting (m)	Northing (m)	Length (m)	Height (m)	Time Up (0000h)	Time Down (0000h)	Photo Numbers
1A	Net	617074	4320564	6	6	2100	0200	Photos 1 & 2
1B	Net	617072	4320509	6	6	2100	0200	Photos 3 & 4
1C	Anabat	617089	4320529	—	—	2100	0200	

Capture Number	Net Number	Time (0000h)	Species	Sex (M/F)	Age (A/J)	Repro. Status	Weight (g)	RFA (mm)	Belly F/M/E	Wing Wind Index (0-3)	Comments
1	1B	2222	E. fuscus	F	A	P	23	50	M	0	
2	1A	0030	E. fuscus	F	A	P	18	47	F	0	
3	1A	0124	L. borealis	F	A	P	13.5	39	F	0	
4	1B	0156	L. borealis	F	A	P	14	40	M	0	
5											
6											
7											
8											
9											
10											

Age: A = Adult, J = Juvenile

Reproduction: P = pregnant, L = lactating, PL = post lactating, NR = non-reproductive, A = ascended testes, D = descended testes

Belly: F = full, M = medium, E = empty

Data structure adopted from Ecological Solutions and Innovations, Inc.

NARDIN · LOCHMUELLER & ASSOCIATES, INC.

BAT CAPTURE DATA

Project Number: 108-0078-0ED-2ED **Survey date:** May 18 2011

Project Name: US 50 By Pass **Site name:** Site 2

State IN **County:** Jennings **UTM Zone:** 16S

USGS quad: North Vernon **GPS unit:** ISU

Biologists: Jane J Helms Angie Zercher

Beaufort Wind Scale

Wind Speed (mph)	Description	Visible Condition
0	Calm	Smoke rises vertically
1-3	Light Air	Direction of wind shown by smoke but not by wind vane
4-7	Light Breeze	Wind felt on face; leaves rustele; ordinary wind vane moved by wind
8-12	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
13-18	Moderate Breeze	Raises dust and loose paper; small branches are moved
19-24	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets on inland water
25-31	Strong Breeze	Large branches in motion; telephone wires whistle; umbrellas used with difficulty
32-38	Moderate Gale	Whole trees in motion; inconvenience in walking against wind
39-46	Fresh Gale	Breaks twigs off trees; generally impedes progress

MOON PHASE

- ☐ New moon
- ☐ Waxing cresent
- ☐ First quarter
- ☐ Waxing gibbous
- ☒ Full moon
- ☐ Waning gibbous
- ☐ Third quarter
- ☐ Waning crescent

METEROLOGICAL DATA

Time (000 h)	Temperature (Celcius)	Wind Speed (Beaufort Scale)	Wind Direction From __ to __	% Cloud Cover	Comments
2100	20.3	0	—	100	
2150	13.9	0	—	90	
2200	13.1	0	—	80	
2230	15.5	0	—	100	
2300	13.7	0	—	100	
2330	14.2	0	—	100	
0000	13.3	0	—	100	
0030	14.0	0	—	100	
0100	14.0	0	—	100	Sprinkle
0130	14.1	0	—	100	
0200	12.7	0	—	100	

Net/Trap/Anabat ID	Net/Trap Type	Easting (m)	Northing (m)	Length (m)	Height (m)	Time Up (0000h)	Time Down (0000h)	Photo Numbers
[redacted] A	Net	0616267	4320298	9	6	20:23	2:10	
[redacted] B	Net	0616221	4320282	9	6	20:30	2:22	
C	Anabat	0616309	4320336			20:30		

Capture Number	Net Number	Time (0000h)	Species	Sex (M/F)	Age (A/J)	Repro. Status	Weight (g)	RFA (mm)	Belly F/M/E	Wind Index (0-3)	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Age: A = Adult, J = Juvenile

Reproduction: P = pregnant, L = lactating, PL = post lactating, NR = non-reproductive, A = ascended testes, D = descended testes

Belly: F = full, M = medium, E = empty

Data structure adopted from Ecological Solutions and Innovations, Inc.

NARDIN • LOCHMUELLER & ASSOCIATES, INC.

BAT CAPTURE DATA

Project Number: 108-0078-0ED-2ED **Survey date:** 19 May 2011

Project Name: US 50 By Pass **Site name:** - Site 2

State IN **County:** Jennings **UTM Zone:** 16S

USGS quad: North Vernon **GPS unit:** ISU

Biologists: Jared Helms Angie Zurcher

Beaufort Wind Scale

Wind Speed (mph)	Description	Visible Condition
0	Calm	Smoke rises vertically
1-3	Light Air	Direction of wind shown by smoke but not by wind vane
4-7	Light Breeze	Wind felt on face; leaves rustale; ordinary wind vane moved by wind
8-12	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
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19-24	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets on inland water
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32-38	Moderate Gale	Whole trees in motion; inconvenience in walking against wind
39-46	Fresh Gale	Breaks twigs off trees; generally impedes progress

MOON PHASE

- ☐ New moon
- ☐ Waxing cresent
- ☐ First quarter
- ☐ Waxing gibbous
- ☒ Full moon
- ☐ Waning gibbous
- ☐ Third quarter
- ☐ Waning crescent

METEROLOGICAL DATA

Time (000 h)	Temperature (Celcius)	Wind Speed (Beaufort Scale)	Wind Direction From __ to __	% Cloud Cover	Comments
2100	18.0	0	—	10	
2130	15.1	0	—	10	
2200	13.9	0	—	05	
2230	13.4	0	—	0	
2300	12.7	0	—	0	
2330	12.2	0	—	0	
000	11.9	0	—	0	
030	11.8	0	—	0	
100	13.4	0	—	0	
130	12.2	0	—	0	
200	11.0	0	—	0	

Net/Trap/Anabat ID	Net/Trap Type	Easting (m)	Northing (m)	Length (m)	Height (m)	Time Up (0000h)	Time Down (0000h)	Photo Numbers
A	Net	0616269	4320298	7	6	20:30		
B	Net	0616221	4320282	9	6	20:42		
C	Anabat	0616309	4320336					

Capture Number	Net Number	Time (0000h)	Species	Sex (M/F)	Age (A/J)	Repro. Status	Weight (g)	RFA (mm)	Belly F/M/E	Wind Index (0-3)	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Age: A = Adult, J = Juvenile

Reproduction: P = pregnant, L = lactating, PL = post lactating, NR = non-reproductive, A = ascended testes, D = descended testes

Belly: F = full, M = medium, E = empty

Data structure adopted from Ecological Solutions and Innovations, Inc.

Appendix E

Photographs

Site 1 (Net A): Looking northwest

Site 1 (Net A): Looking southeast

Site 1 (Net B): Looking northeast

Site 1 (Net B): Looking southwest

Site 2 (Net A): Looking north

Site 2 (Net B): Looking south