Pre-Construction Bat Acoustic Study, Proposed Crowned Ridge I Wind Facility, Grant and Codington Counties, South Dakota

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PREPARED FOR

Crowned Ridge Wind, LLC

PREPARED BY

SWCA Environmental Consultants

PRE-CONSTRUCTION BAT ACOUSTIC STUDY, PROPOSED CROWNED RIDGE I WIND FACILITY, GRANT AND CODINGTON COUNTIES, SOUTH DAKOTA

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1 INTRODUCTION

1.1 Project Overview

Crowned Ridge Wind, LLC, an indirect, wholly-owned subsidiary of NextEra Energy Resources, LLC, plans to develop an approximately 300-megawatt (MW) wind facility known as the Crowned Ridge I Wind Energy Facility (the project) in Grant and Codington Counties, South Dakota (see project boundary, Figure 1). The project will produce energy sold to Xcel Energy through a Power Purchase Agreement. A new transmission line will be constructed to connect the wind facility to Otter Tail Power's Big Stone South 230-kilovolt (kV) substation near Big Stone City, South Dakota (Figure 1). Construction is anticipated to commence in early 2019, and the project is scheduled to achieve commercial operation on or before the end of 2019.

The U.S. Fish and Wildlife Service (USFWS) has developed voluntary guidance that includes measures intended to address potential concerns to bird and bat species as related to wind energy facilities. This voluntary guidance is outlined in the *Land-Based Wind Energy Guidelines* (WEGs) (USFWS 2012). Crowned Ridge Wind, LLC requested that SWCA Environmental Consultants (SWCA) conduct long-term, passive monitoring acoustic bat surveys in 2017. The purpose of this report is to document the methods and results of acoustic bat studies within a 58,548-acre study area (Figure 1) in consideration of the WEGs.

2 SITE CHARACTERIZATION

2.1 Environmental Setting

Ecoregions are delineated based on the continuity of natural resource availability, vegetation communities, and other factors (Bryce et al. 1998). The U.S. Environmental Protection Agency and the Commission for Environmental Cooperation (CEC) defined a hierarchy of ecoregions at various scales, with Level I ecoregions being the coarsest level defined at the global scale, through Level III at the national scale (CEC 1997). Bryce et al. (1998) defined smaller Level IV ecoregions at a regional scale within the Level III ecoregions for the states of North and South Dakota.

The project is located within the Level IV Prairie Coteau and Big Sioux Basin ecoregions, which are subdivisions of the Level III Northern Glaciated Plateau ecoregion (Bryce et al. 1998). The Prairie Coteau ecoregion resulted from stagnant glacial ice melting beneath a layer of sediment, and it is dominated by a tightly undulating, hummocky landscape with no drainage pattern. This ecoregion has large chains of lakes and scattered semi-permanent or seasonal wetlands (Bryce et al. 1998). The Big Sioux Basin ecoregion is within the surrounding Prairie Coteau ecoregion and differs from that region in that it has a well-defined drainage network and gentler topography (Bryce et al. 1998).

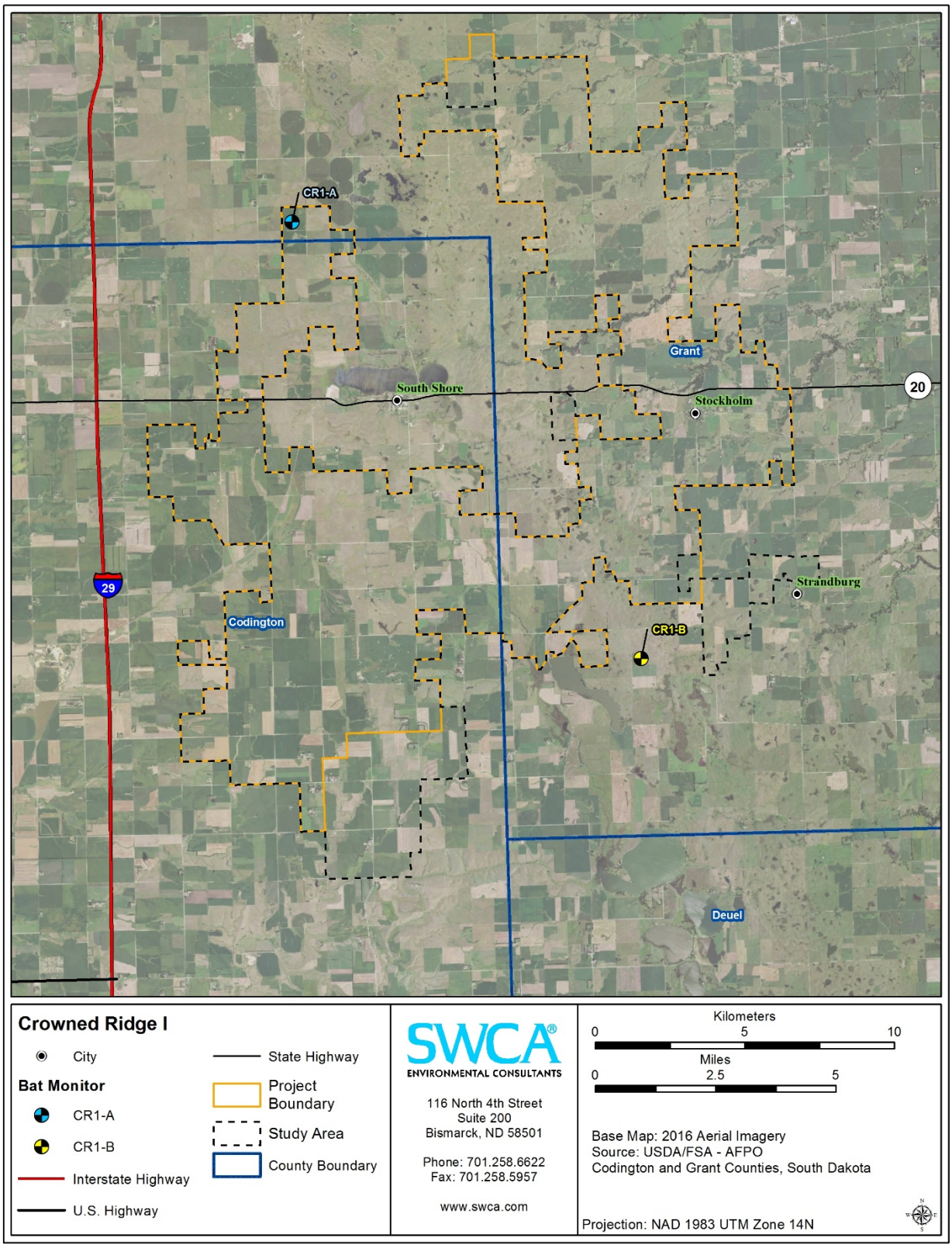

Figure 1. General location of the proposed project showing acoustic detector unit locations.

3 METHODS

Most bats emit vocalizations (calls) and interpret the echo patterns (a system called echolocation) for orientation and for catching prey in complete darkness (Griffin 1944). These echolocation calls may range from 11 kilohertz (kHz) to 212 kHz (Fenton and Bell 1981; Fullard and Dawson 1997). The implementation of devices that can detect and record sounds upward of 200 kHz has become a useful and economically feasible tool for monitoring bats at wind energy facilities (Arnett et al. 2008).

3.1 Desktop Review

Several sources were reviewed to identify bat species with potential to occur within Grant and Codington Counties, South Dakota. These are as follows:

- South Dakota Bat Working Group
- South Dakota Game, Fish and Parks (SDGFP) *South Dakota Wildlife Action Plan* (SDWAP; SDGFP 2014)
- *Annotated Checklist of Bats from South Dakota* (Jones and Genoways 1967)
- NatureServe (Hammerson 2015a–d)
- *Guide to Mammals of the Plains States* (Jones et al. 1985)

The USFWS threatened and endangered species list (USFWS 2017); the threatened, endangered, and candidate species list of South Dakota (SDGFP 2017); and the SDWAP (SDGFP 2014) were cross referenced with the list of bat species with potential to occur within Grant and Codington Counties to identify currently protected species; and those with established, state-specific conservation recommendations. This analysis was narrowed down to include those species that may be present in the study area.

3.2 Field Survey

3.2.1 Acoustic Detectors

Although zero-crossing recording methods, which record the frequency of the single loudest soundwave detected, have historically been the standard in the field of bat acoustic monitoring, new technology allows for recording the full spectrum of sound created when a bat echolocates. The Song Meter SM4BAT FS (SM4) developed by Wildlife Acoustics is a bat detection system that uses a broadband microphone and data storage unit to detect and record ultrasonic sounds in the full spectrum. However, the conventional wisdom within the field, and in SWCA's experience, is that although recording in full spectrum collects the best data, processing and analysis in zero-crossing format yield the most accurate results. Therefore, all full-spectrum call files were converted into zero-crossing files prior to analysis.

Two SM4 units (SD2 compact flash units, Wildlife Acoustics) were installed in the study area: CR1-A and CR1-B (see Figure 1, Table 1). The locations of the SM4 units were determined by initial project meteorological (met) tower placement and habitat distribution on properties to which legal access had been obtained, and the units were spaced to provide maximum coverage of habitat types within the study area.

Table 1. SM4 Unit Locations (latitude, longitude, height) within the Crowned Ridge I Study Area

Unit	Latitude	Longitude	Approximate Height (m)
CR1-A	45.160311	-96.971421	4
CR1-B	45.026333	-96.828580	50

Unit CR1-A was placed on a project met tower by climbing a ladder and securing the microphone to the tower at a height of approximately 4 meters (m) above ground. The microphone was connected to the SM4 unit with a microphone cable, and the SM4 unit was secured to the tower. Unit CR1-B's microphone was elevated to approximately 50 m on a met tower using a preinstalled pulley system. The unit was similarly secured to the base of the met tower and connected using a 50-m cable. These locations were representative of the larger region and the study area, which is primarily dominated by herbaceous cover-types such as row-crops, pasture, hay, and native prairie. SM4 unites were set to record bat activity at least 30 minutes before sunset and through the night until at least 30 minutes after sunrise the following day. The units began collecting data on April 6, 2017, and concluded on November 29 and December 1, 2017, for CR1-A and CR1-B, respectively. CR1-B experienced equipment malfunction and did not record between October 27 and November 8, 2017, likely because of extremely low temperature.

3.2.2 Acoustic Analysis

SWCA used Kaleidoscope, BCID, and Analook analysis software to calculate the number of "bat passes." A *bat pass* is defined as a sequence of echolocation calls that are separated by greater than 1 second (O'Farrell et al. 1999; White and Gehrt 2001). A bat pass is a commonly used metric for interpreting bat activity at a site; however, the number of bat passes cannot be translated into the abundance of bats, because a single bat foraging near a bat detector can record multiple passes.

Bat species produce echolocation calls based on their ecological niche requirements, which may demand different frequency bandwidth, call note duration, and other characteristics. These parameters can be assessed in the sonograms to facilitate species identification. However, intraspecific variation based on confounding factors (e.g., habitat, presence of other bats) can make species identification difficult or impossible (Barclay and Brigham 2004), with *Myotis* bat species generally recognized as being the most difficult to differentiate. Furthermore, the microphones cannot discriminate between bat calls and other ultrasonic sounds (e.g., rain, insects, electrical or mechanical [collectively called noise]). Therefore, post-survey data analysis also includes separating files with bat calls from files containing noise.

Bat passes were then identified to species, when possible. Many species have similar, overlapping echolocation signatures, and bat calls can vary depending on habitat or activity; therefore, species differentiation is not always possible (Barclay 1999), particularly when only portions of the calls are recorded. As a result, SWCA categorized unidentifiable calls according to high and low frequency groups (≥ 35 kilohertz [kHz] and < 35 kHz, respectively; Table 2).

Table 2. Bat Species Comprising Probable Frequency Groups in the Crowned Ridge I Study Area

Low Frequency Group (< 35 kHz)	High Frequency Group (≥ 35 kHz)	*Myotis* Species
Hoary bat (*Lasiurus cinereus*)	Eastern red bat (*Lasiurus borealis*)	Northern long-eared bat (*Myotis septentrionalis*)
Silver-haired bat (*Lasionycteris noctivagans*)	–	Little brown bat (*Myotis lucifugus*)
Big brown bat (*Eptesicus fuscus*)	–	–

4 RESULTS

4.1 Desktop Review

Using the sources outlined in section 3.1, Table 3 presents those bat species that are likely to occur in the study area.

Table 3. Ecology and Distribution of Bat Species Likely to Occur in Codington and Grant Counties

Common Name	Scientific Name	Status	Species Ecology
Red bat	*Lasiurus borealis*	–	Red bats are a common species throughout their range and are found throughout South Dakota in both coniferous and deciduous forested areas (Jones and Genoways 1967). It is hypothesized that red bats migrate to South Dakota in April and leave the state in late August or early September (Swier 2003).
Silver-haired bat	*Lasionycteris noctivagans*	State: rare, SDWAP*	Silver-haired bats are relatively uncommon throughout their range and erratically distributed (Kunz 1982). Jones and Genoways (1967) suggest the silver-haired bat is a migrant only; however, Swier (2003) captured individuals in July, showing that some are likely summer residents. The species roosts in trees under bark, in cavities, and snags (Mattson et al. 1996), typically in cottonwood forests in eastern South Dakota (Swier 2003). Silver-haired bats migrate great distances in spring and early fall (Kunz 1982).
Hoary bat	*Lasiurus cinereus*	–	Hoary bats are South Dakota's largest bats and are widespread, though they are usually not found in great densities (Jones and Genoways 1967; Shump and Shump 1982). Hoary bats roost in trees generally near a water source (Swier 2003) and forage at higher altitude, relative to other bat species. The species migrates south for the winter, leaving in late August and returning in early June (Turner 1974).
Northern long-eared bat	*Myotis septentrionalis*	Federal: threatened State: rare, SDWAP*	Within South Dakota, the northern long-eared bat is likely restricted to large, riparian forests along the Missouri River (Swier 2003). USFWS considers the species potentially present state-wide, however there are no records of the species from Grant, Codington, or the adjacent counties (USFWS personal communication 2018). The species is typically found near water and dense forest conditions, both coniferous and riparian; roost sites consist of exfoliating bark and tree cavities, open buildings, and caves or mines; winter hibernacula are frequently caves or mines (SDGFP 2014). During the summer, northern long-eared bats roost in trees with cracks, crevices, or exfoliating, as well as human-made structures (USFWS 2016). The species hibernates in caves or cave-like structures during the winter (USFWS 2016).
Little brown bat	*Myotis lucifugus*	–	Little brown bats are considered a common species and a generalist capable of exploiting many habitats. The species is historically commonly found throughout South Dakota (Higgins et al. 2000; Jones et al. 1985). Foraging and roosting areas are selected opportunistically (Fenton and Barclay 1980), though deciduous forests and urban areas appear to support the species more often (Swier 2003). Little brown bat roosts include human-made structures, trees, caves, and mines (Fenton and Barclay 1980) and forage over water (Swier 2003). The species migrates between summer maternity grounds and hibernacula in spring and fall (Fenton and Barclay 1980).

Common Name	Scientific Name	Status	Species Ecology
Big brown bat	*Eptesicus fuscus*	–	Big brown bats are common throughout nearly all of the United States, including South Dakota (Nowak and Paradiso 1983). Though forested areas are frequently used as foraging and roosting habitat, the big brown bat has become closely associated with urban areas and roosts in human-made structures (Nowak and Paradiso 1983). It is hypothesized that big brown bats summer in eastern South Dakota and migrate west to hibernate, though Swier (2003) recorded big brown bats in eastern South Dakota year-round.

* SDWAP: Species is addressed in the SDWAP.

4.2 Field Survey

4.2.1 Acoustic Analysis

RAW TOTAL ACOUSTIC CALLS

From April 6 through December 1, 2017, 757 bat passes were recorded by the CR1-A and CR1-B units (Tables 4 through 6). The CR1-A and CR1-B units recorded for 237 and 227 nights, respectively.

Table 4. Bat Passes Recorded at Unit CR1-A within the Proposed Crowned Ridge I Study Area, April 6 through December 1, 2017

Month	Hoary Bat	Low Frequency Group	Red Bat	*Myotis* Species	Total
April	1	17	0	0	18
May	3	22	1	0	26
June	12	12	1	0	25
July	50	65	22	0	137
August	13	43	15	0	71
September	0	22	5	0	27
October	0	3	0	0	3
November	1	0	0	0	1
Total	**80**	**184**	**44**	**0**	**308**

Table 5. Bat Passes Recorded at Unit CR1-B within the Proposed Crowned Ridge I Study Area, April 6 through November 29, 2017

Month	Hoary Bat	Low Frequency Group	Red Bat	*Myotis* Species	Total
April	0	16	0	0	16
May	0	6	0	0	6
June	16	9	1	0	26
July	60	60	22	0	142

Month	Hoary Bat	Low Frequency Group	Red Bat	*Myotis* Species	Total
August	67	79	29	0	175
September	29	49	6	0	84
October	0	0	0	0	0
November	0	0	0	0	0
Total	**172**	**219**	**58**	**0**	**449**

Table 6. Total Number of Bat Passes Recorded at Units CR1-A and CR1-B Combined within the Proposed Crowned Ridge I Study Area, April 6 through December 1, 2017

Month	Hoary Bat	Low Frequency Group	Red Bat	*Myotis* Species	Total
April	1	33	0	0	34
May	3	28	1	0	32
June	28	21	2	0	51
July	110	125	44	0	279
August	80	122	44	0	246
September	29	71	11	0	111
October	0	3	0	0	3
November	1	0	0	0	1
Total	**252**	**403**	**102**	**0**	**757**

BAT ACTIVITY

The CR1-A and CR1-B units recorded for 237 and 227 nights, respectively, during the survey period, resulting in activity levels of 1.29 passes per detector-night for CR1-A, and 1.97 bat passes per detector-night for CR1-B. The mean activity level for the study area during the survey period was 1.63. However, bat activity varied by season (Table 7).

Table 7. Relative Bat Activity Recorded at Units CR1-A and CR1-B Combined within the Proposed Crowned Ridge I Study Area, April 6 through December 1, 2017

Season	Hoary Bat	Low Frequency Group	Red Bat	*Myotis* Species	Total Bat Activity by Season
Spring (April 6–May 15)	0.03	0.67	0.01	0.00	0.71
Summer (May 16–July 15)	0.41	0.40	0.04	0.00	0.85
Fall (July 16–September 30)	1.32	1.97	0.63	0.00	3.92
Winter (October 1–December 1)	0.01	0.03	0.00	0.00	0.04
Total Bat Activity by Species or Group	**0.54**	**0.87**	**0.22**	**0.00**	**1.63**

Overall, bat activity was low within the study area. Given the heavily agricultural landscape and lack of roosting or foraging habitat within the Crowned Ridge I study area, this low level of activity is unsurprising and likely suggests that the area is not a heavily used migration corridor for bats. Because of the lack of tree cover, it is also likely that the study area has a very small or absent resident bat population, which is supported by the relatively low levels of bat activity in the summer. Potential resident bats might be expected to collect near the small towns in the region, where insects and consistent water sources are more readily available.

Nearly 80% of the calls recorded occurred in the fall. Although the dynamics of bat migration are not fully understood, however, one factor that could contribute to this difference is recruitment of juveniles into the fall migration population.

5 DISCUSSION

Numerous studies have been conducted across the United States to allow for better prediction of the risk of bat mortality associated with wind energy facilities. Multiple variables could affect bat species' risk at wind energy facilities, including vegetation type(s) and habitat suitability, overall landscape and geographic characteristics, bat population densities, migration paths, or a species' use of an area. Specific objectives of these bat studies were to gain an understanding of occurrence and use of the study area by bats and a relative activity index in support of monitoring recommendations provided in the WEGs.

Seasonal differences in the data collected suggest that the study area experiences limited bat migration in spring; however, if 2017 data are indicative of an overall pattern, spring bat populations are sparse when compared with other regions of the United States. The highest levels of activity observed correlated with fall migration, though even these spikes of activity were low when compared with other fall migration events. Overall, the level of bat activity may suggest that bat use of the study area is relatively low. For comparison, Jain (2005) documented a mean activity level in 2003 and 2004 of 34.88 and 36.57 per detector-night, respectively, in Iowa. Because of the lack of suitable roosting and foraging habitat in the study area, the number of bats is likely much lower than what might be observed in other, more ecologically diverse, parts of the country.

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