

NATIONAL PARK SERVICE  
ABRAHAM LINCOLN BIRTHPLACE NATIONAL HISTORIC SITE

ENVIRONMENTAL ASSESSMENT FOR GRANTING SPECIAL USE PERMIT TO THE KENTUCKY  
TRANSPORTATION CABINET FOR SAFETY IMPROVEMENTS TO US-31E



PREPARED BY:  
KENTUCKY TRANSPORTATION CABINET  
200 MERO ST  
FRANKFORT, KY 40601

NATIONAL PARK SERVICE  
ABRAHAM LINCOLN BIRTHPLACE NATIONAL HISTORIC SITE  
2995 LINCOLN FARM RD  
HODGENVILLE, KY 42748



## 1.0 Introduction

This Environmental Assessment (EA) describes potential environmental impacts associated with a proposed Special Use Permit granting temporary easement rights on the Lincoln Boyhood Home (LBH) Unit of the Abraham Lincoln Birthplace National Historic Park (ABLI) to the Commonwealth of Kentucky for highway safety improvements.

### 1.1 Purpose of and Need for the Proposed Action

The National Park Service (NPS) is considering the granting of a Special Use Permit at the LBH Unit of the ABLI to the Kentucky Transportation Cabinet (KYTC) for a roadway improvement project (KYTC Item #4-8504). The purpose of this project is to correct roadway geometric deficiencies that currently exist on US 31E in LaRue County between mile points 16.3 and 18.6. These deficiencies have contributed to numerous severe crashes on this section of US 31E over the past several decades. In addition to correcting these deficiencies, an additional purpose of this project is to protect several areas of US 31E from further erosion caused by Knob Creek. The limits of the proposed work go beyond the boundaries of the LBH Unit and include a number of spot improvements.

US 31E has a speed limit of 55 miles per hour (mph) and is the primary thoroughfare between Hodgenville and Bardstown. This stretch of roadway has several curves that do not meet current geometric design criteria for safe roadways. There are a number of factors that contribute to designing curves in roadways that ensure safe travel at posted speed limits and the *Roadside Design Guide* (AASHTO 2004) provides a set of acceptable design criteria for safe roadway design. The primary variable is the radius, or length, of the curve (Figure 1). Curves with longer radii are considered safer. The minimum curve radius recommended in the Roadside Design Guide (AASHTO 2004) is 1000 feet and Kentucky further refines that to 965 feet with a maximum superelevation of 8% (KYTC 2006). Superelevation is the amount of banking in a curve where the outside of the curve is higher than the inside of the curve (Figure 2). An extreme example of this is the degree of superelevation used in race tracks.

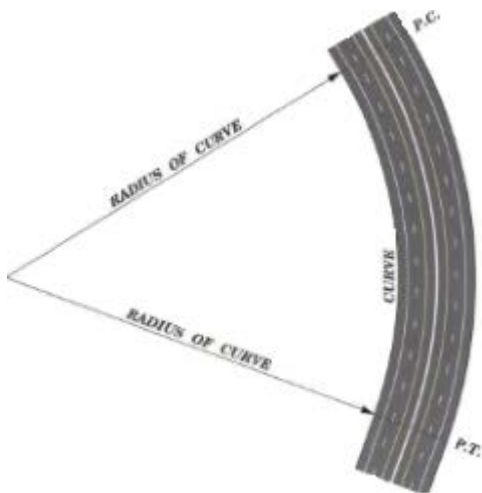


Figure 1 – Defining the radius of a curve

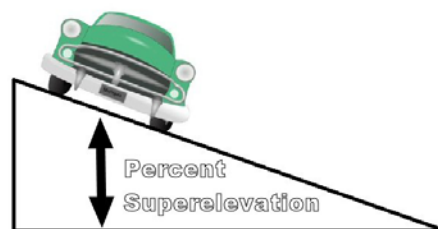


Figure 2 – An illustration showing a superelevated roadway

There are three curves with radii < 1000' along this rural minor arterial: Devers' Curve (MP 16.6), Knob Creek Curve (MP 17.0), Enlow's Curve (MP 17.7). This stretch of roadway has varying degrees of failure to meet current geometric design standards, does not meet clear zone recommendations, is often the sites of crashes, and has been noted as a dangerous stretch of roadway in a newspaper article. Table 1 summarizes the horizontal geometrics of these three curves (Figure 3).

| Curve Name | Radius        | Field-Measured<br>Superelevations | Design<br>Speed |
|------------|---------------|-----------------------------------|-----------------|
| Devers'    | 500'*<br>965' | 7%                                | 35              |
| Knob Creek | 700'          | 7%                                | 40              |
| Enlow's    | 700'          | 7%                                | 40              |

\* - compound curve

Table 1: US 31E Curve Data (AASHTO 2004)

The roadway through the project area has two 10 foot wide driving lanes and a one to two foot paved shoulder. Along the route there are numerous headwalls (pipe inlets/outlets) within two feet of the paved shoulder. Additionally there are several locations with sharp drops within a few feet of the shoulder reducing the traversable clear-zone to four feet. The clear zone is the area available along the roadside for recovery from roadway departures. The AASHTO Roadside Design Guide recommends a minimum clear zone of 20 feet for a design speed of 45mph and 24 feet for a design speed of 55mph (AASHTO 2006).

Between 2005 and 2010, 50 crashes were reported on the 2.3 miles of 31E containing the four deficient curves. Of these 50 crashes, nine were on Dever's Curve and there were 10 each on Knob Creek, and Enlow's curves and an additional 10 distributed throughout the corridor. Of these 50 crashes, 40% were caused by running off the road and an additional 30% involved hitting fixed objects. This corridor has a Critical Rate Factor (CRF) of 1.61. The CRF is used to compare the occurrence of accidents along a roadway to the statewide average of similar roadways. A CRF greater than 1.0 means accidents occur more frequently than the statewide average, while a CRF below 1.0 indicates lower than average occurrence of accidents.

The local newspaper, *The Herald News*, published an article in March 2007 about Enlow's Curve (Ireland 2007). The article draws attention to the high crash rate on Enlow's Curve. Readers of *The Herald News* labeled it a dangerous road of LaRue County.

The safety of the corridor is further compromised by the proximity of Knob Creek. In multiple places the stream encroaches the right-of-way, resulting in a steep drop off only a few feet from the shoulder. At two of these encroachments, the meanders in the stream compromise the integrity of the roadbed, further endangering motorists by creating a vertical hazard within close proximity of the road.

This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and implementing regulations, 40CFR Parts 1500-1508, NPS Director's Order #12 and Section 106 of the National Historic Preservation Act of 1966 as amended.

## **1.2 Purpose and Significance of the Park**

The site commemorating Abraham Lincoln's birthplace was first authorized as a national park in 1916. The park was later redesignated as Abraham Lincoln Birthplace National Historic Site by Congress in 2009 (123 Stat 1202). The main part of the park, the Lincoln's Birthplace Unit, is a 116.5 acre site representing about one-third of the original approximately 350 acre farm owned by Thomas Lincoln at the time of Abraham's birth. On the site is a granite and marble memorial building which houses a log cabin which was part of a traveling exposition proclaiming it the cabin of Abraham Lincoln's birth. Although it is not the actual cabin Lincoln was born in, it is still of the era and has become symbolic of Abraham's humble Kentucky origins.

The LBH Unit of the ABLI is a 232 acre farm located along Knob Creek where the Lincoln family rented 30 acres. The family moved to this site from the Sinking Spring Farm when Abraham was around 2 years old. In a June 4, 1860 letter to Samuel Haycraft Lincoln wrote "My earliest recollection is of the Knob Creek place." Lincoln and his family lived on this farm for 5 years leaving in 1816 for Spencer County, Indiana. The LBH Unit along Knob Creek is located 10 miles east of the Lincoln's Birthplace Unit along US 31E (See Figure 4).

The property was operated as a private tourist attraction from 1931 until 2001 by the Howard family. In 2001 the site was purchased by the Preservation of Lincoln's Kentucky Heritage Inc. and donated to the NPS. The site consists of two structures; the Gollaher Cabin originally built around 1800 and relocated to the Knob Creek farm in 1931 and the Lincoln Tavern constructed in 1933. The site was listed on the National Register of Historic Places in 1988 in recognition of the significant role the site has played in Abraham Lincoln related tourism in LaRue County.

The legislated purpose of ABLI is to:

- Protect and preserve the significant resources of the birthplace of Abraham Lincoln, especially the Log Cabin, Memorial Building, lands and related features.
- Protect and preserve the significant resources associated with the Knob Creek Farm and the early boyhood of Abraham Lincoln.
- Commemorate the birth and early life of Abraham Lincoln and interpret the relationship of his background and pioneer environment to his service for his country as president of the United States during the crucial years of the Civil War.

ABLI is nationally significant for the following reasons:

- This is the birthplace and early boyhood home of the 16th president of the United States who successfully preserved the Union through the turmoil of the Civil War.
- The park protects a formal landscape and the memorial building that was constructed by the Lincoln Farm Association through popular subscription to formally enshrine and preserve a symbolic birthplace cabin.
- The Boyhood Home Unit at Knob Creek preserves the setting and resources of Abraham Lincoln's early character-building years (1811-1816).
- The Boyhood Home Unit protects unusually diverse and abundant flora in the Piedmont Region representative of the mixed mesophytic forest community along with cedar glades.

### **1.3 Project Background**

The proposed project was programmed in “Kentucky’s FY2010-FY2012 Enacted Biennial Highway Plan As Approved by the May 2010 General Assembly” as “Conduct Curve Repair and Rehab Work to Pavement on US-31E Between New Haven and Hodgenville.” The project was given a total budget of 2 million dollars for design, relocation of utilities, purchase of Rights-of-Way, and construction. A project team was formed by KYTC District 4 to determine the location and extent of work to be performed. An accident analysis was used to determine the curves which are the most dangerous. The result of this analysis focused the work on three curves named by District 4 for identification purposes as Dever’s Curve, Boyhood Home Curve and Enlow’s Curve. Design work was undertaken by District 4 staff on the stretch of road between mile points 16.3 – 18.6. A meeting was held on October 10, 2010 where two to three build alternates for each curve were presented for evaluation. The alternatives were evaluated for their cost and impacts to adjacent resources weighed against how each alternative improved the geometry of the curve. The project team identified one alternate for each curve that would be advanced to final design. Since the project area lays within the LBH Unit of the ABLI National Historic Site a federal action, the granting of Special Use Permit process, was initiated requiring an Environmental Analysis. The District initiated consultation with the National Park Service on January 4, 2011.

### **1.4 Project Location**

The proposed project is located in LaRue County Kentucky along US 31E between mile markers 16.3 and 18.6. The work will be concentrated on three curves within this stretch: Dever’s Curve, Knob Creek Curve and Enlow’s Curve. The proposed project is located in the Knobs-Norman Upland of the Interior Plateau Ecoregion and the Knobs Physiographic Region. This region is characterized by its mostly forested, rounded hills and ridges which divide the Bluegrass from the rest of the Interior Plateau. The knobs are the erosion resistant remnants of the weathering of Muldraugh Hill. The underlying geology within the area is primarily Mississippian in age consisting of limestones, dolostones and shales. The project area can best be described as an alluvial valley between two rows of knobs. The existing roadway is adjacent to Knob Creek.

### **1.5 Issues**

Issues as discussed in the context of NEPA describe the interactions between the proposed action and the natural, cultural and socioeconomic environment. Issues differ from impacts in that issues describe the link between the action and the resource whereas impacts describe the intensity or results of the interactions. Internal scoping was conducted through discussions among the KYTC project team and a meeting with NPS Staff in January 2011. The project team presented a summary of its findings regarding impacts to the NPS in a meeting on February 15, 2012 which concurred with the KYTC assessment of impacts (See Appendix A).

## 1.6 Impact Topics

### Impact Topics Carried Forward for Further Analysis

#### Floodplains

Development within floodplains and floodways is regulated by federal and state laws to reduce the risk of property damage and loss of life due to flooding, as well as to preserve the natural benefits floodplain areas have on the environment. Executive Order 11988: Floodplain Management requires all federal agencies to avoid construction within 100-year floodplains unless no other practical alternative exists. Knob Creek is located in a mapped 100-year floodplain based on the Federal Emergency Management Agency (FEMA) map Flood Insurance Rate Map (FIRM). Therefore this impact topic has been carried forward for further analysis in this EA.

#### Public Health and Safety

The *NPS Management Policies 2006* state that the NPS will seek to provide a safe and healthful environment for visitors and employees. The roadway is currently geometrically deficient and the roadbed stability is threatened by streambank erosion. This directly affects visitor safety driving to and from the site. Traffic management during construction activities has the potential to create safety concerns; therefore this impact topic has been carried forward for further analysis in this EA.

#### Visitor Use and Experience

*NPS Management Policies 2006* state that the enjoyment of Park resources and values by the people of the United States is part of the fundamental purpose of all parks, and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Disruptions to traffic patterns during the construction activities could occur. The duration of these impacts is anticipated to be less than two construction seasons. Since the proposed action has the potential to impact visitor use and operations during construction, this impact topic has been carried forward for further analysis in this EA.

#### Wetlands

Executive Order 11990: Protection of Wetlands requires an examination of impacts to wetlands resulting from a Federal Action. For purposes of compliance with this executive order, the NPS uses "Classification of Wetlands and Deepwater Habitats of the United States" (FWS/OBS-79/31; Cowardin et al. 1979) as the standard for defining, classifying, and inventorying wetlands. The U.S. Army Corps of Engineers (USACE) is responsible for the administration of Section 404 of the Clean Water Act (CWA) and the issuances of permits for the discharge of dredged or fill materials into jurisdictional wetlands. KYTC biologists conducted wetland surveys in October 2011 and determined wetlands were present within the project area, therefore this topic is carried forward for further analysis.

## Impact Topics Not Carried Forward for Analysis

### Aesthetics

The NPS Organic Act calls for the conservation of the scenery of Federal lands designated as national parks, monuments and reservations unimpaired for future generations. This project includes improvements to an existing roadway within the Park boundaries. The roadway will maintain its current alignment and number of driving lanes. This will not permanently affect the scenery of the area. This project will not impact any of the existing Park resources.

### Air Quality

The 1963 Clean Air Act (42 USC 7401) requires the protection of air quality from pollution. LaRue County is currently in attainment for all monitored pollutants. The project as proposed will not generate additional traffic through the Park or permanently change travel patterns. The traffic demand will still predominantly be generated by trips between Hodgenville and either New Haven or Bardstown. There will be a slight increase in air pollution during construction however this will be temporary and well within the limits of Attainment for LaRue County. No permit will be required from the Kentucky Division of Air Quality.

### Aquatic Resources

This project will disturb Knob Creek during construction of the bank stabilization features which include displacing habitat, increasing sedimentation and turbidity. This could negatively impact fish and macroinvertebrate communities. In order to minimize the impact to aquatic resources the KYTC will limit work within Knob Creek to occur between June 1 and September 30 which are typically low flow periods in LaRue County and potentially Knob Creek could be dry especially in the later portion of that time period.

### Cultural, Historic and Archaeological Resources

The National Historic Preservation Act of 1966, NEPA, the 1916 NPS Organic Act, *NPS Management Policies 2006*, and NPS-28 require Federal agencies to consider the effects of their proposed actions on cultural resources. In order for a structure or building to be listed in the National Register of Historic Places, it must be associated with an important historic context, i.e. possess significance – the meaning or value ascribed to the structure or building, *and* have integrity of those features necessary to convey its significance, i.e. location, design, setting, workmanship, materials, feeling, and association (see National Register Bulletin #15, *How to Apply the National Register Criteria for Evaluation*). The replica of the Lincoln Boyhood Home and the Lincoln Tavern are both listed on the National Register. However, in a letter dated September 2, 2011 the State Historic Preservation Office (SHPO) determined that No Historic Properties would be affected by the proposed project (Appendix B).

The area was surveyed by the University of Kentucky and Kentucky Archaeological Survey (KAS) for any archaeological sites (Appendix B). The survey noted an extension of an existing site along Knob Creek in front of the LBH Unit. The report does not recommend any additional work and believes the road improvements proposed in the vicinity of the LBH Unit will not impact the documented archaeological site. If any archaeological artifacts or human remains are discovered during the work the contractor will cease operations and notify KYTC, KAS, the NPS, and the SHPO office

immediately. Additionally, if human remains are found law enforcement and the county coroner will be contacted immediately.

#### Designated Natural Areas

There are no designated Natural Areas within the proposed project area

#### Ecologically Critical Areas

There are no ecologically critical areas within the proposed project area such as critical habitat for threatened or endangered species

#### Environmental Justice

*Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* require Federal agencies to avoid disproportionately high adverse human health or environmental impacts from activities on low-income or minority populations. There are no relocations or large property transfers resulting from this project.

#### Indian Sacred and Indian Trust Resources

In consultation with the SHPO and Kentucky Archaeological Survey (KAS) no known Indian Sacred or Indian Trust Resources occur within the project area. The KYTC will initiate Native American Consultation if significant prehistoric archaeological sites are found through survey. The survey performed by the KAS determined there was little significance to the prehistoric materials discovered. None of the 29 artifact pieces found were intact or could provide any diagnostic information for dating. If any archaeological artifacts or human remains are discovered during the work the contractor will cease operations and notify KYTC, KAS and the SHPO office immediately. Additionally, if human remains are found law enforcement and the county coroner will be contacted immediately. If the remains are found to be of Native American descent the NPS and KYTC will open consultation with the appropriate Native American Tribes.

#### Park Operations

The Preferred Alternative would not add new structures or areas that the NPS would have to maintain; therefore the project does not adversely affect park operations.

#### Prime and Unique Farmlands

The Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) states that Federal agency programs must assess the effects of their actions on farmland soils classified by the US Department of Agriculture's Natural Resources Conservation Service as prime or unique. Prime farmland is defined as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other with minimum inputs of fuel fertilizer, pesticides, and labor, and without intolerable soil erosion and unique farmlands are lands "other than prime farmland that is used for the production of specific high-value food and fiber crops." The project area is located within the Sensabaugh silt loam soil complex which is classified as prime farmland if protected from flooding or not frequently flooded during the growing season. However, there is insufficient space between the roadway and Knob Creek for any crop production to occur and there is no protection from flooding.

#### Recreation

No Park Service recreation facilities are located within the project area

### Special Status Species

The Endangered Species Act of 1973 requires Federal actions to consider the effects on species listed as endangered or threatened. The proposed project lies within the range of the Indiana Bat (*Myotis sodalis*), Gray Bat (*Myotis grisescens*), Fanshell mussel (*Cyprogenis stegaria*), Northern Riffleshell mussel (*Epioblasma trulosa rangiana*) and Orangefoot Pimpleback mussel (*Plethobasus cooperianus*). A habitat assessment was conducted to determine if habitat suitable for these listed species exists within the project area. KYTC biologists determined that there was not suitable habitat for listed mussel species and that suitable foraging and roosting habitat occur adjacent to the project area. Therefore a Biological Assessment was prepared to determine the impacts, if any, to the federally listed Gray Bat and Indiana Bat resulting from this federal action. The USFWS concurred that there was No Habitat suitable for the listed mussel species and that although suitable foraging habitat exists the Preferred Alternative was “Not Likely to Adversely Affect” the listed bat species. See Appendix B for a copy of the Biological Assessment and concurrence letters from USFWS.

### Terrestrial Resources and Wildlife

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of the Park’s natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. The proposed project would be conducted to comply with Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds, by minimizing adverse impacts on migratory bird resources. Minimization of adverse impacts would include cutting only the trees necessary to construct the retaining walls. Parkway lands provide habitat for a wide variety of wildlife mammal species, including deer, rabbits, squirrels, foxes, opossums, and raccoons, and a variety of birds, reptiles, amphibians, and fish. The Preferred Alternative would have negligible short-term adverse impacts to wildlife and wildlife habitat during construction. Temporary displacement of wildlife may occur, but the proposed easements are currently adjacent to the existing US 31E roadbed and provide minimal utility. Therefore this topic is not carried forward for further analysis in this EA.

### Vegetation

The NEPA requires an examination of impacts on the components of affected ecosystems. The NPS *Management Policies 2006* require protection of Park resources, including vegetation, to protect Parks’ scenery, natural and historic objects, and the processes and conditions that sustain them. There would be a minimal disturbance to vegetation during construction of the streambank stabilization measures. The existing vegetation does not contain habitat suitable for rare plants known to reside in LaRue County due to the frequent disturbance from roadside mowing and dominance of fescue. Therefore this topic is not carried forward for further analysis in this EA.

### Water Quality/Hydrology

NPS *Management Policies 2006* requires protection of water quality consistent with the CWA. During construction of the concrete retaining wall exposed soil may increase erosion and sedimentation to Knob Creek. Best Management Practices (BMPs) and erosion control measures are necessary to prevent degradation of water quality will be implemented to minimize

degradation. A KYR10 Kentucky Pollutant Discharge Elimination Program stormwater construction permit will be required for this project. This topic will not be carried forward for analysis.

#### Wild and Scenic Rivers

The National Wild and Scenic Rivers System (16 U.S.C. 1271) was created to preserve rivers with outstanding cultural, natural or recreational values in a free-flowing condition for current and future generations. Knob Creek is not designated as a Wild or Scenic River.

### **1.7 Relationships to Other Projects and Planning**

The NPS is planning to renovate the parking and facilities at the LBH Unit and KYTC has obtained preliminary plans and will work closely to ensure that the projects minimize or eliminate any duplicative effort and when possible include improvements in this roadway project that facilitate the renovation of the LBH Unit's parking facilities.

### **1.8 Applicable Laws and Regulations**

The resources of ABLI are protected under the authorities of the National Park Service Organic Act of 1916 (16 U.S.C. § 1), the National Park System General Authorities Act (16 U.S.C. §§ 1a-1 et seq.), Part 36 of the CFR, and the park's enabling legislation (16 USC 1 XXIII § 211).

The Abraham Lincoln Birthplace National Historic Park was established by a gift from the Lincoln Farm Association to the Secretary of War on July 17, 1916, and was renamed Abraham Lincoln Birthplace National Historic Site on March 30, 2009. An additional 228 acres was added by PL 105-355 in 1998. Section 1 of 16 USC 1 XXIII § 211 states the purpose of the park:

*"That the land therein described, together with the buildings and appurtenances thereon, shall be forever dedicated to the purposes of a national park or reservation, the United States of America agreeing to protect and preserve the said lands, buildings, and appurtenances, and especially the log cabin in which Abraham Lincoln was born and the memorial hall inclosing the same, from spoliation, destruction, and further disintegration, to the end that they may be preserved for all time, so far as may be; and further agreeing that there shall never be any charge or fee made to or asked from the public for admission to the said park or reservation."*

In addition to the language presented in 16 USC 1 XXIII § 211 that created ABLI, general preservation and management direction is provided by the National Park Service Organic Act of August 25, 1916.

This act established the NPS and, by extension, states the overall mission for areas managed by the NPS:

*"... promote and regulate the use of the Federal areas known as national parks, monuments, and reservations . . . by such means and measures as conform to the fundamental purpose of said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

Additional laws, regulations and policies that have bearing on this action are listed below. See Appendix C for a brief description of each.

Antiquities Act of 1906  
The Endangered Species Act of 1973  
Archaeological and Historic Preservation Act of 1974  
Archaeological Resources Protection Act (ARPA) of 1979  
EO 11988 (Flood Plains)  
EO 11990 (Wetlands)  
EO 13112 (Invasive Species)  
The National Historic Preservation Act (NHPA) of 1966  
EO 11593 (Cultural Properties)  
The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990  
40 CFR 1500-1508 (Council on Environmental Quality NEPA Regulations of 1978)  
43 CFR 3 (Antiquities Act)  
43 CFR 7, Subparts A and B (ARPA, as amended), "Protection of Archaeological Resources, Uniform Regulations" and "Department of the Interior Supplemental Regulations"  
Historic Sites Act of 1935

All of Part 36 of the CFR provides for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the NPS. Some sections are specifically noted here.

36 CFR 18 (NHPA of 1966), "Leases and Exchanges of Historic Property"  
36 CFR 60 (NHPA and EO 11593), "National Register of Historic Places"  
36 CFR 63 (NHPA and EO 11593), "Determinations of Eligibility for inclusion in the National Register of Historic Places"  
36 CFR 65 (Historic Sites Act of 1935), "National Historic Landmarks Program"  
36 CFR 68 (NHPA)  
36 CFR 79 (NHPA and ARPA), "Curation of Federally-owned and Administered Archeological Collections"  
36 CFR 800 (NHPA and EO 11593), "Protection of Historic and Cultural Properties"

The introduction to Section 9 of the *Management Policies* (NPS, 2006) describes the approach of NPS to park facilities:

*"The National Park Service will provide visitor and administrative facilities that are necessary, appropriate, and consistent with the conservation of park resources and values. Facilities will be harmonious with park resources, compatible with natural processes, esthetically pleasing, functional, energy and water-efficient, cost effective, universally designed, and as welcoming as possible to all segments of the population. Park facilities and operations will demonstrate environmental leadership by incorporating sustainable practices to the maximum extent practicable in planning, design, siting, construction, and maintenance."*

The ABLI General Management Plan (GMP; NPS, 2006) provides the overall concept for management and resource preservation for compatible recreational use

## **2.0 Description of Alternatives**

The CEQ requires that a full range of alternatives are considered for any Federal action. The alternatives should meet the stated purpose and need of a project and should also be developed to minimize the impacts to environmental resources. Alternatives must also be reasonable as CEQ has defined as economically and technically feasible.

### **2.1 No Action Alternative**

The CEQ has specified that one of the alternatives must be a “no action” alternative. This provides the baseline of existing impacts to which other alternatives are compared. If the No Action Alternative is implemented US 31E will continue to have geometric deficiencies presenting safety hazards to drivers and Knob Creek will continue erode the road bed.

### **2.2 Preferred Alternative**

The preferred alternate will preserve the roadway along the existing alignment through the National Park Property adjusting the super elevation in the curve down from maximum of 11% to a 10% maximum. Additionally, there will be two locations where Knob Creek will be stabilized using streambank stabilization measures (gabion baskets, concrete block retaining wall, etc) to prevent the roadbed from eroding. This design will result in a 50 mph design speed, which is a 5 mph increase versus the existing geometric conditions. This alternative will require one lane of traffic to be closed during working hours to allow adequate room for construction. See Appendix C for a set of project plans.

### **2.3 Alternatives Considered but Rejected**

The CEQ allows for alternatives to be dismissed if they are unreasonably expensive; cannot be implemented for technical or logistic reasons; do not meet the Park mandates or do not address the Purpose and Need of the project. There was one additional alternative identified by the Project Team to address the geometric deficiencies along the Boyhood Home Curve.

#### 55 mph Reconstruction

This alternative would have extended the length of the curve away from the Lincoln Boyhood Home Unit. This would require several hundred feet of Knob Creek to be relocated. This alternative was eliminated due to the high environmental damage and cost, both in construction and mitigation fees, of relocating Knob Creek.

### **2.3 Environmentally Preferred Alternative**

The environmentally preferred alternative is determined by applying the criteria from Section 2.7 (D) of NPS Director’s Order 12. This is also the criteria laid out by the CEQ regulations that “the environmentally preferable alternative is the alternative that will best promote the national environmental policy as expressed in Section 101(b) of NEPA.” This alternative will have the least impact to biological and physical environment as well as preserving historic, cultural and natural

resources. Table 2-1 summarizes whether either the No Action or the Preferred alternatives meet the six NEPA goal statements of Section 101(b) of NEPA.

The Preferred Alternative would improve the safety of visitor access to the LBH Unit by improving the geometric deficiencies currently present and do so with minimal impact to the environment. By improving the safety of the traveling public and visitors to the Lincoln Boyhood Home Unit the Action Alternative is the Environmentally Preferred Alternative.

Table 2-1. Selection of the Environmentally Preferred Alternative

| NEPA GOAL STATEMENT                                                                                                                                                                              | NO ACTION ALTERNATIVE                                                                       | PREFERRED ALTERNATIVE                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| (1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations                                                                                     | Does not meet this goal as the stability of US31E is jeopardized by erosion from Knob Creek | Meets the goal by providing safer access to the LBH Unit and protecting the US 31E roadbed |
| (2) Assure for all generations safe, healthful, productive , and aesthetically and culturally pleasing surroundings.                                                                             | Does not meet this goal as the stability of US31E is jeopardized by erosion from Knob Creek | Meets the goal by providing safer access to the LBH Unit and protecting the US 31E roadbed |
| (3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.                               | Meets the goal by maintaining access to the LBH Unit                                        | Meets the goal by providing safer access to the LBH Unit and protecting the US 31E roadbed |
| (4) Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice. | Would meet this goal                                                                        | Meets this goal by having no affect to the historic resources of the LBH Unit              |
| (5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.                                                      | Neither contributes nor detracts from this meeting this goal.                               | Neither contributes nor detracts from this meeting this goal.                              |
| (6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.                                                                            | Neither contributes nor detracts from this meeting this goal.                               | Neither contributes nor detracts from this meeting this goal.                              |

## 2.4 Comparison of Alternatives and Summary of Environmental Consequences

The project team identified two needs for this project: improve the geometric deficiencies to improve the design speed and protect the US 31E roadbed. The Preferred Alternative addresses both needs while the No Action Alternative addresses neither. Table 2-3 summarizes the direct and indirect impacts to the resources at the Lincoln Boyhood Home Unit for the Preferred and the No Action Alternative.

**Table 2-2 Comparison of Environmental Impacts by Alternatives**

|                                                        | <b>No Action Alternative</b> | <b>Preferred Alternative</b>                                 |
|--------------------------------------------------------|------------------------------|--------------------------------------------------------------|
| <b>Aesthetics</b>                                      | No Impact                    | No Impact                                                    |
| <b>Air Quality</b>                                     | No Impact                    | Short Term Minor Adverse Impact                              |
| <b>Aquatic Resources</b>                               | No Impact                    | Short Term Minor Adverse Impact; Long Term Minor Positive    |
| <b>Cultural, Historic and Archaeological Resources</b> | No Impact                    | No Impact                                                    |
| <b>Designated Natural Areas</b>                        | No Impact                    | No Impact                                                    |
| <b>Ecologically Critical Areas</b>                     | No Impact                    | No Impact                                                    |
| <b>Environmental Justice</b>                           | No Impact                    | No Impact                                                    |
| <b>Floodplains</b>                                     | No Impact                    | Long Term Minor Adverse Impact                               |
| <b>Indian Sacred and Indian Trust Resources</b>        | No Impact                    | No Impact                                                    |
| <b>Noise</b>                                           | No Impact                    | Short Term Minor Adverse Impact                              |
| <b>Park Operations</b>                                 | No Impact                    | No Impact                                                    |
| <b>Prime and Unique Farmlands</b>                      | No Impact                    | No Impact                                                    |
| <b>Public Health and Safety</b>                        | No Impact                    | Short Term Minor Adverse and Long Term Major Positive Impact |
| <b>Recreation</b>                                      | No Impact                    | No Impact                                                    |
| <b>Sediment</b>                                        | No Impact                    | Short Term Minor Adverse, Long Term Minor Positive Impact    |
| <b>Soils</b>                                           | No Impact                    | No Impact                                                    |
| <b>Special Status Species</b>                          | No Impact                    | No Impact                                                    |
| <b>Terrestrial Resources</b>                           | No Impact                    | No Impact                                                    |
| <b>Visitor Use and Experience</b>                      | No Impact                    | Short Term Minor Adverse                                     |
| <b>Water Quality and Hydrology</b>                     | No Impact                    | Short Term Minor Adverse                                     |
| <b>Wetlands</b>                                        | No Impact                    | Short Term Minor Adverse                                     |
| <b>Wild and Scenic Rivers</b>                          | No Impact                    | No Impact                                                    |
| <b>Wildlife</b>                                        | No Impact                    | No impact                                                    |

### 3.0 Affected Environment and Environmental Consequences

This chapter describes the existing environmental resources of the area that will be affected by the Preferred Alternative. The chapter focuses on the changes to the existing conditions and any consequences that may result from implementing the Preferred Alternative as required by NPS DO-12 and Handbook: Conservation Planning, Environmental Impact Analysis and Decision Making, which sets the procedures by which NPS will comply with NEPA (NPS 2001)

To determine impacts thresholds were established for each impact topic to help understand the magnitude and duration of any changes to resources either positive or negative from either the No Action or the Preferred Alternative. Impacts are described according to their type, duration and intensity. The baseline for comparisons is the No Action Alternative. This would represent the continuation of existing park management.

#### 3.1 Floodplains

The Federal Emergency Management Agency (FEMA) has Flood Insurance Rate Maps available for Knob Creek in the vicinity of the LBH Unit. As of January 16, 2009 FIRM map 21123C0150C shows Knob Creek and some area adjacent including the US-31E road bed lie within Zone A. Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. (Appendix E)

##### Definition of Intensity Levels

| <b>Negligible</b>                                                                                                                                              | <b>Minor</b>                                                                                                                                                                                                                                           | <b>Moderate</b>                                                                                                                                                                                                                                      | <b>Major</b>                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| There would be very little change in the ability of a floodplain to convey floodwaters, or its values and functions. Project would not contribute to flooding. | Changes in the ability of a floodplain to convey floodwaters, or its values and functions, would be measurable and local, although the changes would be only just measurable. Project would not contribute to flooding. No mitigation would be needed. | Changes in the ability of a floodplain to convey floodwaters, or its values and functions, would be measurable and local. Project could contribute to flooding. The impact could be mitigated by modification of proposed facilities in floodplains. | Changes in the ability of a floodplain to convey floodwaters, or its values and functions, would be measurable and, widespread. Project would contribute to flooding. The impact could not be mitigated by modification of proposed facilities in floodplains. |

##### Definition of Duration

Short-Term: Effects lasting less than 2 years

Long-Term: Effects lasting longer than 2 years

### Environmental Effects – No Action Alternative

The No Action Alternative would have no additional impact to floodplains in Knob Creek adjacent to US 31E. Since there will be no additional impact to the floodplains there will be no cumulative effect within the Knob Creek watershed and therefore no threat of additional impairment of park resources as a result of implementing the No Action Alternative.

### Environmental Effects – Preferred Alternative

The Preferred Alternative calls for installing streambank stabilization measures to protect the roadway embankment of US 31E. This placement this will reduce the storage volume of the channel by 2.3% over a 65 foot stretch of Knob Creek. This will not adversely affect the roadway or increase the likelihood of flooding the National Park Property because the shape of the channel and the adjacent floodplain spread the water to the south side of Knob Creek flooding the agricultural fields. The KYTC LaRue County Maintenance Barn has no records of road closures along US 31E due to flooding from Knob Creek.

## **3.2 Health and Safety**

The project team has established a clear need to make safety improvements to the US 31E corridor based on the vehicle crash history through the area (10 accidents between 2005 and 2010). There are a number of geometric deficiencies that contribute to the unsafe driving conditions. NPS Management Policies 2006 state that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the park and also that the NPS seeks to provide a safe and healthful environment for visitors.

### Definition of Intensity Levels

| <b>Negligible</b>                                                         | <b>Minor</b>                                                                                                                                                                   | <b>Moderate</b>                                                                                                                                                                                                                 | <b>Major</b>                                                                                                                                                   |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Changes in health and safety would be at or below the level of detection. | The impact would be measurable or perceptible and would be localized. Impacts to safety would reflect a minor increase or decrease in the potential for accidents in the area. | The impact would be sufficient to cause a permanent change in accident rates at existing low accident locations or to create the potential for additional accidents in areas that do not currently exhibit recurring accidents. | The impact to safety would be substantial through either the elimination of a potential hazard or the creation of new areas with high potential for accidents. |

### Definition of Duration

Short-Term: Effects lasting less than 2 years

Long-Term: Effects lasting longer than 2 years

### Environmental Effects – No Action Alternative

The No Action Alternative would have a long-term minor adverse impact to health and safety by leaving the geometric deficiencies in the roadway. Additionally, the lack of action would detract from any other safety improvements made in the area.

### Environmental Effects – Preferred Alternative

The Preferred Alternative would have a long-term moderate benefit to health and safety. Improving the geometric deficiencies within the US 31E corridor will decrease the likelihood for accidents. This will by no means eliminate vehicle accidents but it will improve roadway safety. During construction it will be necessary to use temporary lane closures which could cause short term moderate negative impacts to driver safety. Also, the presence of equipment and traffic control devices such as barrier wall may present unexpected obstacles near the driving lanes. This impact will be mitigated with the use of signs, reflective materials and public awareness through local media to alert travelers to construction activities. Overall, this will have a short term moderate negative and a moderate long term positive impact to the Health and Safety of Visitors to the LBH Unit of the Park.

### **3.3 Visitor Use and Experience**

*Management Policies* (NPS 2006) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks, and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. The *Management Policies* (NPS 2006) provides the basic service-wide policies on visitor use and recreation activities, visitor safety, and interpretation and educational activities.

The purpose of this impact analysis is to determine if the alternatives are compatible or in conflict with the purpose of the Park, its visitor use/experience goals, and the direction provided by *Management Policies* (NPS 2006). These policies and goals were integrated into the impact thresholds. The potential for change in visitor use/experience was evaluated by identifying projected changes in use of the LBH Unit. For each alternative, a judgment was made as to the potential for impact. This potential impact was then characterized by type (beneficial or adverse), context (site-specific, local or regional), duration (short term or long term) and intensity. Impact to visitor use/experience at LBH Unit would result from construction activities. The construction activities could involve temporary noise, barricades, and other activities common to construction sites, which are not compatible with the natural setting of the LBH Unit. The activities could therefore produce adverse impacts.

#### Definition of Intensity Levels

| <b>Negligible</b>                                                                                                                                                           | <b>Minor</b>                                                                                                                                          | <b>Moderate</b>                                                                                                                                                            | <b>Major</b>                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Changes in visitor use and/or experience would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative. | Visitors would likely be aware of the effects associated with implementing the alternative; however the effects would be slight and likely short term | Visitors would be aware of the effects associated with implementing the alternative. Changes in visitor use and experience would be readily apparent and likely long term. | Visitors would be highly aware of the effects associated with implementing the alternative. Changes in visitor use and experience would be readily apparent and long term. |

### Definition of Duration

Short-Term: Effects lasting less than 2 years

Long-Term: Effects lasting longer than 2 years

### Environmental Effects – No Action Alternative

The No Action Alternative could have a long term moderate adverse impact to visitor use and experience. Safety is an important component of visitor use and failure to address the geometric deficiencies and stabilize the US 31E roadbed would continue unsafe conditions for travel to and from the LBH Unit. The other past, present and future actions would have a long term moderate positive impact to visitor use and experience. The reopening of the Lincoln Tavern at the LBH Unit and planned upgrades to the facilities at the Unit will definitely enhance the visitor experience. This alternative will not detract from these future actions.

### Environmental Effects – Preferred Alternative

During construction there will be a short-term moderate adverse impact. The appeal of the LBH Unit is that the area is largely unchanged since Abraham Lincoln's time spent on the farm. The viewshed includes very few modern structures visible and the presence of construction equipment will impinge on visitor's ability to experience that setting. This would be temporary and limited to one summer recreation season. In the long-term there will be a minor long-term positive impact to visitor use. The correction of geometric deficiencies and protecting the stability of the US 31E roadbed will enhance the safety of visitors traveling to and from the LBH Unit. The majority of visitors will not even perceive this change but the roadway will be safer due to these improvements. This will contribute in a positive way to the past, present and future actions to improve visitor use at LBH Unit of the Park.

## **3.4 Wetlands**

Pursuant to Executive Order 11990: Protection of Wetlands, the impact of a project on wetland areas must be assessed according to the guidance in Director's Order #77-1. The National Park Service has adopted the U.S. Fish and Wildlife Service's "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et. al 1979) methodology for identifying and classifying wetland habitats.

Under this classification system a wetland must have one or more of the following attributes

1. At least periodically, the land supports predominantly hydrophytic vegetation
2. The substrate is predominantly undrained hydric soil
3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of the year.

The Cowardin definition is broader and more inclusive than the wetland definition (33 CFR 328.3) and delineation manual used by the US Corps of Engineers for identifying wetlands subject to Section 404 of the Clean Water Act. The Corps of Engineers requires that all three indicators listed above (hydrophytic vegetation, hydric soil, and wetland hydrology) are present to consider the wetland jurisdictional. NPS guidance requires that the 1987 Corps Manual is used for delineation and mapping of vegetated wetlands and the Cowardin classification is used to describe un-vegetated wetlands such as stream channels.

A qualified KYTC Biologist conducted wetland investigations on 10/25/2011 and 2/2/2012 within the proposed project area. These investigations included plant identification to determine the presence of hydrophytic vegetation and soil core samples were taken to determine if hydric soils exist or if evidence of oxidation channels exist. The Natural Resources Conservation Service Soil Survey of Hardin and LaRue Counties, Kentucky was also consulted to supplement soil investigations. The wetland investigation found that within the project area Knob Creek was classified as Riverine Intermittent Streambed Cobble-Gravel wetland. The remaining area between Knob Creek and US 31E was not wetland because it did not support hydrophytic vegetation, contain hydric soils and was not frequently inundated with water.

| <b>Negligible</b>                                        | <b>Minor</b>                                                                                                                                                                                | <b>Moderate</b>                                                                                                                                                                                                                             | <b>Major</b>                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The effects would be at or below the levels of detection | The effects to wetlands would be detectable and relatively small in terms of area. The action would affect a limited number of individuals of plant or wildlife species within the wetland. | The effects to wetlands would be readily apparent over a small area but the impact could be mitigated by restoring previously degraded wetlands. The action would have a measurable effect on plant or wildlife species within the wetland. | The effects to wetlands would be readily apparent over a large area. The action would have measurable consequences for the wetland area that could not be mitigated. Wetland species dynamics would be upset and plant and/or animalspecies would be at risk of extirpation from the area. |

#### Definition of Duration

Short-Term: Effects lasting less than 2 years

Long-Term: Effects lasting longer than 2 years

#### Environmental Effects – No Action Alternative

The No Action Alternative would not negatively impact any wetland habitat and would not contribute to any cumulative effects of actions taken within the Knob Creek Valley such as agricultural cultivation or silviculture within the bottomlands.

#### Environmental Effects – Preferred Alternative

The construction of streambank stabilization measures to protect erosion of the roadbed would cause a short-term minor adverse impact to 1114 ft<sup>2</sup> (0.026 acres) of Riverine Intermittent Streambed Cobble-Gravel wetland. This impact will be temporary while crews are working within the stream channel. The impact will be mitigated by limiting the work to the summer months when Knob Creek has minimal flow of surface water through the channel and through the use of construction BMPs to limit the sediment input into the stream channel. The Preferred Alternative would contribute to past, present and future actions within the Knob Creek valley that have negatively impacted wetlands. Previous channel changes to maximize agricultural fields, silviculture and the siltation resulting from these activities, residential construction and the original construction of US 31E have all had significant impact on Knob Creek and its adjacent wetlands. These actions combined with maintaining such

practices into the future would have a long-term minor adverse impact to the Riverine wetland complex of Knob Creek.

#### Mitigation Measures

During construction the following Best Management Practices and Conditions from Appendix 2 of PM-77-1 Wetlands Protection (NPS 2011) will be used to mitigate and minimize impacts to riverine wetland habitat.

- 1. Effects on hydrology and fluvial processes:** Action must have only negligible to minor, new adverse effects on site hydrology and fluvial processes, including flow, circulation, velocities, hydroperiods, water level fluctuations, sediment transport, channel morphology, and so on. Care must be taken to avoid any rutting caused by vehicles or equipment.
- 2. Effects on fauna:** Action must have only negligible to minor, new adverse effects on normal movement, migration, reproduction, or health of aquatic or terrestrial fauna, including at low flow conditions.
- 3. Water quality protection and certification:** Action is conducted so as to avoid degrading water quality to the maximum extent practicable. Measures must be employed to prevent or control spills of fuels, lubricants, or other contaminants from entering the waterway or wetland. Action is consistent with state water quality standards and Clean Water Act Section 401 certification requirements (check with appropriate state agency).
- 4. Erosion and siltation controls:** Appropriate erosion and siltation controls must be maintained during construction, and all exposed soil or fill material must be permanently stabilized at the earliest practicable date.
- 5. Proper maintenance:** Structure or fill must be properly maintained so as to avoid adverse impacts on aquatic environments or public safety.
- 6. Heavy equipment use:** Heavy equipment use in wetlands must be avoided if at all possible. Heavy equipment used in wetlands must be placed on mats, or other measures must be taken to minimize soil and plant root disturbance and to preserve preconstruction elevations.
- 7. Stockpiling material:** Whenever possible, excavated material must be placed on an upland site. However, when this is not feasible, temporary stockpiling of excavated material in wetlands must be placed on filter cloth, mats, or some other semipermeable surface, or comparable measures must be taken to ensure that underlying wetland habitat is protected. The material must be stabilized with straw bales, filter cloth, or other appropriate means to prevent reentry into the waterway or wetland.
- 8. Removal of stockpiles and other temporary disturbances during construction:** Temporary stockpiles in wetlands must be removed in their entirety as soon as practicable. Wetland areas temporarily disturbed by stockpiling or other activities during construction must be returned to their pre-existing elevations, and soil, hydrology, and native vegetation communities must be restored as soon as practicable.
- 9. Topsoil storage and reuse:** Revegetation of disturbed soil areas should be facilitated by salvaging and storing existing topsoil and reusing it in restoration efforts in accordance with NPS policies and guidance. Topsoil storage must be for as short a time as possible to prevent loss of seed and root viability, loss of organic matter, and degradation of the soil microbial community.

## **4.0 Public Involvement and Agency Coordination**

### **4.1 Public Scoping**

In order to give the public and all interested parties a chance to review the EA, it will be noticed for public comment for a minimum of 30 days through local newspapers and on the world-wide-web. During this 30-day comment period, a hardcopy version of the EA will be available for review at the Abraham Lincoln Birthplace Visitor Center, and at the LaRue County Public Library. An electronic version of this document can be found on the National Park Service's Planning Environment and Public Comment (PEPC) website at <http://parkplanning.nps.gov>. This site provides access to current plans, environmental impact analyses, and related documents on public review. Users of the site can submit comments for documents available for public review. Copies of the EA will also be sent to applicable federal, state and local agencies.

### **4.2 Agency and Stakeholder Consultation**

A list of agencies and organizations that were consulted are presented in Appendix B of this Document

## **5.0 List of Preparers**

Joseph M. Ferguson  
District Environmental Coordinator  
KYTC District 4

William Justice  
Superintendent  
Abraham Lincoln Birthplace National Historic  
Park

Scott Schurman  
Environmental Project Manager  
KYTC Division of Environmental Analysis

Steven M. Wright  
Environmental Protection Specialist  
Southeast Regional Office, National Park  
Service

## **6.0 References**

American Association of State Highway and Transportation Officials. 2006. *Geometric Design of Highways and Streets 2004*, "

Cowardin, L.M., W. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of wetland and deepwater habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Service. Washington D.C. FWS/OBS-79/31.

Kentucky Transportation Cabinet. 2010. *Kentucky's FY2010-FY2012 Enacted Biennial Highway Plan: As Approved by the May 2010 General Assembly*.

American Association of State Highway and Transportation Officials, *Roadside Design Guide*, 3rd Edition, 2006, Table 3.1.

Ireland, Linda. 2007. *Enlow's Curve a hot spot for wrecks*. The LaRue County Herald Leader, 7 Feb. 2007, pg 1A and 14A.

National Park Service, U.S. Department of the Interior 2001. *The DO-12 Handbook*.

National Park Service, U.S. Department of the Interior 2006. *Abraham Lincoln Birthplace National Historic Site Final General Management Plan/Environmental Impact Statement*.

National Park Service, US Department of Interior. 2006. *Management Policies*.

National Park Service, US Department of Interior. 2011 *Procedural Manual 77-1: Wetland Protection*.

Transportation Research Board. 2000. *Highway Capacity Manual*, National Research Council, Washington D.C..

## **APPENDIX A: Summary of Impact Topics presented to NPS**

**Table 2-2 Comparison of Environmental Impacts by Alternatives**

|                                                       | <b>No Action<br/>Alternative</b> | <b>Preferred<br/>Alternative</b>                     | <b>Supporting Evidence</b>                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------|----------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aesthetics</b>                                     | No Change                        | No Impact to minimal impact                          | There is no change in the alignment of the roadway. Some superelevation change will affect the entrance. The bank stabilization will not be readily visible from the park side of the road and there is no access across Knob Creek.                                                                                                                                                                           |
| <b>Air Quality</b>                                    | No Change                        | Short term negative impact                           | The project will not on its own increase traffic through the area. There will be a temporary decrease in air quality in the vicinity of the park during construction but no lasting impacts to air quality will occur                                                                                                                                                                                          |
| <b>Aquatic Resources</b>                              | No Change                        | Short term minor negative impact; Long term positive | During construction of the bank stabilization features there will be an immediate and intense disturbance to the aquatic habitat including displacing habitat and increased sedimentation and turbidity. When the bank is armored it will ultimately decrease the amount of sediment produced from the eroding streambank. Impacts will be mitigated by performing the work during summer low-flow conditions. |
| <b>Cultural, Hisoric and Archaeological Resources</b> | No Change                        | No Impact to minimal impact                          | A quilified KYTC historian conducted an investigation based on the plans and the SHPO agree there will be No Historic Resources Affected. UK archaeologists conducted an archaeological survey and determined no arch resources will be affected by the project. If cultural artifacts or remains are discovered during construction the SHPO will be notified immediately.                                    |
| <b>Designated Natural Areas</b>                       | No Change                        | No Impact                                            | There are no designated natural areas in the proposed project limits                                                                                                                                                                                                                                                                                                                                           |
| <b>Ecologically Critical Areas</b>                    | No Change                        | No Impact                                            | There are no Ecologically Critical areas in the proposed project limits                                                                                                                                                                                                                                                                                                                                        |
| <b>Environmental Justice</b>                          | No Change                        | No Impact                                            | There are no relocations associated with this project                                                                                                                                                                                                                                                                                                                                                          |
| <b>Floodplains</b>                                    | No Change                        | No Impact                                            | The project does lie within the FEMA mapped 100 year flood plain. The plan is to maintain the existing channel cross section with the bank stabilization features. Since there will be no increase in fill there will be no loss in flood storage.                                                                                                                                                             |
| <b>Indian Sacred and Indian Trust Resources</b>       | No Change                        | No Impact                                            | There are no indian sacred sites known within the project area.                                                                                                                                                                                                                                                                                                                                                |
| <b>Noise</b>                                          | No Change                        | Short term negative impact                           | During construction the noise level increase temporarily. No additional traffic is expected due to this project. The roadway will not be moved from its current location.                                                                                                                                                                                                                                      |
| <b>Park Operations</b>                                | No Change                        | Short Term Negative Impact                           | During construction there will be lane closures in the vicinity of the park increasing the difficulty for visitors to reach the park.                                                                                                                                                                                                                                                                          |
| <b>Prime and Unique Farmlands</b>                     | No Change                        | No Impact                                            | The area disturbed is between the existing roadway and Knob Creek and is not pcabable of supporting agriculutral operations.                                                                                                                                                                                                                                                                                   |

| Table 2-2 Comparison of Environmental Impacts by Alternatives |                       |                                            |                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------|-----------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                               | No Action Alternative | Preferred Alternative                      | Supporting Evidence                                                                                                                                                                                                                                                                                                                                                   |
| <b>Public Health and Safety</b>                               | No Change             | Short Term Negative and Long Term Positive | This project will have a short term negative impact to public health and safety during lane closures, but the purpose of the project is to make the US 31E corridor safer by correcting geometric deficiencies and improving the clear zone. This will have a long term positive impact on the safety of travelers through the area and to the park                   |
| <b>Recreation</b>                                             | No Change             | No Impact                                  | No recreation facilities will be impacted during the project                                                                                                                                                                                                                                                                                                          |
| <b>Sediment</b>                                               | No Change             | Short Term Negative, Long Term Positive    | During construction there will be an immediate and intense disturbance due to the increasing the sediment load. This will be mitigated by using Best Management Practices. When the project is completed this impact will be reduced. Additionally, once the bank is armored it will ultimately decrease the amount of sediment produced from the eroding streambank. |
| <b>Soils</b>                                                  | No Change             | No Impact                                  | The project area disturbs a small area and will not change the character of the existing soils                                                                                                                                                                                                                                                                        |
| <b>Special Status Species</b>                                 | No Change             | No Impact                                  | A biological assessment was conducted by qualified KYTC personnel and it was determined by the USFWS that the project is Not Likely to Adversely Affect any federally listed species.                                                                                                                                                                                 |
| <b>Terrestrial Resources</b>                                  | No Change             | No Impact                                  | The project area is small and already disturbed.                                                                                                                                                                                                                                                                                                                      |
| <b>Visitor Use and Experience</b>                             | No Change             | Short Term Negative                        | During construction visitor use and experience will be negatively impacted by closing one lane of traffic and by the construction noise. This will be a temporary impact and the public will ultimately be better off having a safer route to the LBH Unit from the main LBH Park.                                                                                    |
| <b>Water Quality and Hydrology</b>                            | No Change             | Short Term Negative                        | During construction there will be increased sedimentation. This will be mitigated by using BMPs. A KPDES KYR10 stormwater construction permit will be required by the Kentucky Division of Water. There will be no change in the hydrology.                                                                                                                           |
| <b>Wetlands</b>                                               | No Change             | Short Term Negative                        | During construction there will be a disturbance to X.XX acres of Riverine Streambed Intermittent Cobble-Gravel Wetland. This will not result in the permanent loss of wetland because the channel cross section will match the existing Knob Creek Channel                                                                                                            |
| <b>Wild and Scenic Rivers</b>                                 | No Change             | No Impact                                  | Knob Creek is not a designated Wild and Scenic River                                                                                                                                                                                                                                                                                                                  |
| <b>Wildlife</b>                                               | No Change             | No impact                                  | There is minimal wildlife habitat in the project area. The area is already disturbed by the adjacent roadway and annual maintenance ensures that the area remains fescue.                                                                                                                                                                                             |

## APPENDIX B: AGENCY CORRESPONDANCE

US Fish and Wildlife Service  
Kentucky Ecological Services Field Office  
330 West Broadway, Suite 265  
Frankfort, KY 40601

Kentucky Heritage Council  
State Historic Preservation Office  
300 Washington Street  
Frankfort, KY 40601

National Park Service  
Southeast Regional Office  
100 Alabama Street, SW  
1924 Building  
Atlanta, GA 30303



## United States Department of the Interior

FISH AND WILDLIFE SERVICE  
Kentucky Ecological Services Field Office  
330 West Broadway, Suite 265  
Frankfort, Kentucky 40601  
(502) 695-0468

November 25, 2011

Mr. David Waldner  
Division of Environmental Analysis  
Kentucky Transportation Cabinet  
200 Mero Street  
Frankfort, Kentucky 40622

Re: FWS 2011-B-0868; KYTC Item Number 4-8504; Biological Assessment for Indiana bat and gray bat in association with the proposed spot improvements along US 31E in Larue County, Kentucky

Dear Mr. Waldner:

Fish and Wildlife Service (Service) personnel have reviewed the Biological Assessment (BA) dated August 2011 regarding the gray bat and Indiana bat in association with the above referenced project proposal. It is our understanding that the proposed project has been assessed for federally listed mussel species and suitable habitat for these species through a separate KYTC review. Specifically, a habitat assessment and "no effect" finding for listed mussel species were performed by KYTC biologists and documentation of these additional findings is on file at KYTC. Service biologists have reviewed the information pertaining to the Indiana bat and gray bat, and offer the following comments.

The biological assessment is adequate and supports the conclusion of "not likely to adversely affect" for the Indiana bat and gray bat. Based on our review of the information, we concur with these determinations. Please ensure that the minimization measures associated with gray bat foraging habitat and Indiana bat seasonal clearing restrictions (October 15 – March 31) are fully implemented.

In view of this, we believe that the requirements of Section 7 of the Endangered Species Act (Act) have been fulfilled. However, obligations under Section 7 of the Act must be reconsidered if: (1) new information reveals that the proposed action may affect listed species in a manner or to an extent not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered in this biological assessment, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

If you have any questions or if we can be of further assistance, please contact Phil DeGarmo at 502-695-0468 x110.

Sincerely,

Virgil Lee Andrews, Jr.  
Field Supervisor



## TRANSPORTATION CABINET

Frankfort, Kentucky 40622  
[www.transportation.ky.gov/](http://www.transportation.ky.gov/)

**Steven L. Beshear**  
Governor

**Michael W. Hancock, P.E.**  
Secretary

Date: 01 September 2011

Mr. Virgil Lee Andrews, Jr.  
Field Supervisor  
U.S. Fish and Wildlife Service  
J.C. Watts Federal Building  
330 W. Broadway  
Frankfort, KY 40601

Subject: Biological Assessment for *Myotis sodalis* and *Myotis grisescens*  
Spot Improvements along US 31E  
Larue County  
Hodgenville 7.5 minute Quadrangle  
**KYTC Item Number: 4-8504**

Please find attached the Biological Assessment for the subject project. The action proposed in this Biological Assessment is to address geometric deficiencies in three curves along US 31E in Larue County near the Lincoln Boyhood Home Farmstead property northeast of Hodgenville. KYTC assumed presence for both federally listed bat species. The listed mussel species were addressed with a No Effect document since the only stream that will be impacted by the project is not considered suitable mussel habitat. No *Myotis sodalis* winter habitat or *Myotis grisescens* summer roosting/winter habitat will be impacted by the proposed project.

Concerning *M. sodalis*, no hibernacula were found within 1km of the project, the project is located within an area deemed as "potential" habitat by USFWS, and the removal of approximately 3 acres of summer roosting habitat will have no direct effects on the species because KYTC has committed to clearing the trees during a time when they are unoccupied (October 15-March 31). Indirect effects to Indiana bats as a result of removing 3.29 acres of potential roosting habitat are discountable due to the ample suitable alternative summer habitat located in the surrounding landscape (over 4000 acres within 2.5 miles). These findings have led KYTC to believe this project "may affect, not likely to adversely affect" the federally listed *M. sodalis*.



An Equal Opportunity Employer M/F/D

Concerning *M. grisescens*, no suitable roosting habitat was found within 1km of the project, and potential impacts to foraging habitat associated with the area stream (Knob Creek) will be mitigated for/minimized through project-specific, strict sediment and erosion control measures, outlined in the BA. These findings have led KYTC to believe this project **“may affect, not likely to adversely affect”** the federally listed *M. grisescens*.

This request is being made pursuant to Section 7 (c) concerning interagency consultation of the Endangered Species Act of 1973 as amended. Our intention is to be in full compliance of the Act. We respectfully request your review and concurrence with our finding of **“may affect, not likely to adversely affect”** for *Myotis sodalis* and *Myotis grisescens*. If you require additional information, you may contact me at (502) 564-7250.

Sincerely,

A handwritten signature in cursive script, reading "David M. Waldner". The signature is written in dark ink on a white background.

David M. Waldner, P.E., Director  
Division of Environmental Analysis

CC:

Central Files

Scott Schurman

Andrew Logsdon

Joseph Ferguson (District 4)

# **Biological Assessment**

## **Spot Improvements along US 31E in Larue County, KY**

**Prepared by:**



**KENTUCKY TRANSPORTATION CABINET  
Division of Environmental Analysis**

**For submittal to:**



**UNITED STATES FISH AND WILDLIFE SERVICE**

**August 2011**

## Table of Contents

|                                                 |    |
|-------------------------------------------------|----|
| Project Description-----                        | 1  |
| Identification of Species and their Status----- | 2  |
| Survey Methods-----                             | 6  |
| Survey Results-----                             | 6  |
| Effects Analysis-----                           | 7  |
| Effects Determination-----                      | 10 |
| References-----                                 | 11 |

Appendix A—Coordination Efforts

Appendix B—Exhibits

Appendix C—Project Photos

## 1.0 PROJECT DESCRIPTION

The proposed project, Kentucky Transportation Cabinet (KYTC) Item 4-8504, will address geometric deficiencies in three curves along US 31E in Larue County near the Lincoln Boyhood Home Farmstead property Northeast of Hodgenville between mile points 16.3 and 18.6. The work will be concentrated on three curves within this stretch: Dever's Curve, Lincoln Boyhood Curve, and Enlow's Curve. In Dever's curve the radius will be extended to create a gentler sweeping curve. At the Lincoln Boyhood Curve bank stabilization along Knob Creek is needed to prevent erosion of the roadbed and Enlow's Curve will also have the curve radius extended. The project will require 2.15 acres of new permanent right-of-way and 0.34 acres of new permanent roadway easement. Construction will be partial width; which will require the closure of one lane of traffic at a time while under construction.

### 1.1 PROJECT SETTING

The proposed project is located in the Knobs-Norman Upland of the Interior Plateau Ecoregion and the Knobs Physiographic Region. This region is characterized by its mostly forested, rounded hills and ridges which divide the Bluegrass from the rest of the Interior Plateau. The knobs are the erosion resistant remnants of the weathering of Muldraugh Hill. The underlying geology within the area is primarily Mississippian in age consisting of limestones, dolostones and shales (Table 1). The project area can best be described as an alluvial valley between two rows of knobs. The existing roadway is adjacent to Knob Creek, a deeply incised third order stream.

Table 1 – Geologic Layers

| Geologic Layer                                                           | Karst Potential |
|--------------------------------------------------------------------------|-----------------|
| St. Louis Limestone                                                      | Very High       |
| Salem Limestone                                                          | Medium          |
| Harrodsburg Limestone                                                    | Medium          |
| Crinoidal Limestone                                                      | Very High       |
| Borden Formation, Muldraugh Member                                       | Medium          |
| Borden Member                                                            | Non Karst       |
| Lower Part of Shale Member, Borden Formation                             | Non Karst       |
| New Albany Shale and Beechwook Limestone Member of Sellersburg Limestone | Non Karst       |
| New Albany Shale                                                         | Non Karst       |
| Quaternary Alluvium                                                      | Non Karst       |

## 2.0 IDENTIFICATION OF LISTED SPECIES AND THEIR STATUS

The United States Fish and Wildlife Service (USFWS) has determined that five federally listed species are known to occur or have the potential to occur in Larue County:

- Fanshell Mussel (*Cyprogenia stegaria*)
- Northern Riffleshell Mussel (*Epioblasma torulosa rangiana*)
- Orangefoot Pimpleback Mussel (*Plethobasus cooperianus*)
- Indiana Bat (*Myotis Sodalis*)
- Gray Bat (*Myotis grisecens*)

The Kentucky Dept. of Fish and Wildlife list, as well as the Kentucky State Nature Preserve list are attached as part of Appendix A (Coordination efforts).

The USFWS determination is dated July 30, 2008. The Division of Environmental Analysis has assumed presence of both Indiana and Gray bat. A KYTC biologist conducted a habitat assessment on the area streams for suitable mussel habitat and it was determined that the streams are underlain in bedrock, with a layer of silt over the substrate, and are heavily impacted by adjacent land uses, and therefore do not offer suitable habitat for the listed mussel species (some pictures of the affected streams are included in Appendix C). A No habitat/No effect document was completed for the listed mussels. This Biological Assessment will only address the listed bat species.

### 2.1 INDIANA BAT

The Indiana bat (*Myotis sodalis*) was listed as an endangered species by the U.S. Fish and Wildlife Service on 11 March 1967 (United States Fish and Wildlife Service 2007) and is currently protected under the Endangered Species Act of 1973, as amended (Public Law 93-205). The range of the *Myotis sodalis* includes Alabama, Arkansas, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. Most capture records of reproductively active female and juvenile *Myotis sodalis* have occurred in the upper Midwest including southern Iowa, northern Missouri, much of Illinois, most of Indiana, southern Michigan, western Ohio, and in Kentucky; however, a growing number of maternity records have been documented in New York, New Jersey, and Vermont in recent years. As of November 2006, the USFWS has records of extant winter populations (i.e., positive winter occurrence since 1995) of the *Myotis sodalis* at approximately 281 different hibernacula located in 19 states. Even though the winter range is dispersed across the eastern U.S., over 90 percent of the estimated rangewide population (in 2005) hibernated in just five states: Indiana, Missouri, Kentucky, Illinois, and New York (USFWS 2007). Critical habitat was designated for the species on September 24, 1976 (41 FR 41914) and included 11 caves and 3 mines in six states. In Kentucky, these critical habitat designations include Bat Cave (Carter County) and Coach Cave (Edmonson County) (USFWS 1976).

The species uses different habitats during the summer and winter months. In addition, male and female bats may use different habitat types. Both sexes of bat overwinter in caves or mines. In the summer, female bats form maternity colonies in characteristic trees. Males are more opportunistic and roost singly or in small groups in trees and small caves. During mid-fall the bats migrate to their winter habitat and begin swarming. Both males and females require forested areas and wetland/riparian areas for foraging (USFWS 2007).

The life history strategy of *M. sodalis* is to produce one young each year with high survival rates for both young and adults (Humphrey and Cope 1977; Racey et al 2003). To survive through all stages of their annual cycle, energy regulation is critical. Not only do *Myotis sodalis* need efficient access to good foraging areas to maximize energy inputs, they also need appropriate year-round conditions for effective thermoregulation and energy conservation to control outputs. Thus, availability of hibernacula and forest roosting sites that facilitate energy conservation are needed throughout the range of the species to maintain current distribution and population viability (USFWS 2007).

Commuting habitat that connects summer foraging and roosting areas is also necessary to maximize foraging success and conserve energy. As a rule, *Myotis sodalis* do not cross large open areas and will follow tree lines or fencerows to reach foraging areas despite increased energy expenditures and commuting distances (Murray and Kurta 2004, Winhold et al. 2005), although exceptions to this have been noted. Variable distances to foraging areas may be attributed to rangewide differences in habitat type, interspecific competition, and landscape terrain. Fall swarming also requires the presence of suitable roost trees, foraging areas, and water in the vicinity of each occupied hibernaculum. Adequate habitat connectivity is needed to allow for movement of bats among these various elements (USFWS 2007).

Summer habitat includes potentially any tree  $\geq 3$ " dbh which possesses any or all of the following characteristics- exfoliating bark (e.g., shagbark hickory), dead or dying trunk/branches (species of vegetation which don't normally possess exfoliating bark can develop this characteristic as the bark dies and begins to separate from the dying trunk/branch), cavities/fissures (e.g., woodpecker holes, lightning damage, heart rot). Primary roosts usually receive direct sunlight for more than half the day. Roost trees are typically within canopy gaps in a forest, in a fenceline, or along a wooded edge. Habitats in which maternity roosts occur include riparian zones, bottomland and floodplain habitats, wooded wetlands, and upland communities (USFWS 2007, 2007c).

The *Myotis sodalis* requires forested areas for foraging and roosting; however, at a landscape level *Myotis sodalis* maternity colonies occupy habitats ranging from completely forested to areas of highly fragmented forest. Within the core range in the Midwest, forest cover is much more fragmented, at the landscape scale, than at the eastern edge of the range (Brack et al. 2002). Forest cover is not a completely reliable predictor of where *Myotis sodalis* maternity colonies will be found on the landscape (Farmer et al. 2002).

*Myotis sodalis* show fidelity to summer roosting and foraging areas (USFWS 2007, Winhold et al 2005). Benefits of site familiarity include reduction in time spent searching for new sites, more profitable exploitation of local food resources, and greater awareness of resident predators. Whenever roosts and foraging sources are eliminated, bats are forced to seek new habitat and expand their foraging range, potentially reducing foraging success and exposing bats to increased predation and competition. Availability of traditional roosting and foraging areas, at least at the landscape level, are important to survival and productivity (USFWS 2007).

*Myotis sodalis* migration has not been extensively studied and is poorly understood; further, little information is available to determine habitat use and needs for *Myotis sodalis* during migration. However, Fleming and Eby (2003) noted that migratory populations require spatially distinct habitats to complete their annual cycles and that migration is often identified as a trait that compounds the risk of extinction of endangered wildlife.

The *Myotis sodalis* hibernates colonially in caves and mines in the winter. During the winter months, *Myotis sodalis* are restricted to suitable underground hibernacula. The vast majority of hibernacula are caves located in karst areas of the east-central United States; however, *Myotis sodalis* also hibernate in other cave-like locations, including abandoned mines. Hibernacula tend to have large volumes and often have large rooms and vertical or extensive passages, often below the lowest entrance. Cave volume and complexity help buffer the cave environment against rapid and extreme changes in outside temperature, and vertical relief helps provide a range of temperatures and roost sites. Most *Myotis sodalis* hibernate in caves or mines where the ambient temperature remains below 10°C (50.0°F) but infrequently drops below freezing, and the temperature is relatively stable. In these caves, they form tight groups that can consist of hundreds to thousands of individuals (USFWS 2007). It is generally accepted that most *Myotis sodalis* return to the same hibernaculum each year (LaVal and LaVal 1980). These bats also tend to hibernate in the same cave or mine at which they swarm, although there are exceptions to this pattern. Colonization of new hibernacula has been documented (Hall 1962, Hicks and Novak 2002, Kath 2002), indicating that *Myotis sodalis* have some capacity to exploit unoccupied habitats and expand their winter distribution.

Cluster density may also be limiting for hibernating bats. *Myotis sodalis* roost in dense clusters in hibernacula, potentially for thermal benefits or the conservation of water. Although the link between cluster size and overwinter survival has not been quantified, there are several benefits to being a member of a large hibernating population, including the social and energetic advantages of roosting in dense clusters, and having many individuals available during fall swarming to ensure reproductive success (USFWS 2007).

The location of relatively few maternity colonies is known. Assuming an average maternity colony size of 80 adult female bats and assuming that half of all hibernating bats are female, the current population of approximately 457,000 bats would represent approximately 2,860 maternity colonies, although there is no way to currently assess the accuracy of this estimate. The location of 269 maternity colonies has been documented (USFWS 2007), which represents a relatively small proportion of all colonies.

Although researchers have found it difficult to predict where maternity colonies may occur relative to forested habitat, they show high maternity site fidelity from year to year. Philopatry of *Myotis sodalis* maternity colonies to their summer range is well documented (USFWS 2007, Winhold et al 2005). Implications of philopatry are discussed by Kurta and Murray (2002). It is not known how long or how far female *Myotis sodalis* will search to find new habitat if their traditional maternity range is lost or degraded. If they are required to search for new habitat, it is assumed that this effort places additional stress on pregnant females at a time when fat reserves are low or depleted and they are already stressed from energy demands of migration and pregnancy.

The minimum size of a forest patch that will sustain *Myotis sodalis* maternity colonies has not been established. However, in highly fragmented landscapes the loss of connectivity among remaining forest patches may degrade the quality of the habitat for *Myotis sodalis*. Patterson et al. (2003) noted that the mobility of bats, associated with flight, allows them to exploit fragments of habitat. However, they cautioned that reliance on already diffuse resources (e.g., roost trees) leaves bats highly vulnerable, and that energetics may preclude the use of overly patchy habitats. Connectivity of habitats has been demonstrated to be important to *Myotis sodalis*. Murray and Kurta (2004) demonstrated the importance of wooded travel corridors for *Myotis sodalis* within their maternity habitat in Michigan; they noted that bats did not fly over open fields but traveled along wooded corridors, even though use of these corridors increased commuting distance by over 55 percent. Sparks et al. (2005a) also noted the importance of a wooded riparian travel corridor to *Myotis sodalis* in the maternity colony at their study

site in Indiana. In addition, the distance and wooded connectivity between roosts and foraging areas may be limiting for *Myotis sodalis* at some sites (Murray and Kurta 2004, Sparks et al. 2005b).

MacGregor et al. (1999; in USFWS 2007) studied male *Myotis sodalis* roost use during the autumn pre-hibernation swarming period in Kentucky. They found that bats did not roost in areas clear-cut within the past 35 years, whereas forested habitat not actively managed during the past 40 years was used at about twice the expected level based on its availability. Two-age shelterwood cuts were used four to seven times as much as expected based on availability. They noted that the guidelines used for the shelterwood cuts called for retention of more live trees and more snags than previous guidelines, and that retention of these trees was key to providing favorable roosting for male *Myotis sodalis* during the autumn pre-hibernation period, at least over the short-term. Based on research of roosting habits of male *Myotis sodalis* in Kentucky, Gumbert (2001) recommended that cutting of standing dead trees for firewood in the vicinity of hibernacula not be permitted.

Threats to the species vary with its annual cycle. At the hibernacula, threats include modifications to the caves, mines, and surrounding areas that result in changes in airflow and alteration of the microclimates in the hibernacula (Humphrey 1978, Richter et al. 1993, Johnson et al. 2002). Human disturbance and vandalism pose significant threats to the species during hibernation by inducing arousal and consequent depletion of fat reserves (Thomas et al. 1990, Speakman et al. 1991, Thomas 1995) and through direct mortality (Greenhall 1973, Humphrey 1978, Murphy 1987). Natural catastrophes (flooding and freezing events) can also have a significant effect on the population during winter because of the large number of individuals that hibernate in a relatively few sites (Hall 1962, DeBlase et al. 1965, Humphrey 1978, Richter et al. 1993, Johnson et al. 2002). Following emergence, when fat reserves and food supplies are low, migration provides an additional stress and, consequently, mortality may be higher immediately following emergence (Tuttle and Stevenson 1977).

During summer months, possible threats relate to the loss and degradation of forested habitat (Gardner et al. 1990, Garner and Gardner 1992, Drobney and Clawson 1995, Whitaker and Brack 2002). Migration pathways and swarming sites can also be affected by habitat loss and degradation (Hall 1962, Fleming and Eby 2003). Habitats surrounding swarming sites may be particularly important in that these sites are discrete areas that apparently must be suitable to support large numbers of bats that, in addition to engaging in swarming activities, must forage to build up sufficient fat reserves to sustain them through the hibernation period (Hall 1962).

In addition, the effects of environmental contaminants cannot be ignored and need further research. Climate change and wind turbines may present additional threats to the species; the full impact of these factors will be realized with time. Additional reasons for the decline of *Myotis sodalis* populations include channelization of streams, impoundment of waterways and associated flooding of bottomland hardwood forests, deforestation, and application of insecticides (Barbour and Davis 1974; USFWS 2007; Slone and Wethington 2001). Despite the abundance of threats to *Myotis sodalis* throughout its lifecycle, since 2001 *Myotis sodalis* have seen their numbers increase from 328,526 to an estimated 468,184 in 2007, range wide (King 2008).

## 2.2 GRAY BAT

On April 21, 1975, *Myotis grisescens* was proposed for listing under the Endangered Species Act (40 FR 17590) and formally attained endangered status on April 28, 1976 (United States Department of Interior 1976). Causes for decline in the overall population of *M. grisescens* is often attributed to human disturbance at roosting sites (Tuttle 1976), impoundment of waterways (USFWS 1982), pesticide

poisoning (Clark et al. 1978, USFWS 1982), cave commercialization and improper gating (Tuttle 1977, USFWS 1982), and natural calamities including cave flooding (Tuttle 1979, USFWS 1982).

Foraging usually occurs in riparian areas or over water bodies. While foraging, *M. grisescens* consumes a variety of insects most of which are considered aquatic-based (Brack and LaVal 2006). Studies in Indiana, Kentucky, Alabama, and Missouri have revealed that tricopterans, lepidopterans, coleopterans, and dipterans are frequently consumed while some 14 total insect orders have been shown to be consumed by the species (Brack et al. 1984, Whitaker et al. 2001, Lacki et al. 1995, Best et al. 1997, Brack and LaVal 2006). Whitaker et al. (2001) reported variability in *M. grisescens* diet by season with a spring and autumn diet composed mostly of midges and other dipterans while coleopterans composed a majority of their diet during the summer. Brack and LaVal (2006) described diet variation based on age class with juveniles consuming more coleopterans than did adults. *M. grisescens* also demonstrates opportunistic foraging on a microscale by feeding on available prey while it is considered to be more selective in regards to diet on a macroscale with consumption primarily of aquatic insects (Brack and LaVal 2006).

*M. grisescens* is restricted to regions in south central United States where large cave systems occur with records from Indiana, Illinois, Kentucky, Virginia, West Virginia, Tennessee, Alabama, Georgia, Florida, South Carolina, Missouri, Arkansas, Oklahoma and Kansas (NatureServe 2007). *M. grisescens* roosts in caves year-round and is often found in large numbers with colonies in excess 1,000,000 individuals reported (USFWS 1982). Habitat requirements for roosts are highly specific with fewer than 5% of caves representing suitable habitat (Tuttle 1979). *M. grisescens* utilizes different caves throughout a year with winter caves usually defined with deep vertical shafts providing a cold air trap while caves utilized during the summer (especially maternity caves) are usually characterized as having domed ceilings (acting as a warm air trap) which are located in close proximity to a stream or water body (USFWS 1982, Tuttle 1976). Other caves, known as dispersal caves are used as roosting sites during migration from maternity caves to hibernacula.

### 3.0 SURVEY METHODS

KYTC District 4 Environmental Coordinator and DEA Staff Biologist conducted a Habitat Assessment according to the KYTC Habitat Assessment Manual (HAM) and using best professional judgment. In order to assess gray bat roosting and Indiana Bat winter habitat a 5 km record search was requested from Kentucky Speleological Survey (KSS) for any known cave openings (response from KSS in Appendix A). Additionally, a 1 km search was conducted on foot, by a KYTC biologist, in areas containing geologic layers and features most likely to contain cave or sinkhole openings. Areas on topographic maps that depicted sinkholes or springs were ground-truthed in order to determine if any openings could potentially serve as bat habitat. No mist-netting occurred as part of this BA, instead KYTC has chosen to assume summer presence of both listed bat species.

### 4.0 SURVEY RESULTS

The project area provides suitable summer roosting habitat for Indiana bats as well as foraging habitat for both Indiana and gray bats. No caves, mines or cave-like openings are present within 1km of the project area that could serve as either gray bat roosting habitat or as Indiana bat winter habitat. A response from KSS dated May 24, 2011 informed KYTC that no known openings are present within 5km of the project area. This email response is attached in Appendix A.

## 5.0 EFFECTS ANALYSIS

An analysis of effects upon federally threatened and endangered species, as required under Section 7 of the ESA, which may occur as a result of the proposed curve-improvement project, is discussed below for the gray and Indiana bat.

### 5.1 GRAY BAT

The federally endangered gray bat was assessed as part of this study due to known occurrences within five miles of the proposed project. Potential effects to this species are presented below in terms of direct effects, indirect effects, and cumulative effects.

#### 5.1.1 Direct Effects

Potential direct effects to this species as a result of the proposed project are limited to impacts of riparian areas utilized for foraging habitat. No caves, mine portals, or rock shelters were observed in the project area; therefore, impacts to summer roosting habitat or winter hibernacula are not anticipated as a result of this project. Therefore no direct effects to this species are anticipated as a result of this project.

#### 5.1.2 Indirect Effects

Potential indirect effects to this species as a result of the proposed project could include impacts to forage supply due to impacts to streams within the project area. Sediment and/or debris deposition downstream of the proposed activities could potentially reduce the number of emerging macroinvertebrates that provide forage for gray bats.

The proposed project will involve some streambank stabilization along Knob Creek. These activities will not temporarily or permanently disrupt the flow of Knob Creek. Appropriate erosion control measures, including timing of the project during low flow, will be utilized to minimize sediment/debris deposition within Knob Creek. The following mitigation/minimization measures will be undertaken to prevent any indirect impacts to gray bats foraging along Knob Creek and its tributaries:

- Construction activities will occur only during daylight hours during times when the bay may be utilizing the area (March 31 through October 15).
- To reduce erosion and sedimentation effects of highway construction projects, and thus indirect effects on Knob Creek, KYTC is bound by the tenets of KPDES permit KYR#10 for all construction projects involving soil disturbance. For the subject project, a site-specific Erosion Control Plan (ECP) has been developed in order to outline potential water quality issues by determining individual Disturbed Drainage Areas (DDA) where construction site effluent will be discharged off-site or into waters of the Commonwealth. Within the ECP, sediment control structures have been developed. These structures are based upon good engineering practices developed by the Design Engineer.
- According to Section 213.03.01 of the KYTC Standard Specifications, a Best Management Plan (BMP) will be developed jointly by the Resident Engineer and contractor prior to the Preconstruction Conference. The BMP will be developed utilizing information contained within the ECP. Through progression of the project, the BMP will be updated in order to address the ever-changing on-site conditions to assure the overall goal of erosion control and sediment containment. The BMP shall be modified if and/or when there is a change in design,

construction, operation or maintenance of the site which has a significant effect on the potential for the discharge of pollutants to waters of the Commonwealth.

- During “grade and drain” operations (occurring after initial clearing and grubbing of the area), mulch will be spread across all areas where no work will be conducted for a 21 consecutive day period as specified in the tenets of KPDES permit KYR#10.
- Prior to disturbance of the forested riparian corridor, the resident engineer and contractor will meet at the project site to determine which trees will be removed in order to minimize riparian disturbance. All disturbed areas will either be re-seeded with a standard native riparian grass seed mix according to the grade of the landscape or be replaced with rip rap and geotextile fabric. A modified Type III standard grass seed mix (40% KY tall fescue [*Festuca arundinacea*] 35% perennial rye [*Lolium perenne*], 25% little bluestem [*Schizachyrium scoparium*], all percentages based on pure live seed, will be seeded in the riparian area at a rate of two pounds per 1000 square feet to facilitate bank stabilization and prevent erosion. This will allow for proper regeneration of the riparian corridor with native species, allowing for thermoregulation of the water within Knob Creek, proper physical stabilization of the impacted area, and aid in providing nutrients via plant matter for macroinvertebrate communities located within Knob Creek.
- Once construction activities have ceased, and where applicable and allowed for by safety concerns, any disturbed wooded riparian areas will be replanted with native trees similar to those that were removed, thus retaining its use as a bat foraging corridor. Non-wooded areas will be re-seeded with a standard native riparian grass seed mix.
- The above mentioned plantings will also provide a buffering effect for storm runoff from the adjacent roadway (US 31E). Sequestration or conversion of chemical species found in highway runoff through plant uptake or microbial activities in the soil will aid in reducing the amount of pollutants entering Knob Creek and smaller tributaries near the proposed project. Despite the highway runoff from the existing US 31E, the listed bat species continue to utilize Knob Creek and its tributaries for foraging and travel. Further, KYTC believes that highway runoff associated with the travel corridor over Knob Creek and its tributaries will be diluted to a negligible concentration by the normal discharge of this perennial blue-line stream and not likely affect the gray or Indiana bat.
- A premium will be placed on keeping debris out of Knob Creek during construction activities. Silt fences, straw bales and other approved sediment controls will be established and maintained at the stream’s edge to prevent excess sediment and small debris from entering the stream. Construction equipment will be kept out of the stream channel of Knob Creek during all phases of the project.
- Equipment cleaning/staging areas will be located such that runoff from these areas will not directly enter the stream. Equipment/staging areas will be located such that effluent will be filtered through vegetated areas and proper sediment control structures located between staging areas and Knob Creek, thereby minimizing the potential for stream impacts such as sedimentation and pollution.
- KYTC will remove potential roost trees for the Indiana bat between October 15 and March 31 while they are unoccupied and gray bats aren’t actively foraging.

### 5.1.3 Cumulative Effects

The ESA regulations define cumulative effects as “those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal

action subject to consultation." Based on the remote location of the project area within Larue County and the fact that the portions of the property within the project area are currently in ownership by the National Park Service no further state or private activities are likely to occur. This area is not prone to commercial or residential development. Additionally, the project's purpose and need is dedicated to safety improvements and correcting geometric deficiencies on the existing US 31E highway and not to spur economic development. Therefore, cumulative effects to gray bats are not anticipated as part of this project.

## 5.2 INDIANA BAT

The federally endangered Indiana bat was assessed as part of this study due to known occurrences within Larue County. Potential effects to this species are presented below in terms of direct effects, indirect effects, and cumulative effects.

### 5.2.1 Direct Effects

Potential direct effects to this species as a result of the proposed project are limited to impacts of riparian areas utilized for summer roosting and/or foraging habitat. No caves, mine portals, or rock shelters were observed in the project area; therefore, impacts to winter habitat are not anticipated as a result of this project. KYTC commits to removing the small amount of forested habitat (3.29 acres) during a time when it is unoccupied by roosting bats (Oct 15-March 31). The trees to be removed are not within a known Indiana bat swarming or maternity polygon. Therefore no direct effects to this species are anticipated as a result of this project.

### 5.2.2 Indirect Effects

Potential indirect effects to this species as a result of the proposed project are limited to the impacts associated with removing approximately 3.29 acres of potential summer roosting habitat and foraging habitat from the landscape. KYTC finds this temporary removal of habitat discountable due to the large amount of forested habitat remaining unaffected in the project area. Within 2.5 miles of the project area over 4000 acres of forested habitat exists that serves as suitable summer roosting and foraging habitat for Indiana bats. In fact, the habitat being removed as part of the proposed project is less valuable to the species due to its close proximity to the existing highway (US31E). Bats are less likely to roost in trees that are directly adjacent to a roadway (Garner et al). The large forested areas in the uplands and along valley streams outside the project area are higher quality roosting habitat and they will remain unaffected by the proposed project. Therefore, no indirect effects to Indiana bats are anticipated as a result of the proposed project.

### 5.2.3 Cumulative Effects

The ESA regulations define cumulative effects as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." Based on the remote location of the project area within Larue County and the fact that the portions of the property within the project area are currently in ownership by the National Park Service no further state or private activities are likely to occur. This area is not prone to commercial or residential development. Additionally, the project's purpose and need is dedicated to safety improvements and correcting geometric deficiencies on the existing US 31E highway and not to

spur economic development. Therefore, cumulative effects to Indiana bats are not anticipated as part of this project.

## 6.0 EFFECTS DETERMINATION

The effects determination for each species is presented below.

### 6.1 INDIANA BAT

No potential winter habitat will be directly or indirectly impacted by the proposed project. The proposed project is located within an area designated as “potential” habitat for Indiana bats by USFWS. KYTC has chosen to remove the 3.29 acres of summer roosting habitat during a time when it is unoccupied by Indiana bats (October 15-March 31) and therefore will not directly affect the species. Also, there is ample suitable summer roosting and foraging habitat located within close proximity of the project area that will remain unaffected (approx 4000 acres within 2.5 miles). These findings lead KYTC to believe the proposed project **“may affect, not likely to adversely affect”** Indiana bats.

### 6.2 GRAY BAT

No potential roosting habitat will be directly or indirectly impacted by the proposed project. KYTC will be removing the potential gray bat foraging habitat near Knob Creek at a time when the area is unoccupied by gray bats (October 15-March 31) and will adhere to strict erosion and sediment control measures to ensure there are no indirect effects to area streams and in turn, gray bat foraging areas. These findings lead KYTC to believe the proposed project **“may affect, not likely to adversely affect”** gray bats.

## REFERENCES

- Barbour, R.W. and W.H. Davis. 1974. Mammals of Kentucky. University of Kentucky Press, Lexington, KY. 322pp.
- Best, T. L., B.A. Milam, T. D. Haas, W. S. Cvilikas, and L. R. Saidak. 1997. Variation in the diet of the gray bat (*Myotis grisescens*). *Journal of Mammalogy*. 78:569-583.
- Brack, V., Jr., C.W. Stihler, R.J. Reynolds, C.M. Butchkoski, and C.S. Hobson. 2002. Effect of climate and elevation on distribution and abundance in the mideastern United States. Pp. 21-28 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX.
- Brack, V., Jr., R.E. Mumford, and V.R. Holmes. 1984. The gray bat (*Myotis grisescens*) in Indiana. *American Midland Naturalist* 111:205.
- Brack, Virgil, Jr., and Richard K. LaVal. 2006. Diet of the gray bat (*Myotis grisescens*): variability and consistency, opportunism, and selectivity. *Journal of Mammalogy*, 87(1):7-18.
- Cicerello, R.R., and G.A. Schuster. 2003. A guide to the freshwater mussels of Kentucky. Kentucky State Nature Preserves Commission Scientific and Technical Series 7:1-62.
- Clark D. R., Jr., and R.M. Prouty. 1976. Organochlorine residues in three bat species from four localities in Maryland and West Virginia, 1973. *J. Pestic. Monin.*, 10: 44-53.
- Clark, D. R., Jr., R. K. LaVal and D. M. Swineford. 1978. Dieldrin-induced mortality in an endangered species, the gray bat (*Myotis grisescens*). *Science*, 199(4335) : 1357-1359
- Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. 194 pp.
- DeBlase, A.F., S.R. Humphrey, and K.S. Drury. 1965. Cave flooding and mortality in bats in Wind Cave, Kentucky. *Journal of Mammalogy* 46:96.
- Drobney, R.D. and R.L. Clawson. 1995. Indiana bats. Pp. 97-98 in E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac (eds.), *Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems*. U.S. Department of the Interior, National Biological Service, Washington, DC. 530 pp. Available at: [http://www.fs.fed.us/r10/outdoor\\_ethics/usdoi\\_national\\_biology\\_service\\_overview\\_of\\_mammals.pdf](http://www.fs.fed.us/r10/outdoor_ethics/usdoi_national_biology_service_overview_of_mammals.pdf) Accessed 24 November 2008.
- Gardner, James E.; Garner, James D.; Hofmann, Joyce E. 1991. Summer roost selection and roosting behavior of *Myotis sodalis* (Indiana bat) in Illinois. Final report. Champaign, IL: Illinois Department of Conservation, Illinois Natural History Survey. 56 p.
- Gordon, M.E., and J.B. Layzer. 1989. Mussels (Bivalvia: Unionidea) of the Cumberland River: review of life histories and ecological relationships. U.S. Department of Interior, Fish and Wildlife Service Biological Report 89(15). 99 pp.
- Grabarkiewicz, J. and T. Crail. 2006. Freshwater mussels of the Maumee Drainage. Ohio Environmental Protection Agency. 61 pp.

- Farmer, A.H., B.S. Cade, and D.F. Stauffer. 2002. Evaluation of a habitat suitability index model. Pp. 172-179 in Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
- Fleming, T.H. and P. Eby. 2003. Ecology of bat migration. Pp. 156-208 in T. Kunz and M.B. Fenton (eds.), Bat ecology. The University of Chicago Press, Chicago, IL.
- Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1990 (IN USFWS 2007). Combined progress reports: 1989 and 1990 investigations of *Myotis sodalis* (Indiana bat) distribution, habitat use, and status in Illinois. Unpublished report to Region 3—U.S. Fish and Wildlife Service, Fort Snelling, MN and Illinois Department of Transportation, Springfield, IL. 19 pp.
- Garner and Gardner 1992 (In USFWS 2007). Determination of summer distribution and habitat utilization of the Indiana bat (*Myotis sodalis*) in Illinois. Unpublished Report. Endangered Species Coordinator, Region 3, Service, Twin Cities, MN.
- Greenhall, A. 1973. Indiana bat: a cave-dweller in trouble. National Parks Conservation Magazine 47:14-17.
- Gumbert, M.W. 2001. Seasonal roost tree use by Indiana bats in the Somerset Ranger District of the Daniel Boone National Forest, Kentucky. M.S. Thesis. Eastern Kentucky University, Richmond, Kentucky. 136 pp
- Hall, J.S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Reading Public Museum and Art Gallery, Scientific Publications 12:1-68.
- Hicks, A.C. and P.G. Novak. 2002. History, status, and behavior of hibernating populations in the northeast. Pp. 35-47 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
- Humphrey, S.R. 1978. Status, winter habitat, and management of the endangered Indiana bat, *Myotis sodalis*. Florida Scientist 41:65-76.
- Humphrey, S.R. and J.B. Cope. 1977. Survival rates of the endangered Indiana bat, *Myotis sodalis*. Journal of Mammalogy 58:32-36.
- Johnson, R. I. 1980. Zoogeography of North American Unionacea (Mollusca: Bivalvia) North of the Maximum Pleistocene Glaciation. Bulletin of the Museum of Comparative Zoology. 149 (2): 77-189.
- Johnson, S.A., V. Brack, and R.K. Dunlap. 2002. Management of hibernacula in the State of Indiana. Pp. 100-109 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
- Kath, J.A. 2002. An overview of hibernacula in Illinois, with emphasis on the Magazine Mine. Pp. 110-116 in A. Kurta and J. Kennedy (eds.), The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, TX.
- Kentucky State Nature Preserves Commission. 2000. Rare and Extirpated Plants and Animals of Kentucky. Trans. Ky. Acad. Sci. 61(2): 115-132.

King, A. 2008. Indiana bat 2007 population estimates, revised 18 October 2008. [Internet]. Bloomington, IN: U.S. Fish and Wildlife Service Ecological Services Field Office. [accessed 24 November 2008] [http://www.fws.gov/midwest/Endangered/mammals/inba/inba\\_2007pop.html](http://www.fws.gov/midwest/Endangered/mammals/inba/inba_2007pop.html)

Kurta, A. and S.W. Murray. 2002. Philopatry and migration of banded Indiana bats (*Myotis sodalis*) and effects of radio transmitters. *Journal of Mammalogy* 83:585-589.

Lacki, M. J., L. S. Burford, and J. O. Whitaker Jr. 1995. Food habits of gray bats in Kentucky. *Journal of Mammalogy* 76:1256-1259.

LaVal, R.K. and M.L. LaVal. 1980. Ecological studies and management of Missouri bats, with emphasis on cave-dwelling species. Missouri Department of Conservation, Terrestrial Series 8:1-52.

MacGregor J., J. Kiser, M. Gumbert, and T. Reed. 1999(In USFWS 2007). Autumn roosting habitat of male Indiana bats (*Myotis sodalis*) in a managed forest setting in Kentucky. Pp. 169-170 in J. Stringer and D. Loftis (eds), Proceedings 12th central hardwood forest conference, 1999 February 28-March 1-2, Lexington, KY. General Technical Report SRS-24. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC.

Murray, S.W. and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis*). *Journal of Zoology* 262:197-206.

Murphy, M. 1987. Vandals destroy hibernating Indiana bats. *Bats Magazine* 5(2): 5-8.

NatureServe. May 12, 2007. <<http://www.natureserve.org/>>

Parmalee, P.W. and A.E Bogan. 1998. The Freshwater Mussels of Tennessee. University of Tennessee Press. Knoxville, TN.

Patterson, B.D., M.R. Willig, and R.D. Stevens. 2003. Trophic strategies, niche partitioning, and patterns of ecological organization. Pp. 536-579 in T. Kunz and M.B. Fenton (eds.), *Bat Ecology*. The University of Chicago Press, Chicago, IL.

Racey, P.A. and A.C. Entwistle. 2003. Conservation ecology of bats: reproduction. Pp. 680-743 in T.H. Kunz and M.B. Fenton (eds.), *Ecology of bats*. University of Chicago Press, Chicago, IL.

Richter, A.R., S.R. Humphry, J.B. Cope, and V. Brack, Jr.1993. Modified cave entrances: thermal effect on body mass and resulting decline of endangered Indiana bats (*Myotis sodalis*). *Conservation Biology* 7:407-415.

Slone, T. and T. Wethington. 2001. Kentucky's Threatened and Endangered species. Kentucky Department of Fish and Wildlife Resources. 34 pp.

Sparks, D.W., C.M. Ritzi, J.E. Duchamp, and J.O. Whitaker, Jr. 2005a. Foraging habitat of the Indiana bat, (*Myotis sodalis*) at an urban-rural interface. *Journal of Mammalogy* 86:713- 718.

Sparks, D.W., J.O. Whitaker, Jr., and C.M. Ritzi. 2005b. Foraging ecology of the endangered Indiana bat. Pp. 15-27 in K.C. Vories and A. Harrington (eds.), *The Proceedings of the Indiana bat and coal mining: a technical interactive forum* Office of Surface Mining, U.S. Department of the Interior, Alton, IL. Available at: <http://www.mcrcc.osmre.gov/PDF/Forums/Bat%20Indiana/TOC.pdf>. (Accessed 24 November 2008).

- Speakman, J.R., P.I. Webb, and P.A. Racey. 1991. Effects of disturbance on the energy expenditure of hibernating bats. *Journal of Applied Ecology* 28:1087-1104.
- Thomas, D.W., M. Dorais, and J.M. Bergeron. 1990. Winter energy budgets and cost of arousals for hibernating little brown bats, *Myotis lucifugus*. *Journal of Mammalogy* 71:475-479.
- Thomas, D.W. 1995. The physiological ecology of hibernation in vespertilionid bats. *Symposia of the Zoological Society of London* 67:233-244.
- Tuttle, M.D. 1976. Population ecology of the gray bat (*Myotis grisescens*): Philopatry, timing and patterns of movement, weight loss during migration, and seasonal adaptive strategies. *Occas. Papers Mus. Nat. Hist., Univ. Kansas, Lawrence*, 54:1-38
- Tuttle, M. D. 1977. Gating as a means of protecting cave dwelling bats. Pp. 77-82 in *National Cave Management Symposium Proceedings, 1976*. (t. Aley and D. Rhodes, eds.), *Speleobooks*, Albuquerque, New Mexico
- Tuttle, M.D. and D.E. Stevenson. 1977. An analysis of migration as a mortality factor in the gray bat based on public recoveries of banded bats. *American Midland Naturalist* 97:235-240.
- Tuttle, M. D. 1979. Status, cause of decline, and management of endangered gray bats. *J. wildl. Mgmt.* 43:1-17.
- United States Fish and Wildlife Service (USFWS). 1982. Gray bat recovery plan. Bethesda Maryland
- United States Fish and Wildlife Service (USFWS). 1984. Orange-footed pearly mussel recovery plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 44 pp.
- United States Fish and Wildlife Service (USFWS). 1991. Fanshell (*Cyprogenia stegaria*) Recovery Plan. Atlanta, GA. 37 pp.
- United States Fish and Wildlife Service (USFWS). 1993. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Northern Riffleshell Mussel (*Epioblasma torulosa rangiana*) and the Clubshell Mussel (*Pleurobema clava*) (Final Rule). *Federal Register*, 58(13): 5638-5642.
- United States Fish and Wildlife Service (USFWS). 1994. Clubshell (*Pleurobema clava*) and Northern Riffleshell (*Epioblasma torulosa rangiana*) Recovery Plan. Hadley, MA. 68 pp.
- United States Fish and Wildlife Service (USFWS). 2007. Species assessment and listing priority assignment form; *Plethobasus cooperianus*. Fort Snelling, MN. 28pp.
- United States Fish and Wildlife Service (USFWS). 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. Fort Snelling, MN. 258 pp.
- United States Department of Interior. 1976. To the list of endangered and threatened species, Fish and Wildlife Service added the gray bat, Mexican wolf, and two butterfly species. *Federal Register* 41:17736-17740
- Whitaker, J.O., Jr. and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48- 54 in A. Kurta and J. Kennedy (eds.), *The Indiana bat: biology and management of an endangered species*. Bat Conservation International, Austin, TX.

Winhold, L., E. Hough, and A. Kurta. 2005. Long-term fidelity by tree-roosting bats to a home area. *Bat Research News* 46:9-10

Williams, J. D., M.L. Warren Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation Status of Freshwater Mussels of the United States and Canada. *Fisheries* 18(9):6-22.

Whitaker, J. O., Jr., L. Pruitt, and S. Pruitt. 2001. The gray bat, *Myotis grisescens*, in Indiana. *Proceedings of the Indiana Academy of Science* 110:114-122.

## **Appendix A**

### **Coordination with Resource Agencies**



U.S. Fish & Wildlife Service  
Kentucky Ecological Services Field Office

U.S. Fish & Wildlife Service  
330 West Broadway, Rm 265  
Frankfort, KY 40601  
Phone: 502-695-0468  
Fax: 502-695-1024

Endangered, Threatened, & Candidate  
Species in LARUE County, KY

| Group   | Species                             | Common name           | Legal*<br>Status | Known**<br>Potential | Special Comments                     |
|---------|-------------------------------------|-----------------------|------------------|----------------------|--------------------------------------|
| Mammals |                                     |                       |                  |                      |                                      |
|         | <i>Myotis sodalis</i>               | Indiana bat           | E                | P                    |                                      |
|         | <i>Myotis grisescens</i>            | gray bat              | E                | P                    |                                      |
| Mussels |                                     |                       |                  |                      |                                      |
|         | <i>Cyprogenia stegaria</i>          | fanshell              | E                | K                    |                                      |
|         | <i>Epioblasma torulosa rangiana</i> | Northern riffleshell  | E                | P                    |                                      |
|         | <i>Plethobasus cooperianus</i>      | orangefoot pimpleback | E                | P                    |                                      |
| Plants  | <i>Helianthus eggertii</i>          | Eggert's sunflower    | Delisted         | K                    | Species was delisted August 18, 2005 |

NOTES:

\* Key to notations: E = Endangered, T = Threatened, C = Candidate, CH = Critical Habitat

\*\*Key to notations: K = Known occurrence record within the county, P = Potential for the species to occur within the county based upon historic range, proximity to known occurrence records, biological, and physiographic characteristics.

**Report of  
Endangered, Threatened, and Special Concern  
Plants, Animals, and Natural Communities  
for Larue County, Kentucky**

**Kentucky State Nature Preserves  
Commission  
801 Schenkel Lane  
Frankfort, KY 40601  
(502) 573-2886 (phone)  
(502) 573-2355 (fax)**

**[www.naturepreserves.ky.gov](http://www.naturepreserves.ky.gov)**

# Kentucky State Nature Preserves Commission

## Key for County List Report

Within a county, elements are arranged first by taxonomic complexity (plants first, natural communities last), and second by scientific name. A key to status, ranks, and count data fields follows.

### STATUS

KSNPC: Kentucky State Nature Preserves Commission status:

N or blank = none    E = endangered    T = threatened    S = special concern    H = historic    X = extirpated

USESA: U.S. Fish and Wildlife Service status:

blank = none    C = candidate    LT = listed as threatened    LE = listed as endangered  
SOMC = Species of Management Concern

### RANKS

GRANK: Estimate of element abundance on a global scale:

G1 = Critically imperiled    GU = Unrankable  
G2 = Imperiled    G#? = Inexact rank (e.g. G2?)  
G3 = Vulnerable    G#Q = Questionable taxonomy  
G4 = Apparently secure    G#T# = Intraspecific taxa (Subspecies and variety abundances are coded with a 'T' suffix; the 'G' portion of the rank then refers to the entire species)  
G5 = Secure    GNR = Unranked  
GH = Historic, possibly extinct    GNA = Not applicable  
GX = Presumed extinct

SRANK: Estimate of element abundance in Kentucky:

S1 = Critically imperiled    SU = Unrankable  
S2 = Imperiled    S#? = Inexact rank (e.g. G2?)  
S3 = Vulnerable    S#Q = Questionable taxonomy  
S4 = Apparently secure    S#T# = Intraspecific taxa  
S5 = Secure    SNR = Unranked  
SH = Historic, possibly extirpated    SNA = Not applicable  
SX = Presumed extirpated

Migratory species may have separate ranks for different population segments (e.g. S1B, S2N, S4M):  
S#B = Rank of breeding population  
S#N = Rank of non-breeding population  
S#M = Rank of transient population

### COUNT DATA FIELDS

# OF OCCURRENCES: Number of occurrences of a particular element from a county. Column headings are as follows:

E - currently reported from the county  
H - reported from the county but not seen for at least 20 years  
F - reported from county & cannot be relocated but for which further inventory is needed  
X - known to have extirpated from the county  
U - reported from a county but cannot be mapped to a quadrangle or exact location.

The data from which the county report is generated is continually updated. The date on which the report was created is in the report footer. Contact KSNPC for a current copy of the report.

Please note that the quantity and quality of data collected by the Kentucky Natural Heritage Program are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Kentucky have never been thoroughly surveyed, and new species of plants and animals are still being discovered. For these reasons, the Kentucky Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of Kentucky. Heritage reports summarize the existing information known to the Kentucky Natural Heritage Program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

KSNPC appreciates the submission of any endangered species data for Kentucky from field observations. For information on data reporting or other data services provided by KSNPC, please contact the Data Manager at:

Kentucky State Nature Preserves Commission  
801 Schenkel Lane  
Frankfort, KY 40601  
(502) 573-2886 (phone)  
(502) 573-2355 (fax)  
email: [naturepreserves@ky.gov](mailto:naturepreserves@ky.gov)  
internet: [www.naturepreserves.ky.gov](http://www.naturepreserves.ky.gov)

County Report of Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky  
Kentucky State Nature Preserves Commission

| County | Taxonomic Group    | Scientific name                          | Common name                  | Statuses     | Ranks          | # of Occurrences |   |   |   |   |
|--------|--------------------|------------------------------------------|------------------------------|--------------|----------------|------------------|---|---|---|---|
|        |                    |                                          |                              |              |                | E                | H | F | X | U |
| Larue  | Vascular Plants    | <i>Carex crawei</i>                      | Crawe's Sedge                | S/           | G5 / S2S3      | 1                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Castanea pumila</i>                   | Allegheny Chinkapin          | T/           | G5 / S2        | 1                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Castilleja coccinea</i>               | Scarlet Indian Paintbrush    | E/           | G5 / S1        | 1                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Helianthus eggertii</i>               | Eggert's Sunflower           | T/           | G3 / S2        | 3                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Heteranthera limosa</i>               | Blue Mud-plantain            | S/           | G5 / S2S3      | 0                | 1 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Myriophyllum heterophyllum</i>        | Broadleaf Water-milfoil      | S/           | G5 / S3?       | 0                | 0 | 0 | 1 | 0 |
| Larue  | Vascular Plants    | <i>Silphium pinnatifidum</i>             | Tansy Rosinweed              | S/           | G3Q / S3       | 2                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Spiranthes magnicamporum</i>          | Great Plains Ladies'-tresses | T/           | G4 / S2        | 1                | 0 | 0 | 0 | 0 |
| Larue  | Vascular Plants    | <i>Symphoricarichum pratense</i>         | Barrens Silky Aster          | S/           | G4? / S3       | 2                | 0 | 0 | 0 | 0 |
| Larue  | Freshwater Mussels | <i>Cyprogenia siegaria</i>               | Fanshell                     | E / LE       | GIQ / S1       | 2                | 1 | 0 | 0 | 0 |
| Larue  | Freshwater Mussels | <i>Epioblasma torulosa rangiana</i>      | Northern Riffleshell         | E / LE       | G2T2 / S1      | 0                | 0 | 0 | 1 | 0 |
| Larue  | Freshwater Mussels | <i>Epioblasma triquetra</i>              | Snuffbox                     | E / PE       | G3 / S1        | 1                | 1 | 0 | 1 | 0 |
| Larue  | Freshwater Mussels | <i>Lampsilis ovata</i>                   | Pocketbook                   | E/           | G5 / S1        | 3                | 1 | 0 | 0 | 0 |
| Larue  | Freshwater Mussels | <i>Pleurobema clava</i>                  | Clubshell                    | E / LE       | GIQ2 / S1      | 0                | 0 | 0 | 1 | 0 |
| Larue  | Freshwater Mussels | <i>Quadrula cylindrica cylindrica</i>    | Rabbitsfoot                  | T / C        | G3G4T3 / S2    | 0                | 1 | 0 | 0 | 0 |
| Larue  | Freshwater Mussels | <i>Villosa lienosa</i>                   | Little Spectaclecase         | S/           | G5 / S3S4      | 3                | 2 | 0 | 0 | 0 |
| Larue  | Freshwater Mussels | <i>Villosa ormanni</i>                   | Kentucky Creekshell          | T / SOMC     | G2 / S2        | 2                | 0 | 1 | 0 | 0 |
| Larue  | Insects            | <i>Coleophelis muticum</i>               | Swamp Metalmark              | E/           | G3 / S1        | 0                | 0 | 1 | 0 | 0 |
| Larue  | Insects            | <i>Moccaffertium bednariki</i>           | A Heptageniid Mayfly         | S/           | G2G4 / S2      | 2                | 0 | 0 | 0 | 0 |
| Larue  | Insects            | <i>Pseudanophthalmus cnephosus</i>       | A Cave Obligate Beetle       | T/           | GIQ2 / S1S2    | 0                | 2 | 0 | 0 | 0 |
| Larue  | Fishes             | <i>Noturus stigmosus</i>                 | Northern Madtom              | S / SOMC     | G3 / S2S3      | 4                | 0 | 0 | 0 | 0 |
| Larue  | Reptiles           | <i>Elaphe guttata</i>                    | Corn Snake                   | S/           | G5 / S3        | 1                | 0 | 0 | 0 | 0 |
| Larue  | Reptiles           | <i>Ophisaurus attenuatus longicaudus</i> | Eastern Slender Glass Lizard | T/           | G5T5 / S2      | 0                | 2 | 0 | 0 | 0 |
| Larue  | Reptiles           | <i>Thamnophis sauritus sauritus</i>      | Eastern Ribbon Snake         | S/           | G5T5 / S3      | 1                | 0 | 0 | 0 | 0 |
| Larue  | Breeding Birds     | <i>Ammodramus henslowii</i>              | Henslow's Sparrow            | S / SOMC     | G4 / S3B       | 1                | 0 | 0 | 0 | 0 |
| Larue  | Breeding Birds     | <i>Chondestes grammacus</i>              | Lark Sparrow                 | T/           | G5 / S2S3B     | 0                | 1 | 0 | 0 | 0 |
| Larue  | Breeding Birds     | <i>Cisnothorus platensis</i>             | Sedge Wren                   | S/           | G5 / S3B       | 1                | 0 | 0 | 0 | 0 |
| Larue  | Breeding Birds     | <i>Haliaeetus leucocephalus</i>          | Bald Eagle                   | T / Delisted | G5 / S2B,S2S3N | 1                | 0 | 0 | 0 | 0 |

County Report of Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky  
Kentucky State Nature Preserves Commission

| County                     | Taxonomic Group | Scientific name                    | Common name      | Statuses | Ranks                    | # of Occurrences |           |          |          |          |  |  |
|----------------------------|-----------------|------------------------------------|------------------|----------|--------------------------|------------------|-----------|----------|----------|----------|--|--|
|                            |                 |                                    |                  |          |                          | E                | H         | F        | X        | U        |  |  |
| Larue                      | Breeding Birds  | <i>Passerculus sandwichensis</i>   | Savannah Sparrow | S /      | G5 /<br>S2S3B, S2S3<br>N | 1                | 0         | 0        | 0        | 0        |  |  |
| Larue                      | Communities     | <i>Calcareous sub-xeric forest</i> |                  | N /      | GNR / S5                 | 1                | 0         | 0        | 0        | 0        |  |  |
| Larue                      | Communities     | <i>Limestone slope glade</i>       |                  | S /      | GNR / S2S3               | 1                | 0         | 0        | 0        | 0        |  |  |
| Larue                      | Communities     | <i>Limestone/dolomite prairie</i>  |                  | E /      | GNR / S1                 | 1                | 0         | 0        | 0        | 0        |  |  |
| <b>Larue County Total:</b> |                 |                                    |                  |          |                          | <b>37</b>        | <b>12</b> | <b>2</b> | <b>4</b> | <b>0</b> |  |  |

Species  
Information  
KDFWR  
Maps  
Public  
Hunting  
Area Maps  
Game Maps  
Download  
GIS Data  
Links

## Species Information

Federal Threatened, Endangered, and Candidate Species observations for selected counties

Linked life history provided courtesy of [NatureServe Explorer](#).

**Records may include both recent and historical observations.**

[US Status Definitions](#)

[Kentucky Status Definitions](#)

**List Federal Threatened, Endangered, and Candidate Species observations in 1 selected county.**

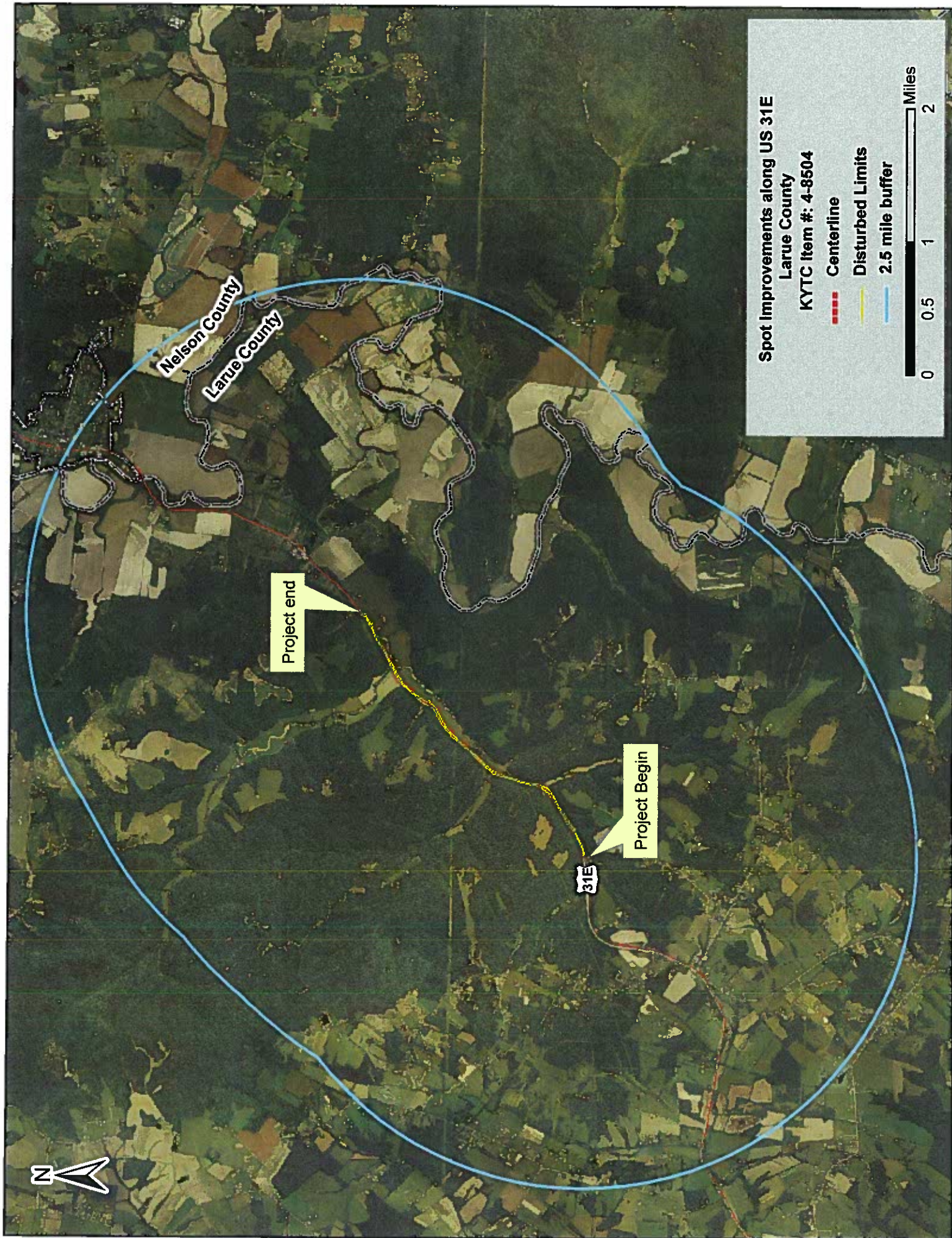
**Selected county is: Larue.**

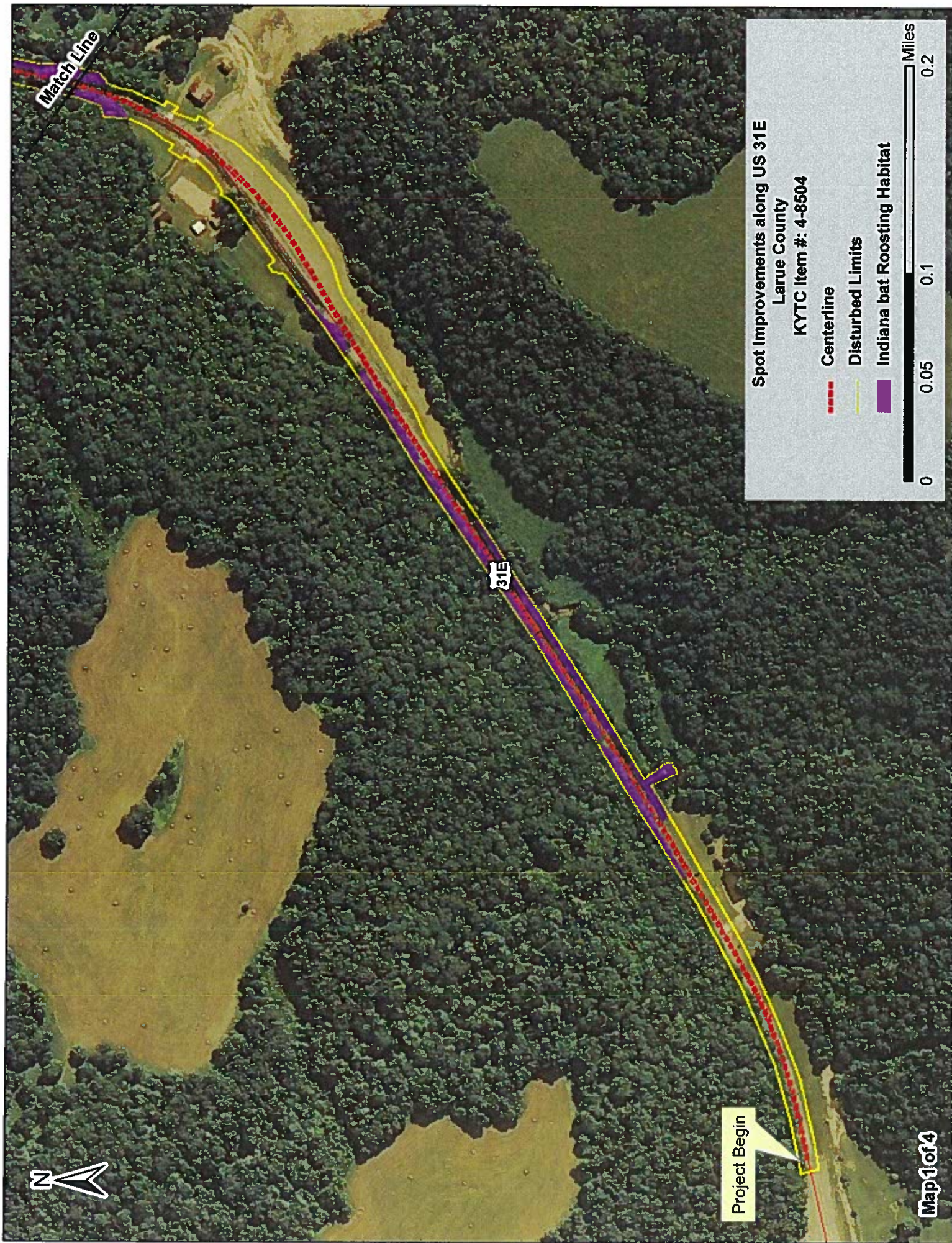
| Scientific Name and Life History             | Common Name and Pictures             | Class    | County | US Status | KY Status | WAP | Reference                 |
|----------------------------------------------|--------------------------------------|----------|--------|-----------|-----------|-----|---------------------------|
| <a href="#">Cyprogenia stegaria</a>          | <a href="#">Fanshell</a>             | Bivalvia | Larue  | LE        | E         | Yes | <a href="#">Reference</a> |
| <a href="#">Epioblasma torulosa rangiana</a> | <a href="#">Northern Riffleshell</a> | Bivalvia | Larue  | LE        | E         | Yes | <a href="#">Reference</a> |
| <a href="#">Pleurobema clava</a>             | <a href="#">Clubshell</a>            | Bivalvia | Larue  | LE, XN    | E         | Yes | <a href="#">Reference</a> |

**3 species are listed**

## Appendix B

### Exhibits





Spot Improvements along US 31E

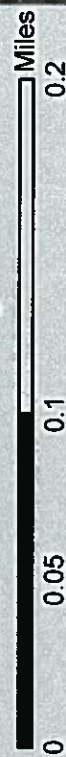
Larue County

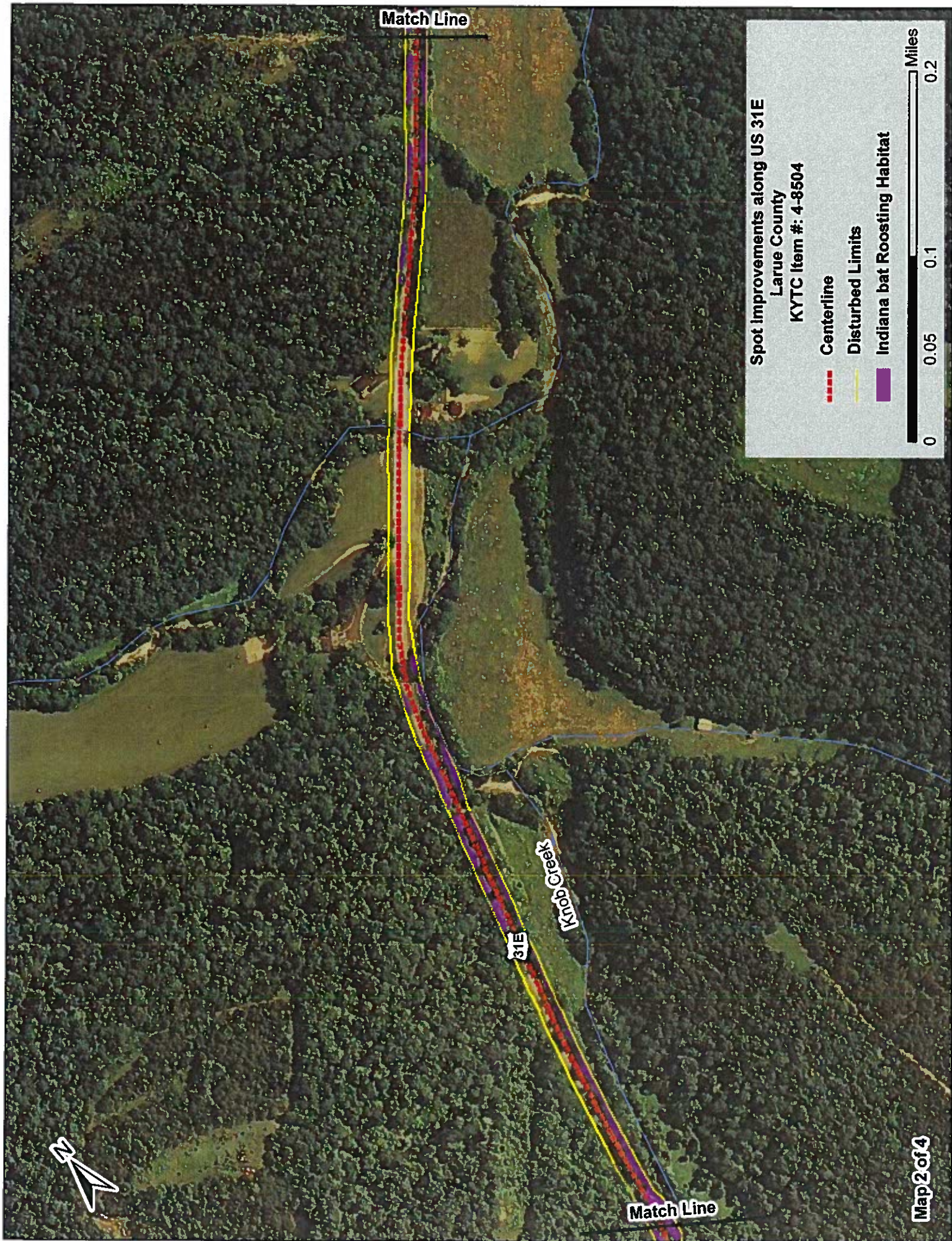
KYTC Item #: 4-8504

Centerline

Disturbed Limits

Indiana bat Roosting Habitat





Spot Improvements along US 31E

Larue County

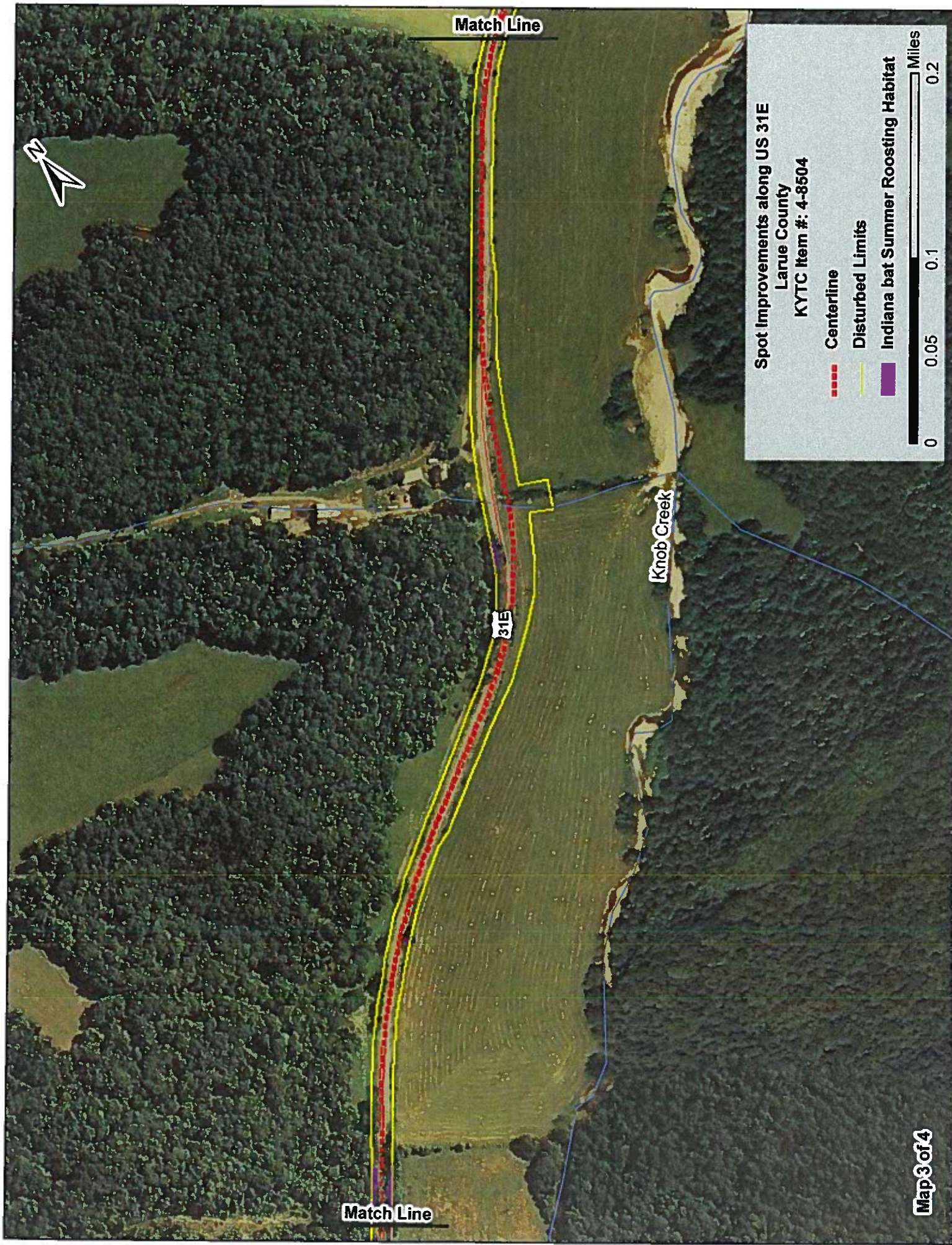
KYTC Item #: 4-8504

Centerline

Disturbed Limits

Indiana bat Roosting Habitat

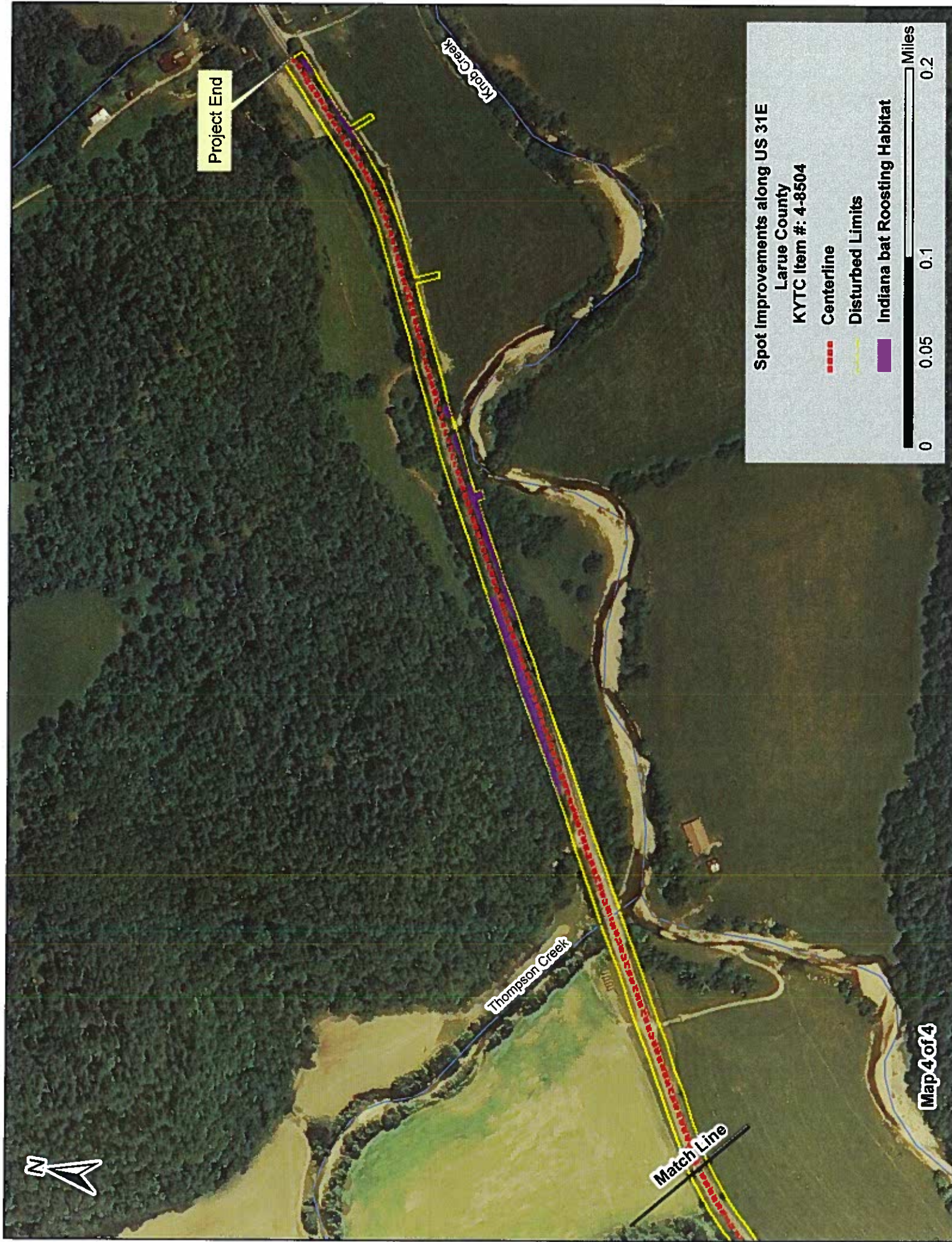




Spot Improvements along US 31E  
Larue County  
KYTC Item #: 4-8504

- Centerline
- Disturbed Limits
- Indiana bat Summer Roosting Habitat





**Spot Improvements along US 31E**

Larue County

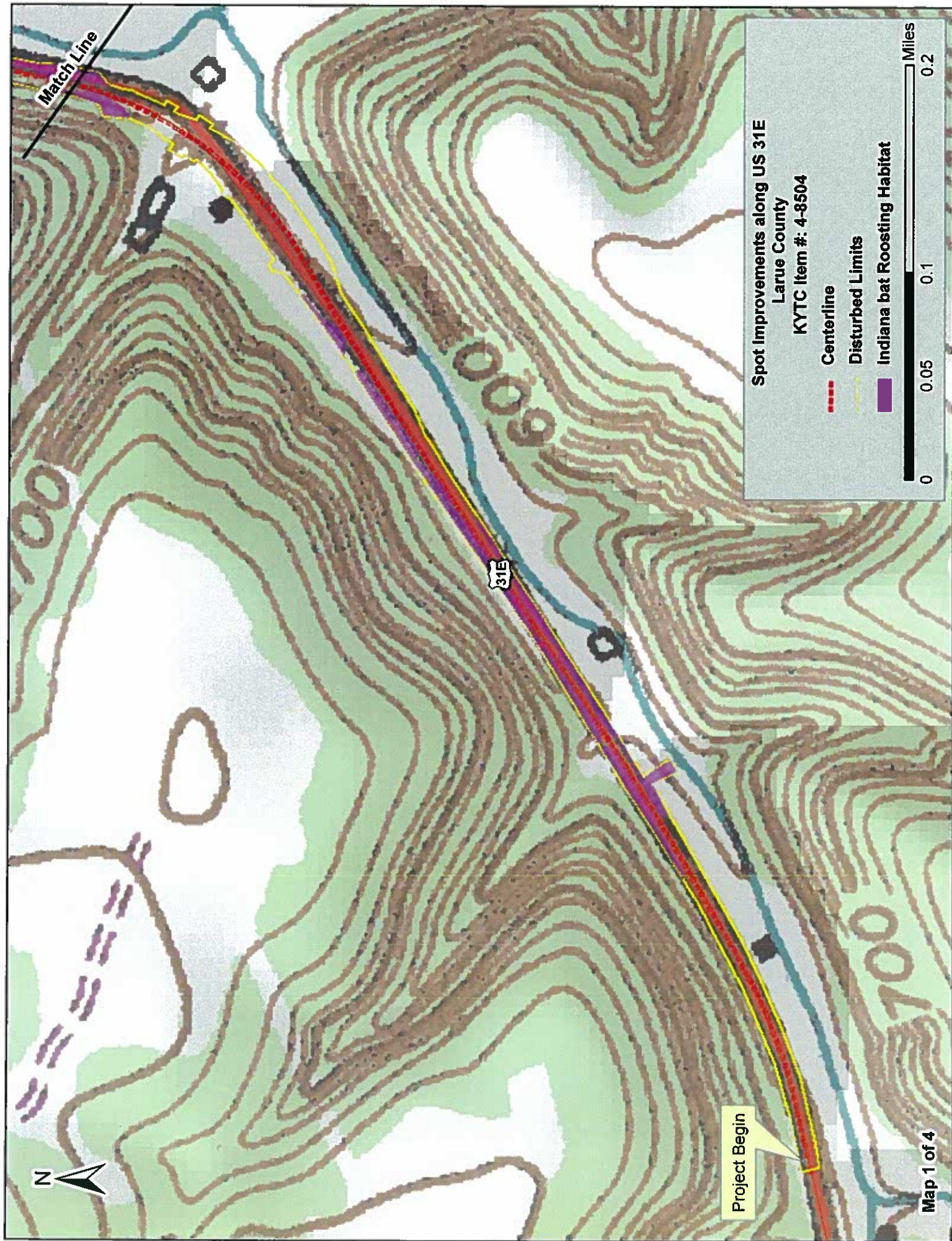
KYTC Item #: 4-8504

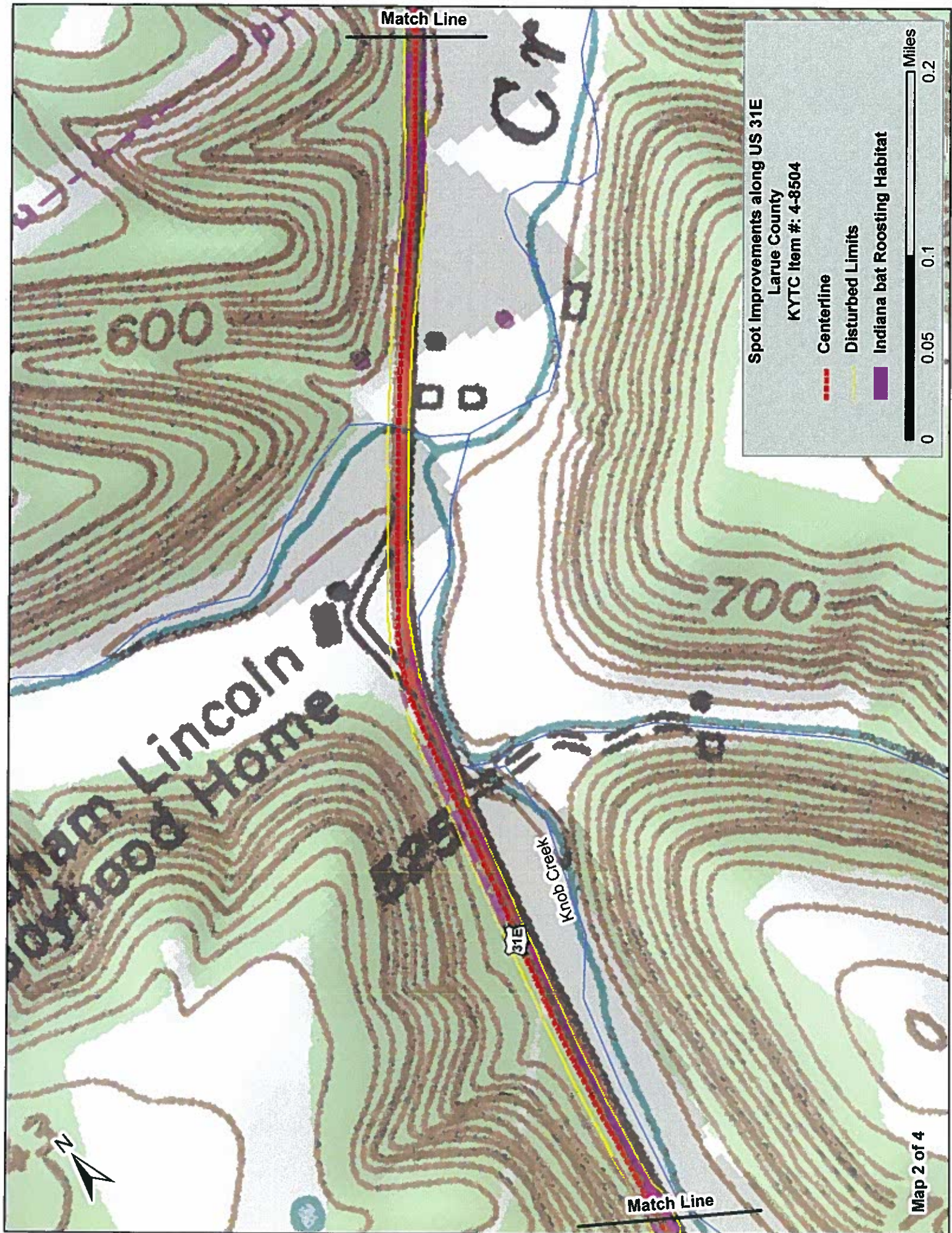
Centerline

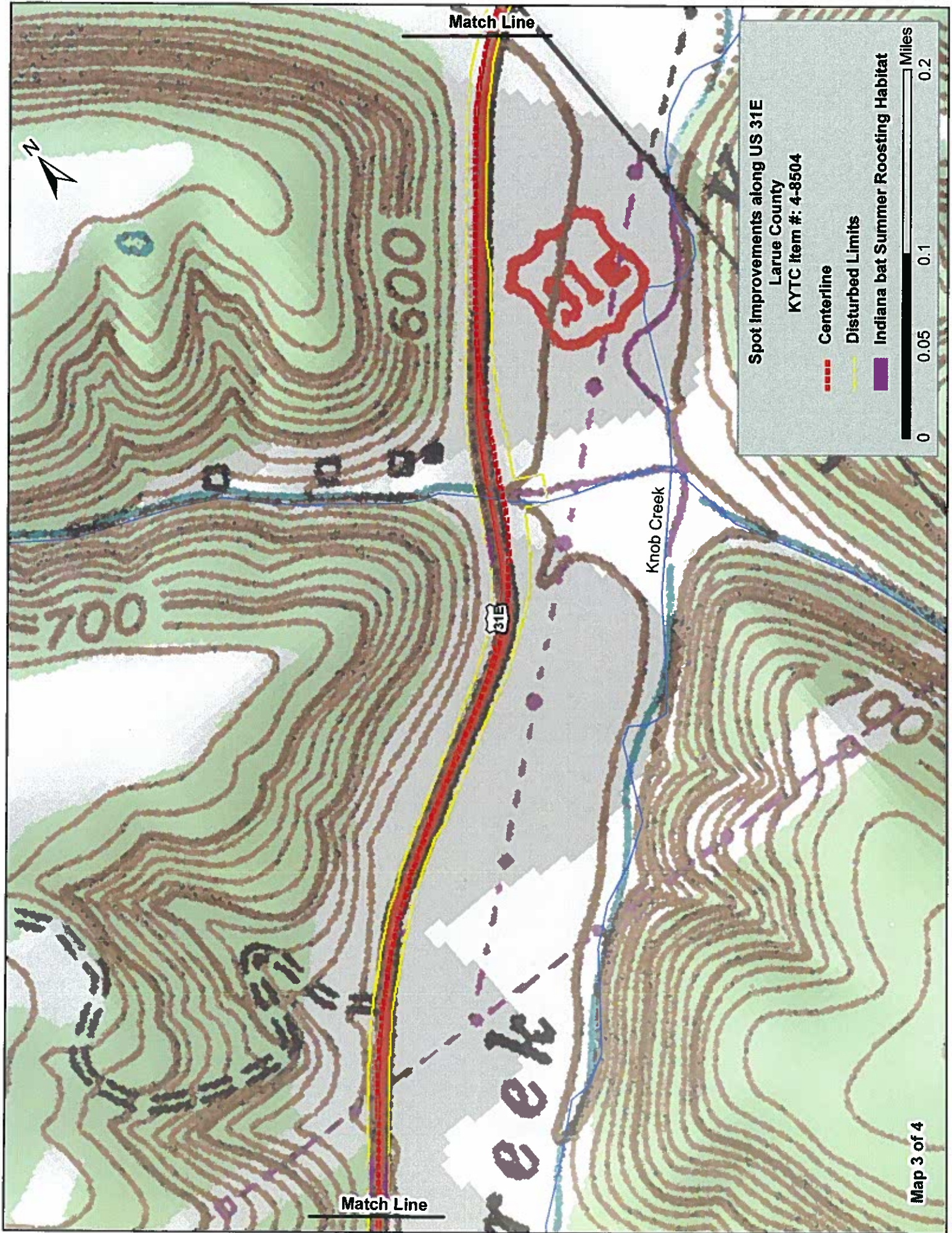
Disturbed Limits

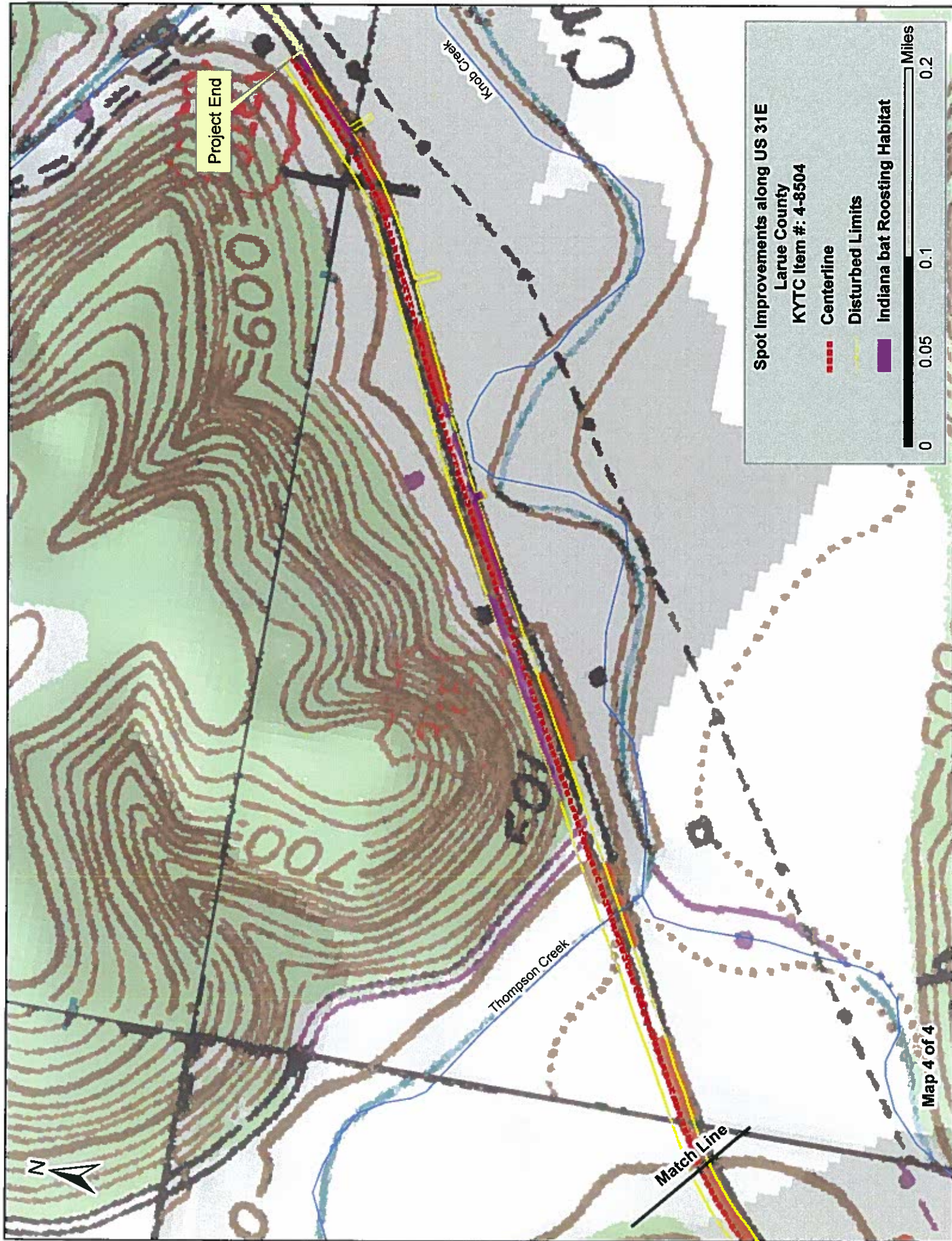
Indiana bat Roosting Habitat











## Appendix C

### Project Photos

✕



Downstream view of a tributary to Knob Creek that runs under US31E that will have a culvert extension installed as part of the proposed project.



Upstream view of the same stream as above.



Tributary to Knob Creek exhibiting bedrock substrate typical of area streams.



Example of geometrically deficient curve along US31E that will be corrected as part of the proposed project.