Bat Likelihood of Occurrence Report

Ashley Wind Energy Project
McIntosh County, North Dakota

Prepared For:

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EXECUTIVE SUMMARY

Tetra Tech EC, Inc. (Tetra Tech) was contracted by CPV Ashley Renewable Energy Company, LLC (CPV) to assess the potential likelihood of occurrence of bats within the Ashley Wind Energy Project location (WEP) in McIntosh County, North Dakota. The objective of this likelihood of occurrence analysis was to evaluate the biological and landscape features of the WEP to determine the potential for bats to occur. Thus, Tetra Tech developed a likelihood index based on habitat-based variables and species-based variables. Habitat-based variables include the amount of suitable foraging and roosting habitat, the number of natural areas, number of perennial streams, and number of human developments. Species-based variables included bat species known to occur in the region and behavioral characteristics. The likelihood index does not predict how many bats will occur or the anticipated bat mortality level, rather it scores a site based on a suite of variables that are related to bats. Bat presence is more likely to occur over the life of a project at a project with a higher score, thus indicating higher likelihood of occurrence and, thus, potential for turbine-related fatalities given the patterns of bat fatalities at other wind farms in the United States.

Of the 46 bat species in the United States, 10 occur in North Dakota. Of these 10 species, 6 potentially occur within the Ashley WEP based on current known distribution ranges. None of these species are federally listed as threatened or endangered or listed as a Level I or II state species of conservation concern. When viewed on a regional scale, the Ashley WEP contains less suitable bat habitat than the surrounding landscape. Overall, Tetra Tech calculates a low likelihood of occurrence for bat species for the entire Ashley WEP.

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1.0 INTRODUCTION

CPV Ashley Wind Energy Company, LLC (CPV) is currently developing plans for a wind energy facility in McIntosh County, North Dakota (Figure 1). Recent monitoring studies indicate that utility-scale wind energy facilities have had greater bat mortality than was expected based on early monitoring studies where birds were the primary focus of attention (NRC 2007). The potential for bat collisions with turbines is highest in the forested regions of the eastern part of the United States (NWCC 2004); however, relatively high numbers of bat fatalities have been documented in the mixed-grass plains and agricultural regions of Iowa (Jain 2005), Oklahoma (Piorkowski 2006), and Minnesota (Johnson et al. 2004).

CPV contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct an in-depth literature review and landscape scale analysis to assess the potential occurrence and risk for bat species that may occur within the Ashley Wind Energy Project (WEP). Although, to date, there is no clear relationship between pre-construction occurrence and post-construction mortality, certain features of a project may make it more or less attractive to bats, thus increasing or decreasing the relative mortality risk. Tetra Tech developed a likelihood index to evaluate the Ashley WEP based on the number of species potentially occurring in the WEP, the amount of suitable foraging and roosting habitat within the WEP and the surrounding landscape, and several additional factors that were likely to increase the presence of bats including the presence of perennial streams, number of human developments, and the number of natural areas. The likelihood index does not predict bat occurrence or mortality. Rather, it scores the project based on a suite of variables that are related to occurrence and potential mortality. Bat presence is more likely to occur over the life of a project at a project with a higher score, thus indicating higher likelihood of occurrence and, thus, potential for turbine-related fatalities given the patterns of bat fatalities at other wind farms in the United States.

2.0 BATS AND WIND ENERGY

Wind energy generation facilities can help reduce dependence on non-renewable energy sources and have many environmental benefits including reduction in the generation of greenhouse gases, preserving open space habitat, and improving air quality. Wind farms do, however, have the potential to result in adverse environmental impacts, including the potential to impact bat species directly and indirectly. Historically, some wind energy generation facilities have experienced unexpected levels of bat mortality (Kunz et al. 2007). Several variables may contribute to the fatalities of bats at wind facilities including, but not limited to, biology of the bat species, season, region, and turbine design (Kunz et al. 2007). Species that have the highest risk of fatalities at wind facilities are tree, foliage, or cavity roosting migratory bats (Kunz et al. 2007; Arnett et al. 2008). Nearly 75 percent of all bat fatalities have been associated with migratory tree bats including the hoary bat, eastern red bat and silver-haired bat, all three of which occur within the range of the WEP. Migratory bats travel long distances at altitudes occupied by wind turbine blades, making them susceptible to collisions. The probability of mortality events increases during periods of poor weather, such as just before or after the passing of a storm front (Arnett et al. 2008).

There is a seasonal trend with bat fatalities at wind facilities, with spikes occurring in the late summer and early autumn which coincide with fall migration or dispersing juveniles that may be more prone to collisions with structures (Johnson 2004, 2005); however, Kunz et al. (2007) speculate this is a function of intensive carcass searches during this time and not due to seasonal factors. Many, if not most, of the bat species detected as fatalities at wind facilities in the United States (Arnett et al. 2008) are also resident during spring and summer months (Barbour and Davies 1969).

There are geographic differences in fatalities/megawatt (MW)/year among bat species, ranging from 0.2 to 53.3 bats/MW/year, with the highest fatalities being reported along forested ridges in the eastern United States (Arnett et al. 2008). However, bat fatalities have also been reported from the agricultural regions of northern Iowa (8.9 bats/MW/year; Jain 2005) and the mixed-grass prairie of north-central Oklahoma (0.8 bats/MW/year; Piorkowski 2006). Therefore, caution must be taken in assuming that only facilities in the forested eastern United States have the potential of producing high bat fatalities because of the small number of studies to date and the possibility of other regions being underrepresented.

3.0 STATUS OF BATS IN NORTH DAKOTA

Of the 46 bat species in the United States, 10 occur in North Dakota (ASM 2007). Of these 10 species, six potentially occur within the Ashley WEP based on current known distribution ranges (ASM 2007, NatureServe 2008, BCI 2009; Table 1). None of the species that potentially occur within the WEP are federally listed as threatened or endangered or are listed as Level I or II state species of concern. Three of the species that could potentially occur within the WEP–hoary bat, silver-haired bat, and eastern red bat–are highly migratory and are found in the greatest abundance in North Dakota during late May through early September (Cryan 2003).

Bats rank among North America's least studied wildlife, yet declines in population numbers among all species have been documented since the 1960s (Tuttle 2004). Compared to bird species, there are relatively few laws that protect bats. On federal lands such as National Forests, National Wildlife Refuges, and lands administered by the Bureau of Land Management, agencies have developed habitat management guidelines and other regulations to enhance or minimize disturbance to habitats; none of these apply at the Ashley WEP. Existing environmental laws primarily address the protection of caves and wanton destruction of wildlife. The protection and regulation of non-threatened bat species on private lands is typically left at the state wildlife agencies' discretion.

4.0 PROJECT AREA DESCRIPTION AND ENVIRONMENTAL SETTING

4.1 Project Area Description

The WEP is located on privately owned lands in south-central North Dakota, consists of approximately 17,400 acres under easement with CPV, and is located slightly more than 6 miles north of the town of Ashley in McIntosh County (Figure 1). The WEP area is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture, rangelands, and native prairie. The area contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Residences and abandoned farmsteads are scattered throughout the WEP. Patches of trees and shrubs exist throughout the WEP, and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

4.2 Environmental Setting

The WEP is located within the Northwestern Glaciated Plain. This landscape is a transitional region between the generally more level, moister, more agricultural Northern Glaciated Plains to the east and the generally more irregular, dryer, Northwestern Great Plains to the west and southwest. The western and southwestern boundary roughly coincides with the limits of continental glaciation. Pocking this ecoregion is a moderately high concentration of semi-permanent and seasonal wetlands, locally referred to a Prairie Potholes.

5.0 GENERAL BAT BIOLOGY

5.1 Roosting Habitat

Bats depend on roosts for hibernation, mating, rearing of young, protection from predators, and protection from adverse weather conditions (Lacki et al. 2007). Due to bats' dependence on these structures during all stages of their life cycle, they have been identified as the key factor in the survival of bats in North America (Kunz 1982, Pierson 1998, Kunz and Lumsden 2003).

Generally, bats can be divided into three broad roosting categories: tree roosting, cave roosting, and species adapted to roosting in multiple habitats. Many bat species that are found in North Dakota exhibit a seasonal shift in habitat where they may use trees for roosting in the summer and then use rocky outcrops, caves, or other structures for hibernation during the winter; other species may utilize a single habitat year-round. Studies have examined variables that influence roost selection at local (Hutchinson and Lacki 2000) and larger spatial scales (Elmore et al. 2004); however, little information is available on the roosting preferences of bats at the landscape scale (Carter and Menzel 2003, Duff and Morrell 2007). In states such as North Dakota where roost habitat is limited due to the fragmentation of tree stands caused by agricultural activities; roost availability may be a limiting factor in bat species occurrence and distribution (Carter and Menzel 2003).

5.2 Foraging Ecology

The need for resources occurs during three general life-history periods: maternity, migration, and hibernation (Lacki et al. 2007). This section focuses on foraging behavior during the summer maternity season. All the bat species found in North Dakota are insectivorous and feed on a variety of prey including moths, beetles, flies, and mosquitoes – many of which are agricultural pests. Their importance for controlling these pests equates to millions of dollars in savings from loss of crops, and by minimizing the application of pesticides (BCI 2001).

Selection of resources is a hierarchical process of behavioral choices by bats that results in a differential use of habitats (Block and Brennan 1993). Resources such as type and size of foraging habitat and the selection of prey are species-specific and dependent of the species' energetic needs, sex and reproductive status. The availability and suitability of resources in a landscape may affect the size of the foraging areas and commuting distances to them (Lacki et al. 2007). Species typically choose areas high in prey concentrations in a number of diverse habitats such as riparian areas (Waldien and Hayes 2001), water bodies (Henry et al. 2002), streetlights (Rydell 1992) or forest edges; however, the commonality in most studies is the proximity to water (Carter et al. 2002).

5.3 Migration Behavior

Bat migration is defined as a seasonal, usually two-way, movement from one place or habitat to another to avoid unfavorable climatic conditions and to seek more favorable energetic conditions (Fleming and Eby 2003). This annual shift in distribution is generalized by individuals occupying northern latitudes during the summer and southern latitudes during the winter (Cryan 2003). Migratory tree-roosting species that travel long distances tend to form larger aggregations than species that exhibit partial migration or are year-round residents (Fleming and Eby 2003). How species form groups is unclear, yet there is evidence that the sexes separate during migration (BCI 2001, Cryan 2003). Typically, mating occurs in the fall, either during migration or prior to hibernation with the young being born the following spring.

6.0 ASSESSMENT OF BAT LIKELIHOOD OF OCCURRENCE

The primary threats of wind energy facilities to bats are fatalities associated with wind turbines and loss of roosting and foraging habitat. Because of the high levels of concern regarding bats, the ability to evaluate the risk to bats at an individual project is a critical component to understanding the environmental impacts of a proposed wind facility. There is no clear relationship between pre-construction occurrence and post-construction mortality; however, certain features of landscapes may make them more attractive to bats. Here, Tetra Tech presents a method used to evaluate the likelihood of bat occurrence at a given project. This evaluation method includes the use of both habitat- and species-based variables. Identifying the habitat-based variables essential to the species' requirements during roosting and foraging is key in determining the suitability of the habitat (Duchamp et al. 2004), whereas understanding the species' ecology and behavior is key in developing a model that leads to understanding the relative risk from wind energy development. Habitat-based variables include the amount of suitable foraging and roosting habitat, the number of natural areas, the number of perennial streams, and the number of human developments. Species-based variables included using bat species known to occur in the region and behavioral characteristics. Specific details about each variable and how they were used to estimate likelihood are presented below.

6.1 Forest-Aquatic Matrix

Biological Justification

Landscapes that contain a greater amount of roosting and foraging habitat are expected to be more attractive to bats. Specifically, research shows there is a strong relationship between the number of individuals and species composition with the presence of water and forests or small tree stands (Everette et al. 2001). In North Dakota, roosting habitat includes trees found in forested patches, along riparian corridors, and around homesteads. Water features are typically used for foraging and include ephemeral and perennial wetlands, streams, rivers, ponds and lakes (Carter et al. 2002). For the purposes of this analysis, the foraging distance was defined as a radius of 0.8 mile, which corresponds to the average maximum foraging distance of the bat species found in North Dakota (Hutchinson and Lacki 2000). In addition, habitats associated with North Dakota bats that are within 3.0 miles of the WEP were evaluated to determine the attractiveness of the project to bats on a landscape scale and account for bat species' movement into and out of the WEP. Three miles was selected as an appropriate analysis distance because it was approximately triple the maximum foraging distance; therefore, 3 miles should provide a conservative estimate of bat use into and out of the WEP. Furthermore, this 3-mile buffer accommodates the foraging distances recorded for the bat species potentially occurring within the WEP (Table 1).

Scoring

To quantify the amount of roosting and foraging habitat in the WEP, Geographic Information Systems (GIS) land-cover data was obtained for North Dakota. The degree of resolution incorporated in the datasets accurately depicted shelterbelts, field windbreaks and other planted woodlands represented on United States Geological Survey (USGS) 7.5-minute maps (USGS 2007). The accuracy and spatial extent of waters was verified with National Wetlands Inventory (NWI; USFWS 2006) data and hydrologic features represented on USGS topographic maps. However, it is possible that agricultural conversion and long term drought have substantially reduced the extent of hydrologic features on the site, and thereby reduced the amount of available bat habitat.

Using these datasets, minimum thresholds for habitat sizes were generated. The minimum area for forest features was set at one acre whereas the minimum area for water features was set at 0.004 acre. All wetlands within 0.8 mile of a forested area represent a forest aquatic patch (FAP). Each habitat type (forest and wetland) included an additional 75-foot area beyond the habitat to account for foraging and flight behavior immediately adjacent to each habitat (i.e., a buffer area; Figure 2). The total area of the

FAP includes the bat habitat, the buffer area around the habitats, and the area between them. The model is nonrestrictive and includes FAPs if they are within 0.8 mile of another FAP, provided an additional forested area is within the WEP. When multiple FAPs are combined, they are referred to as a forest-aquatic matrix (FAM). Based on Tetra Tech's professional judgment and experience, areas that contained 1 to 25,000 acres received a ranking of low, areas that contained 25,001 to 50,000 acres received a ranking of moderate, and more than 50,001 acres received a ranking of high. The greater amount of FAM in a particular area, the higher the likelihood bats would occur.

FAM Assumptions

- The maximum foraging area includes the estimated foraging range expected by bat species found in North Dakota regardless of sex, reproductive condition, age, energetic requirements or other life history traits.
- Each woodland feature in the dataset is considered available and suitable, regardless of plant species composition, age, density, or patch size. Similarly, each water feature in the dataset is considered available and suitable, regardless of type or size.
- Those habitats not classified as forest or water are considered of neutral value to bats.
- The GIS datasets used in this analysis accurately reflect current land cover conditions.

Field Verification

In October 2009, a Tetra Tech field biologist visited the WEP to confirm the presence of desktop-identified forest patches. Any areas deemed to be unfit to support foraging or roosting bats (e.g., insufficient vertical complexity) were removed from the analysis. The field visit resulted in the removal of 855 acres of wetland and 17.4 acres of forest from the analysis; no acreage of either type was added.

6.2 Natural Areas

Biological Justification

Wildlife management areas, wildlife refuges, state parks and recreation sites, hereafter natural areas, typically have woodland and water habitats that are attractive to bats (Everette et al. 2001, Swier 2003, Jain 2005). Swier (2003) selectively sampled in these natural areas due to the increased possibility of detections, whereas a study in Iowa found higher bat activity at a natural area than in the adjacent project (Jain 2005). In contrast, Jain's study did not find a significant relationship between distance to the nearest natural area and bat activity in the study area. In order to provide a conservative estimate of potential bat use and activity, Tetra Tech has assumed that natural areas may play a role in the habitat selection process by providing suitable roosting and foraging habitat.

Scoring

The total number of natural areas in and within 3 miles of the WEP were counted using readily accessible landownership data. Three miles was chosen as a distance from the WEP to account for species movement during foraging activity and to match the buffer used in FAM calculations. Information on lands in the WEP enrolled in the Conservation Reserve Program (CRP) have not been made available to CPV and, therefore, not included in the evaluation. The total number of natural areas were counted in the WEP and assigned to a category with a corresponding score based on the total number of natural areas found. Based on Tetra Tech's professional judgment and experience, assigned rankings were low for 1 to 10 natural areas, moderate for 11 to 30 natural areas, and high for 31 or more natural areas.

Natural Area Assumptions

- Each natural area provides an equal value to bat species regardless of size, current habitat and management objective.
- Data obtained from the North Dakota Game and Fish Department represents the most current data available.

6.3 Perennial Streams

Biological Justification

There is a lack of studies investigating bat foraging requirements in North Dakota. However, inferences can be made from other studies, typically those involving forest-dwelling bats. One common theme among studies of foraging bats is the importance of perennial streams, rivers, riparian areas, ponds or other forms of open water. From arid habitats (Bell 1980) to forested habitats (Wilhide et al. 1998), studies suggest that the proximity of water (suitable foraging habitat) to suitable roosting habitat is a critical variable in determining species occurrence (Carter et al. 2002). Bats have been documented to travel longer distances to reach these types of foraging areas that provide higher concentrations of prey and water quality (Hayes and Loeb 2007).

Scoring

The presence of perennial streams in the WEP was evaluated using hydrological data from the NWI data (USFWS 2006), NLCD data (USGS 2007), and existing resource reports produced for the WEP. Based on Tetra Tech's professional judgment and experience, each area was given a score based on the presence or absence of this type of water feature. If there were no perennial streams within the WEP, it received a ranking of low. If there was one perennial stream within the WEP, it received a ranking of moderate. If there was more than one perennial stream within the WRA, it received a ranking of high.

Perennial Stream Assumptions

- All perennial streams are used equally, regardless of size, length and characteristics of riparian habitat.
- Water qualities of all perennial streams are similar and produce the same type of density of prey items.
- Perennial streams depicted in utilized databases have not been altered (diverted, dewatered, drought) to produce ephemeral conditions.

6.4 Human Development

Biological Justification

Planted vegetation and human structures can serve as suitable roost habitat for some bat species due to the overall increased availability of natural (trees, caves, outcrops) and human-made (houses, barns, bridges) roosts across the landscape (Everette et al. 2001, Swier 2003). This availability of suitable roosting habitat may lead to a higher abundance of species that are adapted to multiple roosting substrates, provided there is also suitable foraging habitat available nearby (Evelyn et al. 2004).

Scoring

All communities in and within 3 miles of the WEP were identified using the National Land Cover Database (NLCD) data (USGS 2007) for North Dakota. Communities with populations greater then 50 (as of the 2000 census) were tallied, and a corresponding ranking was assigned. The WEP received a ranking of low if there 0-2 towns within 3 miles, a ranking of moderate for 3-4 towns, and a ranking of high for 5 or more towns.

Structure and Human Development Assumptions

- The housing/population density of developments within a community has no affect on the suitability for bats.
- Habitat availability and suitability is similar between towns regardless of surrounding habitat features.
- Smaller communities or isolated residences such as farms and structures such as bridges, overpasses and culverts are assumed to be uniformly distributed over the area.

6.5 Species Ranking Index

Biological Justification

The defining characteristic that differentiates mortality rates among bat species at operating wind facilities appears to be correlated with species life-history traits. Migratory tree-roosting bats are known to have a higher risk of mortality at wind facilities then resident bat species (Kunz et al. 2007), although large numbers of resident bat species have also been reported during post-construction mortality searches (Kerns and Kerlinger 2004, Jain 2005). In order to reflect this differential risk, a species-based index was calculated to reflect the relative risk to all bats found at a project based on individual species' life history traits and documented mortality at other existing wind energy facilities.

Scoring

A species ranking index was developed by Tetra Tech to provide a single score that incorporates the species diversity and the relative morality risk for each species found within the WEP. Species occurrence was estimated using range maps, historic occurrences, and habitat characteristics from landcover data. Because mortality events are not uniform among species, species were assigned a score that reflected their mortality risk. Higher scores were assigned to common, migratory tree bats and lower scores were assigned to less abundant species or to those species that are not common mortalities at wind farms. For each area, the scores of all species likely to occur within the project boundary were summed and then divided by the number of species to provide a relative index of occurrence and risk. A ranking index of less than 0.75 was considered low, 0.75-1.00 moderate, and greater than 1.00 high.

Species Ranking Index Assumptions

- Risk of mortality is equal for a given species across its range. *Example:* For a hoary bat, the risk of collision with a wind turbine in North Dakota is equal to that in West Virginia.
- Data on distribution and occurrence accurately reflects current species distribution.

6.6 Species Landscape Index

Biological Justification

Landscapes that provide greater amounts of available and suitable roosting and foraging habitat have a greater probability for bats to occur (Duchamp et al. 2004, Lacki et al. 2007). However, the threshold at which landscapes become more attractive to bats remains unclear and makes predicting species occurrence difficult (Jaberg and Guisan 2001, Duchamp et al. 2004). Therefore, some assumptions about attractiveness were necessary. First, we assumed that attractiveness was based on the presence of the FAM. Second, we assumed that bats make landscape-based decisions based on an area within 3 miles of the WEP (Table 1).

Scoring

The objective of this index was to recognize the attractiveness of habitat within a landscape. Areas that have a greater amount of suitable foraging and roosting habitat, expressed as FAM, than that of their surrounding areas may have a greater potential for species to occur. First, the amount of FAM in the WEP was compared to the amount of FAM within 3 miles outside of the project. Those values were divided by the total size of their respective areas, in acres, and a habitat index (HI) was produced, using:

$$HI = \left(\frac{FAMI / PA}{FAMO / BA} \right)$$

Where FAMI is the amount of FAM inside the WEP, PA is the total area of the project, FAMO is the amount of FAM outside the WEP and BA is the total area of the 3-mile buffer surrounding the project. This index provided a habitat index value where values:

> 1.0 indicate that the total acres of FAM inside the WEP is greater then the surrounding area; hence, more unique and potentially more attractive to bats; and,

< 1.0 indicate that the total acres of FAM inside the WEP is less then the surrounding area; hence, less unique and potentially less attractive to bats.

This value was multiplied by the potential number of species (P) occurring in the WEP and a species landscape index (SL) was calculated as:

$$SL = \sum P * HI$$

A landscape index of less than 5 was considered low, 5-10 moderate, and greater than 10 high

Species Landscape Index Assumptions

- The suitability and availability of FAM habitat is restricted to distinct project and buffer boundaries.
- The spatial distribution of bat species and the scale of their decision making coincide with the boundaries of the WEP and 3-mile buffer.
- Patch dynamics are not influencing bat behavior.
- The increasing uniqueness of habitat in the landscape increases the attractiveness to bats.

7.0 ASHLEY WEP ASSESSMENT AND SUMMARY

Overall, there is a low likelihood of occurrence for bats at the Ashley WEP; five of the six assessed variables received a ranking of low (Table 4). The Ashley WEP contains 887 acres of FAM (5.2% of WEP; Table 2: Figure 3) and the 3-mile buffer contains 9,058 acres (13.6% of buffer). The total FAM within the WEP and the 3-mile buffer equals 9,945 acres which equates to a FAM ranking of low. Four natural areas occur within 3 miles of the Ashley WEP: Ashley Wildlife Management Area (WMA), Clear Lake WMA, Green Lake WMA, and Macintosh Waterfowl Production Area; therefore, the ranking the natural areas variable is low. There are no perennial streams within the Ashley WEP; therefore, the ranking for this variable is low. The closest perennial stream is 12 miles from the WEP. There are no communities with more than 50 people within 3 miles of the Ashley WEP; therefore, the ranking for the human development variable is low. The closest community with more than 50 people is the City of Lehr, ND located 4.4 miles north of the WEP. The Ashley WEP has a moderate species ranking index of 0.92 (5.5/6), based on the likelihood of encounter for the six species whose ranges overlap with the WEP (Table 3). The Ashley WEP contains less suitable bat habitat than the surrounding landscape (Figure 3); therefore, the habitat index (HI) is calculated to be 0.38. As there are six species of bats that could potentially occur within the WEP, the species landscape index (SL) is 2.28 and is ranked as low (Table 4).

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TABLES

Table 1. Life history, behavior and habitat preferences of bat species for the Ashley WEP, North Dakota*.

English Name	Scientific Name	Listing Status	Abundance and ND Distribution	Maximum Foraging Area	Habitat/Foraging Habits	Summer Maternity Colony Size	Bachelor Summer Roosts	Winter Hibernacula Colony Size	Winter Roosts or Hibernacula
big brown bat	*Eptesicus fuscus*	None	Common year - round resident. Statewide	1.2 square miles	A generalist, more common in deciduous forests. Adapted to human development. Forages over land and water, open areas and forests. Aerial hawking.	25–75 individuals	Roosts in hollow trees, crevices in cliffs, buildings, bridges and bat houses.	Rarely more than a few hundred individuals.	Winters in caves, mines, and man-made structures.
eastern red bat	*Lasiurus borealis*	None	Common migratory species. Statewide (except southwest corner)	3.5 square miles	Conifer and deciduous trees in floodplain preferred. Aerial hawking.	Small family groups of 2-3 individuals	Solitary. Roosts on foliage.	Solitary; groups up prior to migration	Not believed to winter in the Dakotas
hoary bat	*Lasiurus cinereus*	None	Common migratory species. Statewide	0.03 square mile	Conifer and deciduous trees in floodplain preferred. Found near water. Aerial hawking.	Small family groups of 2-3 individuals	Solitary. Roosts on foliage.	Solitary; groups up prior to migration	Not believed to winter in the Dakotas
little brown bat	*Myotis lucifugus*	None	Common year - round resident. Statewide	0.11 square mile	Found commonly in cottonwood floodplains, typically near water. In arid parts of state found in riparian woodlands. Often hunts over water. Aerial hawking.	Solitary or small colonies.	Diverse range of roost substrates: buildings, caves, hollow trees, piles of stacked lumber	NA	Winters in caves, tunnels and abandoned mines. Winter roosts have high humidity.
northern myotis	*Myotis septentrionalis*	None	Uncommon year-round resident. Southwest part of the state.	0.85 square mile	Associated with large forest galleries in floodplains in plains and badland habitat. Forages in the area of the tree canopy. Aerial hawking and gleaning insects.	Typically small numbers (5 individuals) but has been documented as up to 75 individuals in the Black Hills, SD.	Diverse range of roost substrates: tree cavities, under loose bark, in buildings, caves, mines. Seeks cooler temperatures.	Not found in large aggregations-known from a single cave in the Black Hills	Winters in caves and mines.
silver-haired bat	*Lasionycteris noctivagans*	None	Uncommon migratory species. Erratic statewide distribution	2.8 square miles	Found in forested areas, most abundant in Oregon in older Douglas-fir/western hemlock forests. Forages over ponds and streams in woods. Aerial hawking.	6-65 individuals	Roosts on tree foliage, tree cavities and under loose bark.	Usually solitary	Winters in small tree hollows, underneath bark, in woodpiles and cliff faces.

* *Sources*: ASM 2007, Lacki et al. 2007, NatureServe 2008, Swier 2003, WBWG 2009

Table 2. Total amount of forest-aquatic matrix (FAM) habitat and percent composition within the Ashley WEP and the respective 3-mile buffer.

Area	Size of Area (acres)	Acres of FAM	% FAM in Area
Ashley WEP	17,204	887	5.2
Ashley WEP buffer	66,435	9,058	13.6

Table 3. Ranked scoring system used to develop species risk index for bat species found in south-central North Dakota.

English Name	Score (*P*)	Justification
hoary bat	1.25	Migratory tree bat. Commonly documented mortality at wind facilities (Johnson et al. 2004, Kunz et al. 2007, Arnett et al. 2008).
eastern red bat	1.25	Migratory tree bat. Commonly documented mortality at wind facilities (Johnson et al. 2004, Kunz et al. 2007, Arnett et al. 2008).
silver-haired bat	1.25	Migratory tree bat. Commonly documented mortality at wind facilities (Johnson et al. 2004, Kunz et al. 2007, Arnett et al. 2008).
little brown myotis	0.75	Prefer riparian habitat near water. Low levels of mortality at wind facilities (Arnett et al. 2008).
big brown bat	0.75	Local breeder but low levels of mortality documented at wind facilities (Arnett et al. 2008).
northern myotis	0.25	Project located on the margin of the know distribution range of this species. No documented fatalities at wind facilities (Arnett et al. 2008).
Total	**5.50**	

Table 4. Summary statistics for each variable used in the analysis for the Ashley WEP.

Element	Value	Ranking
Forest-Aquatic Matrix (FAM)	9,945 acres	Low
Number of natural areas within 3 miles	4	Low
Perennial streams present	0	Low
Number of residential communities within 3 miles	0	Low
Species ranking index	0.92	Moderate
Species landscape index	2.28	Low

FIGURES

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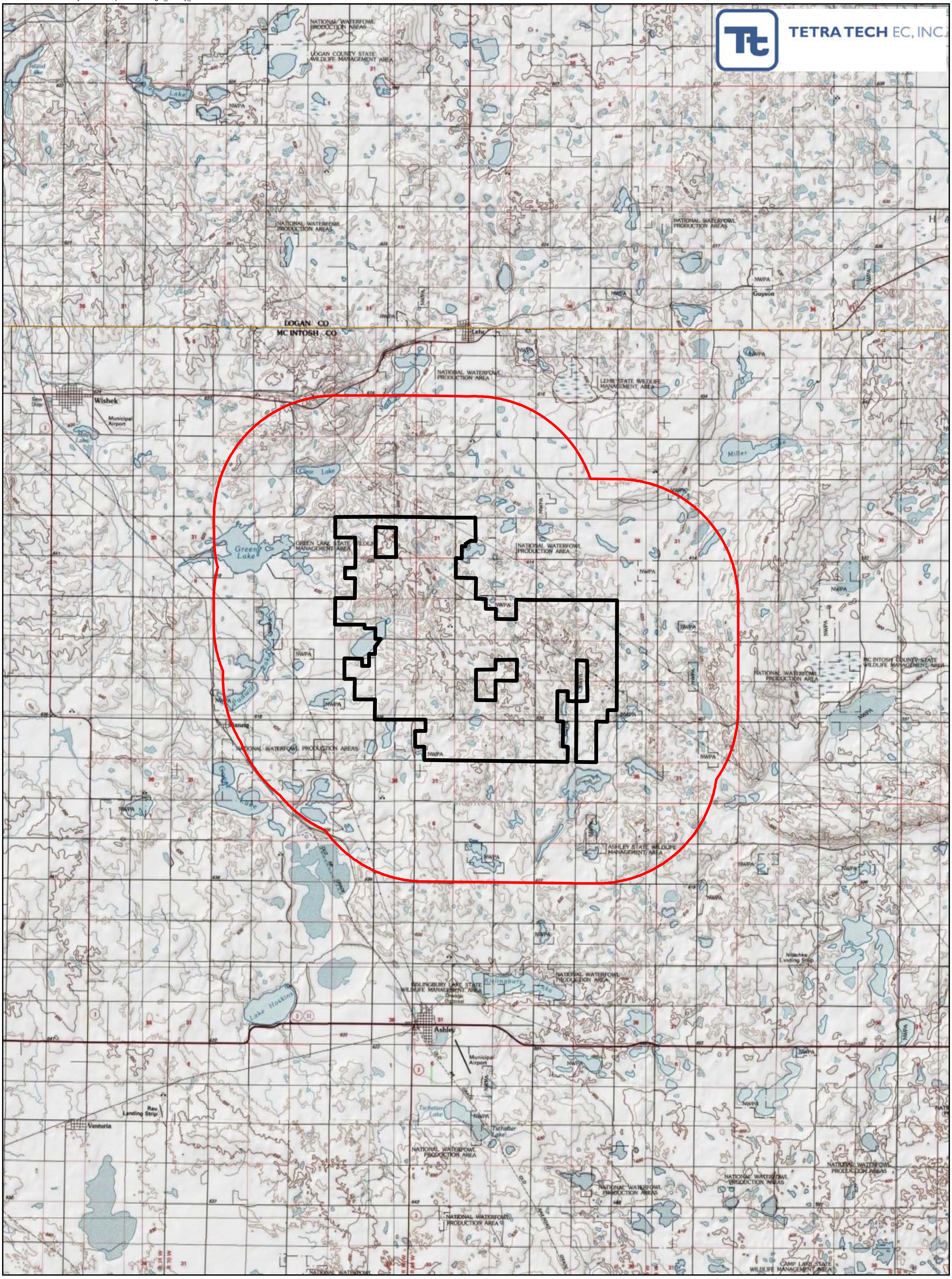


LOCATION MAP

LEGEND

- WEP Boundary
- 3-Mile Buffer
- Highway
- County Boundary
- State Boundary

0 0.45 0.9 1.8 2.7 3.6
Miles

Scale 1:500000
(when printed on tabloid size paper)

Data Sources:
ESRI Streetmap 9.3

Figure 1.
Project Area for Bat Likelihood of Occurrence Analysis Ashley Wind Energy Project

McIntosh County
North Dakota

TETRA TECH EC, INC.

Competitive Power Ventures, Inc.

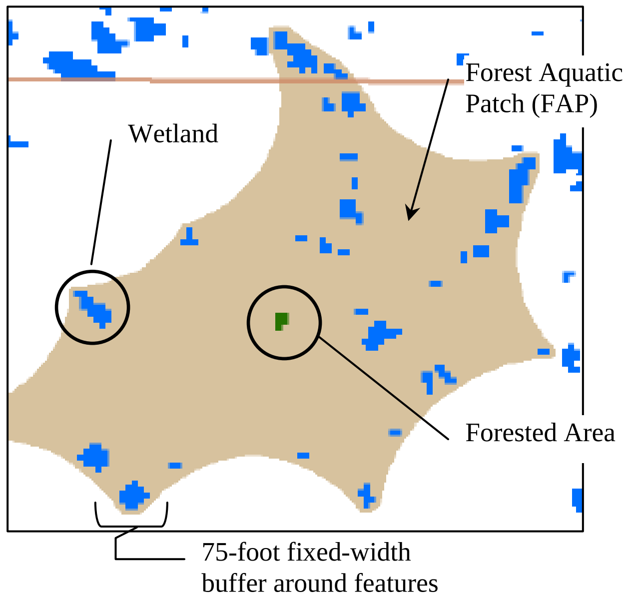
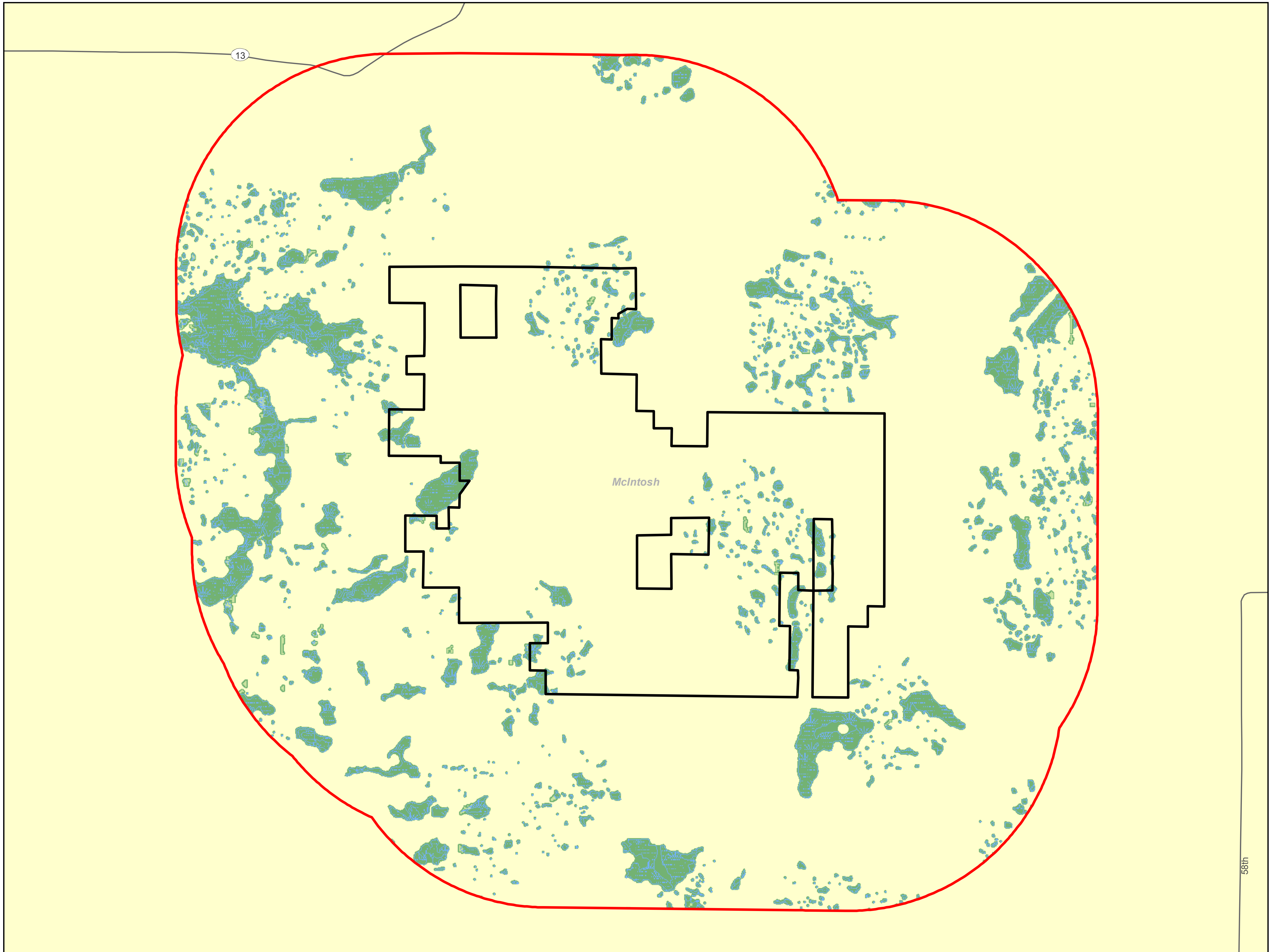


Figure 2. Representation of elements used to calculate FAP. Distance from the forested area is 0.8 mile. Multiple FAPs constitute the FAM.

Figure 3.
Ashley Wind Energy Project
Bat Habitat Map

McIntosh County
North Dakota



L E G E N D

- WEP Boundary
- 3-Mile Buffer
- Wetland
- Forest
- Forest/Aquatic Matrix
- Highway
- Major Road
- Local Road

Data Sources:
NLCD Data
NWI Wetlands
ESRI Streetmap 9.3

0 0.2 0.4 0.8 1.2 1.6
Miles

L O C A T I O N   M A P

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Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 14N