DRAFT REPORT

Wildlife Baseline Studies for the Wilton Expansion Wind Resource Area Burleigh County, North Dakota

Final Report
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EXECUTIVE SUMMARY

NextEra Energy Resources is constructing a wind-energy facility in Burleigh County, North Dakota, south and east of the city of Wilton. NextEra Energy Resources contracted Western Ecosystems Technology, Inc. to conduct surveys and monitor wildlife resources in the Wilton Expansion Wind Resource Area to estimate the impacts of project construction and operations on wildlife. The following document contains results for fixed-point bird use surveys, raptor nest surveys, and incidental wildlife observations. The principal objective of the study was to provide site specific bird resource and use data that would be useful in evaluating potential impacts from the wind-energy facility.

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the Wilton Expansion Wind Resource Area by birds, particularly raptors. Fixed-point surveys were conducted from September 17 through November 4, 2008, and March 18 through June 25, 2009 at 18 points established throughout the Wilton Expansion Wind Resource Area. A total of 414 twenty-minute fixed-point surveys were completed and 76 bird species were identified.

Waterfowl use was highest during the spring (3.33 birds/plot/20-min survey), primarily due to high use by Canada geese. Raptor use was highest during the summer (0.46 birds/plot/20-min survey) and lowest during the fall (0.20). The most common raptors observed in the Wilton Expansion Wind Resource Area were red-tailed hawk and northern harrier. Passerines had use ranging from 2.15 birds/plot/20-minute survey in summer to 0.66 in fall; although the focus was within a100-meter viewshed and is not directly comparable to the other bird types.

Levels of bird use varied within the Wilton Expansion Wind Resource Area by point. For all large bird species combined, use was highest at Point 15, with 25.5 birds/20-minute survey. The mean use at Point 15 was due mostly to high use by waterbirds and waterfowl at this point (7.74 and 16.1 birds/20-minute survey, respectively). Use at the other points ranged from 1.13 to 18.2 birds/20-minute survey for large bird species. Raptor use was highest at Point 2, comprised primarily of buteo use. Passerine use, within 100 meters, was relatively uniform with the highest use at Point nine (3.04 birds/20-minute surveys), and ranging from 0.74 to 2.65 at the other points.

The proposed wind-energy facility contains a diversity of habitats. Approximately 55% of the study area contains cropland habitats, while approximate 41% is grassland. While the various habitat types are found throughout the study area, there is somewhat more grasslands along the east and southeast boundary of the project area. No obvious flyways or concentration areas were observed. No strong association with topographic features within the study area was noted for raptors or other large birds. Although some differences in bird use were detected among survey points, the differences are not large enough to suggest that any portions of the Wilton Expansion Wind Resource Area should be avoided when siting turbines.

During the study, 237 single or groups of large birds totaling 1,774 individuals were observed flying during fixed-point bird use surveys. For all large bird species combined, 18.3% of birds were observed flying below the likely zone of risk, 48.9% were within the zone of risk, and

32.8% were observed flying above the zone of risk for typical turbines that could be used in the Wilton Expansion Wind Resource Area. Bird types most often observed flying within the turbine zone of risk were waterfowl (82.9%), large corvids (53.5%), and raptors (43.4%). A total of 297 passerines and other small birds in 134 groups were recorded flying within 100 meters of the survey plots in the proposed Wilton Expansion Wind Resource Area, with 99.0% below the zone of risk, 1.0% within the zone of risk, and none observed above the zone of risk.

Based on the use (measure of abundance) of the Wilton Expansion Wind Resource Area by each species and the flight characteristics observed for that species, the sandhill crane had the highest probability of turbine exposure, with an exposure index of 0.93. The raptor species with the highest exposure index was the red-tailed hawk, which was ranked fourth of all large bird species; although its exposure index was only 0.06. For passerines and other small birds, the bird with the highest exposure index within 100 meters was western meadowlark, with an exposure index of 0.01.

Based on fixed-point bird use data collected for the Wilton Expansion Wind Resource Area, mean annual raptor use was 0.28 raptors/plot/20-minute survey. The annual rate was low relative to raptor use at other wind-energy facilities that implemented similar protocols to the present study and had data for three or four different seasons.

A regression analysis of raptor use and raptor collision mortality for 13 new-generation wind-energy facilities where similar methods were used to obtain raptor use estimates showed a significant (R^2 = 69.9%) correlation between raptor use and raptor collision mortality. Using this regression to predict raptor collision mortality the Wilton Expansion Wind Resource Area yields an estimated fatality rate of 0.01 fatalities/megawatt/year, or one raptor fatality per year for each 100-megawatt of wind-energy development. Based on species composition of raptors observed at the Wilton Expansion Wind Resource Area during the surveys, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawks. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with the lowest risk in the fall and spring, and highest risk during the summer.

The data collected during this study suggests that the Wilton Expansion Wind Resource Area may occasionally receive substantial use by waterfowl, but does not appear to be within a major migratory pathway for raptors. In addition, the study area does not appear to provide important stopover habitat for migrant songbirds based on fixed-point bird use surveys. Construction and operation of the wind-energy facility may displace some types of birds. Siting turbines within altered habitats (crop fields) to the extent possible will reduce potential impacts of bird displacement.

The objective of the raptor nest mapping was to record raptor nests that may be subject to disturbance and/or displacement by wind-energy facility construction and/or operation. Ground based surveys were conducted in conjunction with bird use surveys in March and April. The surveys were conducted prior to leaf-out to improve the chances of finding nests. A total of 16 raptor nests (five active) were recorded in or within 0.25 mi of the Wilton Expansion Wind Resource Area. One active nest was in the construction path and had a ¼ mi "no disturbance" buffer placed around it until it was no longer active.

The objective of incidental wildlife observations was to provide record of wildlife seen outside of the standardized surveys. The most abundant large bird species recorded incidentally was sandhill crane.

Some species considered to be sensitive or of conservation concern by the state of North Dakota were observed within the Wilton Expansion Wind Resource Area. During all surveys and incidental observations, 17 sensitive species were observed. This is a tally that in some cases represents repeated observations of the same individual. These species have greater potential to occur in non-cropland areas, such as grasslands. Some potential exists for wind turbines to displace these species within non-cropland habitats. Research concerning displacement impacts of wind-energy facilities are limited, but some show the potential for small scale displacement of 591 feet (180 meters) or less, while impacts to densities of birds at larger scales has not been shown. Two bird species of primary interest to wind energy development in the central and north-central United States are whooping cranes and sharp-tailed grouse. No whooping cranes or sharp-tailed grouse leks (individual grouse were observed) were recorded at the Wilton Expansion Wind Resource Area. However, the location, presence of suitable habitat, and presence of similar species at the Wilton Expansion Wind Resource Area indicates that both whooping cranes and sharp-tailed grouse leks could be found within the project area at some point.

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INTRODUCTION

NextEra Energy Resources (NextEra) has proposed a wind-energy facility in Burleigh County, North Dakota, south and east of the city of Wilton (Figures 1 and 2). NextEra contracted Western Ecosystems Technology, Inc. (WEST) to conduct surveys and monitor wildlife resources in the Wilton Expansion Wind Resource Area (WEWRA) to estimate the impacts of wind-energy facility operations on wildlife.

The principal objectives of the study was to provide site specific bird resource and use data that would be useful in evaluating potential impacts from the proposed wind-energy facility. The methods for the baseline studies are similar to those used at other wind-energy facilities across the nation, and follow the guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999). The protocols have been developed based on WEST's experience studying wildlife at proposed wind-energy facilities throughout the US; and were designed to help predict potential impacts to bird species (particularly raptors).

Baseline surveys, conducted September 17, 2008 through November 4, 2008 and again from March 18, 2009 through June 25, 2009 at the WEWRA, included fixed-point bird use surveys, ground based raptor nest surveys, and incidental wildlife observations. In addition to site-specific data, this report presents existing information and results of studies conducted at other wind-energy facilities. The ability to estimate potential bird mortality at the proposed WEWRA is greatly enhanced by operational monitoring data collected at existing wind-energy facilities. For several wind-energy facilities, standardized data on fixed-point surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The WEWRA is located in Burleigh County, in central North Dakota and lies to the south and east of the city of Wilton (Figure 1). The WEWRA encompasses an existing 32 turbine, wind generating facility. The WEWRA has a flat to rolling topography, and consists mainly of cultivated agriculture and planted grasslands. Elevation within the WEWRA ranges from approximately 1,949 feet (ft; 594 meters [m]) to 2,254 ft (687 m) above mean sea level, with the higher elevations generally running in an east-west and northwest-southeast direction (Figure 2)..

Approximately 55% of the 47,739 acre (72.9 square mile [mi^2]; 188.8 square kilometers [km^2]) area is composed of cropland (Table 1). Small grains appear to be the most common crop. Other crops include corn, sunflowers, soy beans, and other edible beans. Grasslands, both planted and native, comprise another approximate 41% of the area. Wetlands/water cover another approximate 2% of the WEWRA and the remaining approximate 2% is comprised of other habitat types (Table 1). The various habitat types are dispersed throughout the WEWRA with grasslands being somewhat more dominate along the eastern and southeastern boundary (Figure 3).

METHODS

Surveys at the WEWRA consisted of the following components: 1) fixed-point bird use surveys; 2) ground raptor nest surveys; and 3) incidental wildlife observations.

Fixed-Point Bird Use Surveys

The objective of the fixed-point bird use surveys was to estimate the seasonal, spatial, and temporal use of the WEWRA by birds, particularly raptors (defined as kites, accipiters, buteos, harriers, eagles, falcons, and owls). Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980).

Bird Use Survey Plots

Eighteen points were selected to include representative habitats and topography within the WEWRA, while achieving relatively even coverage of the study area (Figure 4). Each survey plot was an 800-m (2,625-ft) radius circle centered on the point.

Bird Survey Methods

All species of birds observed during 20-minute (min) fixed-point surveys were recorded. Observations of large birds beyond the 800-m radius were recorded, but were not included in the statistical analyses; for small birds, observations beyond a 100-m radius were excluded.

The date, start, and end time of the survey period, and weather information such as temperature, wind speed, wind direction, precipitation, visibility, and cloud cover were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, flight direction when first observed, activity (behavior), and habitat(s) were recorded for each observation. A unique observation number was assigned to each observation. The behavior and vegetation type in which, or over which the bird occurred, were recorded based on the point of first observation. Approximate flight height and distance from the plot center at first observation were recorded. Other information recorded about the observation included whether or not the observation was auditory only and the 10-min interval of the 20-min survey in which it was first observed. Any comments were recorded in the comments section of the data sheet. Locations and flight path, if appropriate, of raptors, other large birds, and species of concern seen during fixed-point bird use surveys were recorded on field maps by observation number. Any unusual animal observations were recorded on the incidental datasheets.

Observation Schedule

Sampling intensity was designed to document bird use and behavior by habitat and season within the WEWRA. Fixed-point bird use surveys were conducted from September 17 through November 4, 2008, and March 18 through June 25, 2009. Surveys were conducted approximately once a week during fall (September 17 to November 4), spring (March 18 to May 27), and summer (June 3 to June 25). Surveys were carried out during daylight hours and survey periods varied to approximately cover all daylight hours during a season.

Raptor Nest Surveys

The objective of the raptor nest surveys was to locate and record raptor nests that may be subject to disturbance and/or displacement effects by wind-energy facility construction and/or operation. Surveys were focused on large, stick nest structures, and did not include searches for cavity nests or nests on the ground. Surveys were completed by driving and walking along public roads and accessible private roads during leaf-off conditions and looking for raptor nest structures within areas of suitable habitat (trees, rock outcrops, etc). Potential raptor nests were recorded on aerial photo maps and digitized with GIS software. Other information recorded included nest status, nest height, and nest material.

Incidental Wildlife Observations

The objective of incidental wildlife observations was to provide a record of wildlife seen within the WEWRA outside of the standardized surveys. All raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and general location was recorded.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A sample of records from an electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

Fixed-Point Bird Use Surveys

<u>Bird Diversity and Species Richness</u>

Bird diversity was illustrated by the total number of unique species observed. Species lists, with the number of observations and the number of groups, were generated by season, including all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per plot per survey (i.e., number of species/plot/20-min survey). When appropriate, species diversity and richness were compared between seasons for fixed-point bird use surveys.

Bird Use, Composition, and Frequency of Occurrence

When calculating standardized fixed-point bird use estimates, only observations of large birds detected within the 800-m radius plot were included, and small bird observations were limited to a 100-m radius. Estimates of mean bird use (i.e., number of birds/plot/20-min survey) were used to compare differences between bird types, seasons, and other wind-energy facilities.

Percent composition was calculated as the proportion of the overall mean use for a particular species or bird type. The frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence and percent composition provide relative estimates of species exposure to the proposed wind-energy facility. For example, a particular species might have high use estimates for the study area based on just a few observations of large flocks; however, the frequency of occurrence would indicate that it only occurred during a few of the surveys, therefore making it less likely to be affected by the wind-energy facility or the transmission corridor.

Bird Flight Height and Behavior

To calculate potential risk to a bird species, the flight height at which the bird was first recorded and used to estimate the percentage of birds flying within the likely zone of risk (ZOR) for collision with turbine blades. A height of 35 m to 130 m (114 – 427 ft) AGL was used for the ZOR.

Bird Exposure Index

A relative index of collision exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

Where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys, P_f equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely ZOR.

The exposure index is one means to consider the relative use and flight height between different bird species within the WEWRA. It does not consider all factors related to exposure (e.g., avoidance behaviors, bird size, courtship, etc). Birds with high use rates and many birds in the ZOR would have the highest exposure index. The indices cannot be compared to other projects, but can be compared to different species of birds within this project.

RESULTS

Surveys were completed at the WEWRA from September 17, 2008 through June 25, 2009. Eighty-two bird species and five mammal species were recorded within the WEWRA. Results of the fixed-point bird use surveys are presented below, as well as incidental wildlife observations.

Fixed-Point Bird Use Surveys

Bird Diversity and Species Richness

A total of 414 twenty-minute fixed-point surveys were conducted at the WEWRA between September 17, 2008 and June 25, 2009 over the course of 23 visits (Table 2). Due to heavy snow fall and early spring snow storms, only 10 of the 18 survey points were accessible from 3/17/09 through 4/14/09. Sixteen of the 18 points were accessible on 4/22/09 and 17 of 18 on 04/28/09. All survey points were visited after that. Seventy-six unique species were recorded over the course of fixed-point bird use surveys, with an average of 1.21 large species/plot/20-min survey and 0.75 small species/100-m plot/20-min survey observed. More unique species were observed during the spring (62 species), followed by summer (45), and fall (25). The mean number of species per survey for large and small birds was higher in the summer (2.51 and 1.82 species/survey, respectively) and spring (1.39 and 0.93) compared to the fall (0.51 and 0.14). A total of 3,082 individual birds in 934 separate groups were recorded (Table 3). Cumulatively, regardless of bird size, three species (3.9% of all species) composed approximately 49% of the observations: sandhill crane (*Grus canadensis*), Canada goose (*Branta canadensis*), and red-winged blackbird (*Agelaius phoeniceus*). All other species comprised less than 10% of the observations. The most abundant large bird species were sandhill crane (999 individuals in 20 groups) and Canada goose (352 individuals in 14 groups). A total of 118 individual raptors were recorded within the WEWRA, representing eight species.

Bird Use, Composition, and Frequency of Occurrence by Season

Mean bird use, percent composition, and frequency of occurrence by season are presented in Tables 4a and 4b. The highest overall large bird use occurred in the spring (8.99 birds/plot/20-min survey), followed by summer (4.94), and fall (2.35). For small birds, use was highest in the summer (2.17 birds/plot/20-min survey), followed by the spring (1.79), and fall (0.67).

<u>Waterbirds</u>

Waterbirds had the highest use in spring (4.53 birds/plot/20-min survey), compared to other times of the year (fall 1.27, and summer 0.29; Table 4a). Higher use by waterbirds in spring was largely due to high use by sandhill crane (4.13). Waterbirds comprised more than half of overall bird use in fall and spring, but only 5.9% in summer.

<u>Waterfowl</u>

Waterfowl had the highest use in spring (3.33 birds/plot/20-min survey), compared to other times of the year (summer 2.49 and fall 0). High waterfowl use in spring was due to several large groups of Canada geese that made up 19.0% of the overall large bird use. Waterfowl comprised just over half (50.3%) of large bird use in summer and 37% in the spring. Waterfowl were observed more frequently in summer (27.8%) than in the spring (20.2%).

<u>Shorebirds</u>

Shorebirds had relatively consistent use through the three seasons (0.24 birds/plot/20-min survey in fall, 0.22 in summer, and 0.28 in winter). Shorebirds comprised less than six percent of large bird use for any single season. Shorebirds were observed during 22.2% of the surveys in the summer compared to 12.6% in spring and only 3.5% during fall.

Rails and Coots

American coot (*Fulica americana*) had a use of 0.18 birds/plot/20-min survey in summer, 0.01 in spring, and had no use of the WEWRA in the fall. Rails and coots comprised less than four percent of large bird use in any season. American coot was observed much more frequently in summer (8.3% of surveys) than in spring (one percent).

Raptors

Raptor use was highest in the summer (0.46 birds/plot/20-min survey), followed by spring (0.28), and fall (0.20). Higher use in the summer was primarily due to high use of the area by red-tailed hawks (*Buteo jamaicensis*; 0.26 birds/plot/20-min survey) and northern harrier (*Circus cyaneus*; 0.13). Red-tailed hawks had the highest use of any raptor species during all seasons (0.14 in spring and 0.11 in fall). Raptors comprised less than 10% of the overall bird use in during any season. Raptors were observed during 31.9% of surveys in the summer compared to 22.7% of the surveys in the spring and 18.1% in the fall.

Upland Gamebirds

Upland gamebirds had the highest use in the summer (0.72 birds/plot/20-min survey) and relatively constant use in fall and spring (0.33 and 0.32 birds/plot/20-min survey, respectively). High use in the summer was primarily due to increase use of the WEWRA by ring-necked pheasants (*Phasianus colchicus*; 0.69 birds/plot/20-min survey). Upland gamebirds comprised approximately 14% of large bird use during summer and fall, and only 3.6% in spring. Upland gamebirds were observed during 54.2% of surveys in the summer compared to 22.7% in spring and 14.6% in fall.

Large Corvids

American crow (*Corvus brachyrynchos*) had relatively low use during fixed-point surveys (0.14 birds/plot/20-min survey in fall, 0.21 in spring, and 0.10 in summer). Use by large corvids comprised less than six percent in any given season. Large corvids were seldom observed, with frequencies ranging from 6.9% to 9.1%.

Passerines

Passerine use was highest in summer (2.15 birds/plot/20-min survey), compared to spring (1.78), and fall (0.66). Red-winged blackbird had the highest use by any one species in fall (0.42 birds/plot/20-min survey) and had the same use as western meadowlark (*Sturnella neglecta)* use in summer (0.36). Horned lark (*Eremophila alpestris*) had the highest use in spring (0.42). Passerines were observed during 91.7% of the summer surveys compared to 56.6% in spring and only 12.5% of fall surveys.

Bird Flight Height and Behavior

Flight height characteristics were determined for both bird types and species (Tables 5 and 6). During fixed-point bird use surveys, 1,774 large birds in 237 groups were observed flying within the 800-m radius plot. Just under half (48.9%) were flying within the zone of risk (ZOR) for collision with turbine blades (35 to 135 m [114 – 427 ft] AGL). Approximately 18% were flying below the ZOR, and 33% were flying above the ZOR. A total of 76 raptors (64.4% of observations) were observed flying, of which 43.4% were within the ZOR. The majority of flying buteos and other raptors were observed within the ZOR, while most accipiters, northern harriers, falcons, and owls were observed below the ZOR. No raptors were observed flying above the ZOR. Only one vulture was observed flying, and it was recorded below the ZOR. Over 1,030 waterbirds recorded (97.0% of waterbird observations) were flying, of which 39.6% were within the ZOR. Only 13.1% of waterfowl were recorded in flight, but nearly 83% of flying waterfowl were within the ZOR. Large corvids had the second highest percentage of flying birds within the ZOR (53.5%). Shorebirds, rails and coots, doves and pigeons, and upland gamebirds, were typically observed flying below the ZOR. The majority of passerines were observed below the estimate ZOR (99%), while one percent was recorded within the ZOR. Of 296 individuals observed, 49.1% of passerines were observed flying with a mean flight height of 5.4 ft.

Of all large bird species, two had at least 30 groups observed flying, and only red-tailed hawk was observed flying within the likely ZOR during at least 50% of the observations (75.8%; Table 6a). Three species were always seen flying within the likely ZOR; however, these were only based on one observation. Of all passerine and small bird species, two had at least 20 groups observed flying; neither was observed within the ZOR during the majority of observations.

Bird Exposure Index

A relative exposure index was calculated for each bird species (Tables 6a and 6b). This index is only based on initial flight height observations and relative abundance (defined as the use estimate) and does not account for other possible collision risk factors such as foraging, courtship behavior, or avoidance behaviors. Sandhill crane had an exposure index higher than any other species with 0.93. Canada goose also had a relatively high exposure index (0.65). The only raptor species with a relatively high exposure index was red-tailed hawk (0.06); all other raptor species had an exposure index of 0.01 or less.

Based on observations within 100 m, the small bird species with the highest exposure index was western meadowlark, with an index of 0.01 (Table 6b). All other small bird species had exposure indices of zero.

Spatial Use

Use by large birds was highest at Point 15 (25.5 birds/20-min survey; Figure 5). Large bird use at other points ranged from 1.13 to 18.2 birds/20-min survey. The high mean use estimate for Point 15 was largely due to high waterfowl and waterbird use at this point (16.1 and 7.74 birds/20-min survey, respectively). Waterbird use was highest at Points 14 and 16 with 10.8 and 10.9 birds/20-min survey, respectively, and other points had waterbird use ranging from zero to 7.74 birds/20-min survey. Waterfowl use was highest at Points eight and 15, with 15.7 and 16.1 birds/20-min survey, respectively. Waterfowl use at other points was low, ranging from zero to 0.91 birds/20-min survey at other points. Mean shorebird use was fairly uniform between points, ranging from 0.83 birds/20-min survey at Point two to zero at Points five and nine. Rails and coots were only observed at Points eight and 15 with use of 0.35 and 0.30 birds/20-min survey, respectively. Raptor use was highest at Point two (0.74 birds/20-min survey), and ranged from 0.04 to 0.65 birds/20-min survey at other points. Vultures were only seen at Point 17 (0.04 birds/20-min survey). Upland gamebird use was highest at Points nine and 14 (0.83 and 0.91 birds/20-min survey, respectively), and ranged from 0.04 to 0.61 bird/20-min survey at other points. Large corvids had relatively low use that ranged from zero to 0.52 birds/20-min survey. Passerine use, focused within 100 m, was highest at Point nine (3.04 birds/ 20-min survey), and ranged from 0.74 to 2.65 at other points.

No obvious flyways or concentration areas were observed for any species. The available data do not indicate that any portions of the study area warrant being excluded from development due to very high bird use.

Sensitive Species Observations

A total of 15 sensitive species were recorded during fixed-point surveys (Table 7). Eight of these species are considered level one species (S1), or species of greatest conservation need, by the North Dakota Game and Fish Department (NDGFD) including 39 Franklin's gulls (*Larus pipixcan*), nine grasshopper sparrows (*Ammodramus savannarum*), six upland sandpipers (*Bartramia longicauda*), six Swainson's hawks (*Buteo swainsoni*), five marbled godwits (*Limosa fedoa*), two Wilson's phalaropes (*Phalaropus tricolor*), one black tern (*Chlidonias niger*), and one horned grebe (*Podiceps auritus*). Seven species considered level two (S2) species by the NDGFD, or species in need of conservation but supported by other wildlife programs, were observed: 59 canvasbacks (*Aythya valisinaria*), 33 northern harriers, 31 redheads (*Aythya americana*), 28 northern pintails (*Anas acuta*), 24 bobolink (*Dolichonyx oryzivorus*), 12 sharp-tailed grouse (*Tympanuchus phasianellus*), and one loggerhead shrike (*Lanius ludovicianus*).

Raptor Nest Surveys

Five active nests (three red-tailed hawk and two unidentified hawk) and 11 inactive raptor nests were located in or within 0.25 mile (400 m) of the WEWRA. One active and one inactive nest were within the 0.25-mile buffer of the project boundary. The remaining 12 nests fell within the project boundary (Figure 6).

Incidental Wildlife Observations

Twenty-one bird species were observed incidentally within the WEWRA, totaling 1,289 birds within 99 separate groups (Table 8). Five mammal species were also observed incidentally within the WEWRA.

Bird Observations

The most abundant bird species recorded as an incidental wildlife observation was sandhill crane (620 individuals). Six species, great-horned owl (*Bubo virginianus*), tundra swan (*Cygnus columbianus*), bald eagle (*Haliaeetus leucocephalus*), barn own (*Tyto alba*), ferruginous hawk (*Buteo regalis*), and rough-legged hawk (*Buteo lagopus*) were only seen incidentally at the WEWRA.

Mammal Observations

The most abundant mammal species recorded was white-tailed deer (*Odocoileus virginianus*) with 164 -individuals observed within 15 groups. Six coyote (*Canis latrans*), two white-tailed jack rabbits (*Lepus townsendii*), one fox squirrel (*Sciurus niger*), and one thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*) were also observed incidentally within the WEWRA.

Sensitive Species Observations
A total of five sensitive species were recorded incidentally within the WEWRA (Table 7). One ferruginous hawk, a North Dakota level one species, was observed outside of standardized surveys. Four North Dakota level two species were observed incidentally, including 10 northern harrier, eight sharp-tailed grouse, two bald eagles, and one loggerhead shrike.

DISCUSSION

Bird Impacts

Direct Effects
The most probable direct impact to birds from wind-energy facilities is direct mortality or injury due to collisions with turbines or guy wires of meteorological (met) towers. Collisions may occur with resident birds foraging and flying within the WEWRA or with migrant birds seasonally moving through the study area. Project construction could affect birds through loss of habitat, or potential fatalities from construction equipment. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance, and equipment. Potential mortality from construction equipment is expected to be very low, as equipment used in wind-energy facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality to birds from construction is most likely potential destruction of a nest for ground- and tree/shrub-nesting species during initial site clearing. One red-tailed hawk nest was provided a 0.25-mile “no construction” buffer during initial clearing activities until the nest became inactive.

Substantial data on bird mortality at wind-energy facilities are available from studies in California and throughout the west and Midwest. Of 841 bird fatalities reported from California studies (more than 70% from the Altamont Pass facility in California), about 39% were diurnal raptors, about 19% were passerines (excluding house sparrows [*Passer domesticus*] and European starlings [*Sturnus vulgaris*]), and about 12% were owls. Non-protected birds including house sparrows, European starlings, and rock doves (*Columba livia*) comprised about 15% of the fatalities. Other bird types generally made up less than 10% of the fatalities (Erickson et al. 2002b). During 12 fatality monitoring studies conducted outside of California, diurnal raptor fatalities comprised about 2% of the wind-energy facility-related fatalities and raptor mortality averaged 0.03/turbine/year. Passerines (excluding house sparrows and European starlings) were the most common collision victims, comprising about 82% of the 225 fatalities documented. For all bird species combined, estimates of the number of bird fatalities per turbine per year from individual studies ranged from zero at the Searsburg wind-energy facility in Vermont (Kerlinger 1997) and the Algona facility in Iowa (Demastes and Trainer 2000), to 7.7 at the Buffalo Mountain facility in Tennessee (Nicholson 2003). Using mortality data from a 10-year period from wind-energy facilities throughout the entire United States, the average number of bird collision fatalities is 3.1 per megawatt (MW) per year, or 2.3 per turbine per year (NWCC 2004). Based bird use rates along with species composition at the WEWRA, it is expected that direct fatalities would be low and similar to other rates in the Midwest.

Raptor Use and Exposure Risk

The annual mean raptor use at the WEWRA (0.28 raptors/plot/20-min survey) was compared with other wind-energy facilities that implemented similar protocols and had data for three or four seasons. Similar studies were conducted at 36 other wind-energy facilities. The annual mean raptor use at these wind-energy facilities ranged from 0.09 to 2.34 raptors/plot/20-min survey (Figure 7). Based on the results from these wind-energy facilities, a ranking of seasonal raptor mean use was developed as: low (0 – 0.5 raptors/plot/20-min survey); low to moderate (0.5 – 1.0); moderate (1.0 – 2.0); high (2.0 – 3.0); and very high (> 3.0). Under this ranking, mean raptor use (number of raptors divided by the number of 800-m plots and the total number of surveys) at the WEWRA is considered to be low. Compared to 36 other wind-energy facilities, the WEWRA ranked twenty-ninth (Figure 7).

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g. Altamont Pass), a review of studies at wind-energy facilities across the United States reported that only 3.2% of casualties were raptors (Erickson et al. 2001a). Indeed, although raptors occur in most areas with the potential for wind-energy development, individual species appear to differ from one another in their susceptibility to collision (NRC 2007). Results from Altamont Pass in California suggest that mortality for some species is not necessarily related to abundance (Orloff and Flannery 1992). American kestrels (*Falco sparverius*), red-tailed hawks, and golden eagles (*Aquila chrysaetos*) were killed more often than predicted based on abundance. Thus far, only three northern harrier fatalities at existing wind-energy facilities have been reported in publicly available documents, despite the fact they are commonly observed during point counts at these facilities (Erickson et al. 2001a; Whitfield and Madders 2006). Because northern harriers often forage close to the ground, risk of collision with turbine blades is considered low for this species. Relative use by American kestrels at the High Winds facility is almost six times the use of American kestrels at the Altamont Pass facility (Kerlinger 2005). It is likely that many factors, in addition to abundance, are important in predicting raptor mortality.

Exposure indices analysis may also provide insight into which species might be the most likely turbine casualties; however, the index only considers relative probability of exposure based on abundance, proportion of observations flying, and proportion of flight height of each species within the ZOR for turbines likely to be used at the wind-energy facility. This analysis is based on observations of birds during the surveys and does not take into consideration behavior (e.g. foraging, courtship, avoidance), habitat selection, the varying ability among species to detect and avoid turbines, and other factors that may vary among species and influence likelihood for turbine collision. For these reasons, the index is only a relative index among species observed during the surveys and within the WEWRA. Actual risk for some species may be lower or higher than indicated by these data. At the WEWRA, the raptor species with the highest exposure indices was red-tailed hawk which was influenced by the relatively high use estimates by this species. All other raptor species had exposure indices of 0.01 or less due primarily to the lower use estimates or low proportion of flight heights observed in the ZOR.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality (R^2 = 69.9%; Figure 8). Using this regression to predict raptor collision mortality at the WEWRA, based on an adjusted mean raptor use of 0.28

raptors/20-min survey, yields an estimated fatality rate of 0.01 fatalities/MW/year, or one raptor fatality per year for each 100-MW of wind-energy development. A 90% prediction interval around this estimate is zero to 0.25 fatalities/MW/year.

Based on the relative abundance of red-tailed hawks throughout the year and a higher exposure index than other raptor species, there is higher potential for red-tailed hawk fatalities compared to other species.

<u>Non-Raptor Use and Exposure Risk</u>

Most bird species in the US are protected by the Migratory Bird Treaty Act (MBTA 1918). Passerines (primarily perching birds) have been the most abundant bird fatality at wind-energy facilities outside California (Erickson et al. 2001a, 2002b), often comprising more than 80% of the bird fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines made up a large proportion of the birds observed during the baseline study, passerines would be expected to make up a large proportion of fatalities at the WEWRA. Exposure indices based on observations within 100 m indicate that western meadowlark is the most likely passerine to be exposed to collision from wind turbines at the WEWRA. Other passerine species are not at high risk based on abundance and flight behavior (Table 6b), but again, this analysis does not take into consideration other behavioral characteristics that could increase or decrease an individual's chance of being impacted. Most non-raptors had relatively low exposure indices due to the majority of individuals flying below the likely zone of risk. Due to the high number of common individuals (e.g., western meadowlarks) that are most likely at risk and the overall low exposure risks at WEWRA, it is unlikely that non-raptor populations will be adversely affected by direct mortality from the operation of the wind-energy facility.

Wind-energy facilities with year-round use by water dependent species have shown higher mortalities of individuals within these groups, but the levels of waterfowl/waterbird/shorebird mortality appear insignificant compared to the use of the facilities by these groups. Of 1,033 bird carcasses collected at US wind-energy facilities, waterbirds comprised about 2%, waterfowl comprised about 3%, and shorebirds comprised less than 1% (Erickson et al. 2002b). At the Klondike, Oregon wind-energy facility, only two Canada goose fatalities were documented (Johnson et al. 2003) even though 43 groups totaling 4,845 individual Canada geese were observed during pre-construction surveys (Johnson et al. 2002). The recently constructed Top of Iowa wind-energy facility is located in cropland between three Wildlife Management Areas (WMAs) with historically high bird use, including migrant and resident waterfowl. During a recent study, approximately one million goose-use days and 120,000 duck-use days were recorded in the WMAs during the fall and early winter, and no waterfowl fatalities were documented during concurrent and standardized wind-energy facility fatality studies (Jain 2005). Similar findings were observed at the Buffalo Ridge wind-energy facility in southwestern Minnesota, which is located in an area with relatively high waterfowl/waterbird use and some shorebird use. Snow geese (*Chen caerulescens*), Canada geese, and mallards (*Anas platyrhynchos*) were the most common waterfowl observed. Three of the 55 fatalities observed during the fatality monitoring studies were waterfowl, including two mallards and one blue-winged teal (*Anas discors*). Two American coots, one grebe, and one shorebird fatality were also found (Johnson et al. 2002). Based on available evidence, waterfowl do not seem especially vulnerable to turbine collisions, but given their overall numbers in the WEWRA some minimal level of mortality would be expected.

A study conducted in England to assess displacement of wintering farmland birds by wind turbines located in an agricultural landscape found that only ring-necked (common) pheasants (*Phasianus colchicus*) apparently avoided turbines to a small degree. The other species/bird groups examined, including granivores, red-legged partridge (*Alectoris rufa*), Eurasian skylark (*Alauda arvensis*) and corvids, showed no displacement from wind turbines. In fact, Eurasian skylarks and corvids showed increased use of areas close to turbines, possibly due to increased food resources associated with disturbed areas (Devereux et al. 2008). It is possible that the WEWRA may have some minimal displacement of pheasant and sharp-tailed grouse use near turbines. Sharp-tailed grouse leks were not surveyed for nor observed incidentally in the project area and it is unknown if the WEWRA would impact any leks.

<u>Sensitive Species Use and Exposure Risk</u>

No federal- or state-listed threatened, endangered, proposed, or candidate species, potentially occurring in Burleigh County, North Dakota, was observed at the WEWRA during fixed-point bird use surveys or incidentally (Table7). However, there were 17 state sensitive species recorded during biological work at the WEWRA (Table 7). Sensitive raptor and waterfowl species probably are at a greater risk than the other sensitive species observed due to their flight characteristics and relative abundance (see discussion above).

The NDGFD and the US Fish and Wildlife Service (USFWS) have expressed concern over potential impacts to whooping cranes (*Grus americana*) for wind-energy facilities constructed in their migratory corridors. Because whooping and sandhill cranes show similar habitat use and behavior during migration, the presence of sandhill cranes may indicate suitability of an area for whooping cranes. No whooping cranes were observed during the study but sandhill cranes were observed flying over the project area in the fall and flying over and feeding within the project boundary during spring. Since surveys were only conducted once a week, crane use of the area may be underestimated. Limited or no mortality of common cranes (G*rus grus*) has been documented at large wind-energy facilities located in western Europe, where common cranes are abundant (Hartwig Prange, pers. comm., 2003 North American Crane Working Group Meeting). Erickson et al. (2001a) did not identify any studies that documented cranes being killed or injured at wind-energy facilities in the US in their review of bird collisions with wind turbines. The low rate of crane collisions with turbines makes it unlikely that whooping or sandhill cranes will be directly impacted by the proposed WEWRA. However, as cranes ascend and descend during landing, or migrate during inclement weather and as thermal lift decreases, they may fly at lower altitudes, and may be at risk for collision with turbine blades.

Indirect Effects

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the wind-energy facilities and suitable habitat. Some studies from wind-energy facilities in Europe consider displacement effects to have a greater impact on birds than collision mortality (Gill et al. 1996). The greatest concern with displacement impacts for wind-energy facilities in the US has been where these facilities have been constructed in grassland or other native habitats (Leddy et al. 1999; Mabey and Paul 2007); however, Crockford

(1992) suggests that disturbance appears to impact feeding, resting, and migrating birds, rather than breeding birds. Results from studies at the Stateline wind-energy facility in Washington and Oregon (Erickson et al. 2004) and the Buffalo Ridge wind-energy facility in Minnesota (Johnson et al. 2000a) suggest that breeding birds are also affected by wind-facility operations.

Raptor Displacement

In addition to possible direct effects on raptors within the study area (discussed above), indirect effects caused by disturbance-type impacts, such as construction activity near an active nest or primary foraging area, also have a potential impact on raptor species. Although there were only five active raptor nests within or next to (0.25 mi) the WEWRA, one nest (nest eight, Figure 6) was in the construction path for this project. A 0.25-mi buffer was established around this nest. However this nest attempt was unsuccessful due to the nest being destroyed by an undetermined cause.

Birds displaced from wind-energy facilities might move to areas with fewer disturbances, but lower quality, with an overall effect of reducing breeding success. Most studies on raptor displacement at wind-energy facilities, however, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, Johnson et al. 2003; Madders and Whitfield 2006). Notable exceptions to this include a study in Scotland that described territorial golden eagles avoiding the entire wind-energy facility area, except when intercepting non-territorial birds (Walker et al. 2005). A study at the Buffalo Ridge wind-energy facility in Minnesota found evidence of northern harriers avoiding turbines on both a small scale (less than 100 m from turbines) and a larger scale in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected.

The only published report of avoidance of wind turbines by nesting raptors in the US occurred at Buffalo Ridge, Minnesota, where raptor nest density on 101 mi^2 (262 km^2) of land surrounding a wind-energy facility was 5.94 nests/39 mi^2 (5.94 nests/101 km^2), yet no nests were present in the 12-mi^2 (31 km^2) facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumes that raptor nests are uniformly distributed across the landscape, an unlikely event, and even though no nests were found, only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. At a wind-energy facility in eastern Washington, based on extensive monitoring using helicopter flights and ground observations, raptors still nested in the study area at approximately the same levels after construction, and several nests were located within 0.5 miles (0.8 km) of turbines (Erickson et al. 2004). At the Foote Creek Rim wind-energy facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 mi (0.5 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl nest, and one golden eagle nest located within one mi (1.6 km) of the wind-energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested 0.5 mi from the facility for three different years after it became operational. A Swainson's hawk also nested within 0.25 mi of a turbine string at the Klondike I wind-energy facility in Oregon after the facility was operational (Johnson et al. 2003). A red-tailed hawk nest (nest three, Figure 6) located approximately 0.5 mi from a turbine string on the WEWRA was active through the last fixed-point survey date. These observations suggest that there will be limited nesting displacement of raptors at the WEWRA, although the creation of a buffer surrounding known nests when siting turbines will further reduce any impact.

Displacement of Non-Raptor Bird Species

Studies concerning displacement of non-raptor species have concentrated on grassland passerines and waterfowl/waterbirds (Winkelman 1990; Larsen and Madsen 2000; Mabey and Paul 2007). Wind-energy facility construction appears to cause small scale local displacement of grassland passerines and is likely due to the birds avoiding turbine noise and maintenance activities. Construction also reduces habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996; Johnson et al. 2000a). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge wind-energy facility in Minnesota, and found mean densities of 10 grassland bird species were four times higher at areas located 180 m (591 ft) from turbines than they were at grasslands nearer turbines. Johnson et al. (2000a) found reduced use of habitat by seven of 22 grassland-breeding birds following construction of the Buffalo Ridge wind energy facility in Minnesota. Results from the Stateline wind-energy facility in Oregon and Washington (Erickson et al. 2004), and the Combine Hills wind-energy facility in Oregon (Young et al. 2005), suggest a relatively small impact of the wind-energy facilities on grassland nesting passerines. Transect surveys conducted prior to and after construction of the wind-energy facilities found that grassland passerine use was significantly reduced within approximately 50 m (164 ft) of turbine strings, but areas further away from turbine strings did not have reduced bird use. Shaffer and Johnson (2007) documented avoidance by grasshopper sparrows out to 150 m (492 ft) at a wind-energy facility in northern South Dakota. While research concerning displacement impacts to songbirds, waterfowl, and waterbirds is limited, the projects that have been completed have only shown small scale (150-200 m [492-656 ft]), while impacts to birds at larger scales has not been shown. As the WEWRA contains areas of native and planted grasslands it is likely that there will be some amount of grassland nesting bird use. Turbines placed in tilled landscapes will have further minimal displacement to grassland nesting birds.

Displacement effects of wind-energy facilities on waterfowl and shorebirds appear to be mixed. Studies from the Netherlands and Denmark suggest that densities of these types of species near turbines were lower compared to densities in similar habitats away from turbines (Winkelman 1990; Pedersen and Poulsen 1991). However, a study from a wind-energy facility in England, found no effect of wind turbines on populations of cormorant (*Phalacrcorax xarbo*), purple sandpipers (*Calidris maritima*), eiders (*Somateria mollissima*), or gulls, although the cormorants were temporarily displaced during construction (Lawrence et al. 2007). At the Buffalo Ridge wind-energy facility in Minnesota, the abundance of several bird types, including shorebirds and waterfowl, were found to be significantly lower at survey plots with turbines than at reference plots without turbines (Johnson et al. 2000a). The report concluded that the area of reduced use was limited primarily to those areas within 100 m of the turbines. Disturbance tends to be greatest for migrating birds while feeding and resting (Crockford 1992; NRC 2007). The majority of waterfowl/waterbirds use at the WEWRA included 20 groups of sandhill crane, 56 groups of mallards, and 14 groups of Canada geese, comprising a total of 1,498 individuals (77.3% of waterfowl/waterbird observations). The presence of similar habitat surrounding the WEWRA means that any displacement of these species is unlikely to impact the population.

Much debate has occurred recently regarding the potential impacts of wind-energy facilities on prairie grouse. Under a set of voluntary guidelines, the USFWS has taken a precautionary approach regarding potential impacts to lek locations (USFWS 2003). The USFWS argues that because prairie grouse evolved in habitats with little vertical structure, placement of tall man-made structures, such as wind turbines, in occupied prairie grouse habitat may result in a decrease in habitat suitability (USFWS 2004). The WEWRA lies within the range of the sharp-tailed grouse. There were 10 groups totaling 20 individuals observed during surveys and incidentally. While no sharp-tailed grouse leks were observed on the WEWRA, no formal lek survey was conducted. With the presences of individual sharp-tailed grouse and suitable leking habitat, there is the potential for sharp-tailed leks within the WEWRA.

CONCLUSIONS AND RECOMMENDATIONS

Based on data collected during this study, raptor and all bird use of the WEWRA is generally lower than most wind resource areas evaluated throughout the western and Midwestern US using similar methods. Based on the results of the studies to date, bird mortality at the WEWRA would likely be similar or lower than that documented at other wind-energy facilities located in the western and Midwestern United States where bird collision mortality has been relatively low.

Currently, few published studies are available from the Midwest that compare bird use to bird mortality rates. Based on research conducted at wind-energy facilities throughout the US, raptor use at the WEWRA is generally lower than use levels recorded at other wind-energy facilites. Raptor fatality rates are expected to be within the range of fatality rates observed at other facilities where raptor use levels are lower. To date, no relationships have been observed between overall use by other bird types, and fatality rates of those bird groups at wind-energy facilities. However, the flight characteristics and foraging habits of some species may result in increased exposure for these species at the WEWRA.

The proposed wind-energy facility contains a diversity of habitats; approximately 55% of the WEWRA contains cropland habitats, while another approximate 41% of the area is grassland (Table 1, Figure 3). Some species considered to be sensitive or of conservation concern were observed within the WEWRA. These species have a greater potential to occur in non-cropland areas, such as grassland. Some potential exists for wind turbines to displace birds within non-cropland habitats. Research concerning displacement impacts to songbirds, waterfowl and waterbirds and wind-energy facilities is limited, but some studies show the potential for small scale (180 m [591 ft] or less) displacement, while impacts to densities of birds at larger scales has not been shown.

Two bird species of concern and/or interest with regard to wind energy development have the potential to occur within the WERA. Since the WEWRA lies within the whooping crane migration corridor and a similar species, sandhill crane, was documented to occur within the WEWRA, the potential exist for whooping cranes to use this area, but to what extent cannot be determined. Although no sharp-tailed grouse leks were observed during this study, suitable lekking habitat and individual sharp-tailed grouse were observed within the WEWRA. It is possible that there are sharp-tailed grouse leks in the project area.

One factor the data for this report does not take into affect is the extreme climatic condition found at the WEWRA throughout this study. Coming into and during the fall of 2008, central North Dakota was experiencing moderate to severe drought conditions. Most wetlands were dry and upland and agricultural habitats were drought stressed. Near record snowfall (100+ inches; 254 centimeters [cm]) during the winter created ample spring flooding and re-charged most wetlands and severe snow storms persisted into mid April. Rainfall was also above normal through mid summer. This drastic change in habitat conditions within the WEWRA may have influenced bird use during this study. However, without seasonal replication of this study, the influence of these weather events on bird use of the WEWRA cannot be quantified.

REFERENCES

Anderson, R., M. Morrison, K. Sinclair, and D. Strickland. 1999. Studying Wind Energy/Bird Interactions: A Guidance Document. Metrics and Methods for Determining or Monitoring Potential Impacts on Birds at Existing and Proposed Wind Energy Sites. Prepared for the Avian Subcommittee and National Wind Coordinating Committee (NWCC). December 1999. National Wind Coordinating Committee/RESOLVE. Washington, D.C. 87 pp. http://www.nationalwind.org/publications/wildlife/avian99/Avian_booklet.pdf

Cooper, B.A., R.J. Blaha, T.J. Mabee, and J.H. Plissner. 2004. A Radar Study of Nocturnal Bird Migration at the Proposed Cotterel Mountain Wind Energy Facility, Idaho, Fall 2003. Technical report prepared for Windland, Inc., Boise, Idaho, by ABR, Inc., Forest Grove, Oregon. January 2004.

Crockford, N.J. 1992. A Review of the Possible Impacts of Wind Farms on Birds and Other Wildlife. Joint Nature Conservancy Committee (JNCC) Report No. 27. JNCC. Peterborough, United Kingdom. 60 pp.

Demastes, J.W. and J.M. Trainer. 2000. Avian Risk, Fatality, and Disturbance at the IDWGP Wind Farm, Algona, Iowa. Final Report Submitted by the University of Northern Iowa, Cedar Falls, Iowa. 21 pp.

Devereux, C.L., M.J.H. Denny, and M.J. Whittingham. 2008. Minimal Effects of Wind Turbines on the Distribution of Wintering Farmland Birds. Journal of Applied Ecology Windfarms and Farmland Birds: 1365-2664.

Erickson, W.P., D.P. Young, Jr., G. Johnson, J. Jeffrey, K. Bay, R. Good, and H. Sawyer. 2003a. Wildlife Baseline Study for the Wild Horse Wind Project. Summary of Results from 2002-2003 Wildlife Surveys May 10, 2002- May 22, 2003. Draft report prepared for Zilkha Renewable Energy, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. November 2003.

Erickson, W.P., J. Jeffrey, D.P. Young, Jr., K. Bay, R. Good, K. Sernka, and K. Kronner. 2003b. Wildlife Baseline Study for the Kittitas Valley Wind Project: Summary of Results from 2002 Wildlife Surveys. Final Report February 2002– November 2002. Prepared for Zilkha Renewable Energy, Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. January 2003.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Final Report: July 2001 - December 2003. Technical report for and peer-reviewed by FPL Energy, Stateline Technical Advisory Committee, and the Oregon Energy Facility Siting Council, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Walla Walla, Washington, and Northwest Wildlife Consultants (NWC), Pendleton, Oregon. December 2004. http://www.west-inc.com

Erickson, W.P., J. Jeffrey, and V.K. Poulton. 2008. Avian and Bat Monitoring: Year 1 Report. Puget Sound Energy Wild Horse Wind Project, Kittitas County, Washington. Prepared for Puget Sound Energy, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 2008.

Erickson, W.P., G.D. Johnson, K. Bay, and K. Kronner. 2002a. Ecological Baseline Study for the Zintel Canyon Wind Project. Final Report April 2001 – June 2002. Technical report prepared for Energy Northwest. Prepared for Energy Northwest by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. June 2002.

Erickson, W.P., G.D. Johnson, D.P. Young, Jr., D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002b. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Technical report prepared for Bonneville Power Administration, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. December 2002. http://www.bpa.gov/Power/pgc/wind/Avian_and_Bat_Study_12-2002.pdf

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr. , K.J. Sernka, and R.E. Good. 2001a. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Bird Collision Mortality in the United States. National Wind Coordinating Committee (NWCC) Publication and Resource Document. Prepared for the NWCC by WEST, Inc., Cheyenne, Wyoming. August 2001. http://www.nationalwind.org/publications/default.htm and http://www.west-inc.com

Erickson, W.P., E. Lack, M. Bourassa, K. Sernka, and K. Kronner. 2001b. Wildlife Baseline Study for the Nine Canyon Wind Project, Final Report May 2000-October 2001 Technical report prepared for Energy Northwest, Richland, Washington.

Gill, J.P., M. Townsley, and G.P. Mudge. 1996. Review of the Impacts of Wind Farms and Other Aerial Structures Upon Birds. Scottish Natural Heritage Review No. 21. Scottish Natural Heritage. Battleby, United Kingdom.

Howell, J.A. and J. Noone. 1992. Examination of Avian Use and Mortality at a U.S. Windpower Wind Energy Development Site, Montezuma Hills, Solano County, California. Final Report to Solano County Department of Environmental Management, Fairfield, California. 41pp.

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Jeffrey, J.D., W.P. Erickson, K.J. Bay, V.K. Poulton, W.L. Tidhar, and J.E. Baker. 2008. Wildlife Baseline Studies for the Golden Hills Wind Resource Area, Sherman County, Oregon. Final Report May 2006 – October 2007. Prepared for BP Alternative Energy North America Inc., Houston, Texas, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Johnson, G.D. 2004. Analysis of Potential Wildlife and Habitat Impacts from the Klondike II Project, Sherman County, Oregon. Technical report prepared by WEST, Inc., for CH2M HILL and PPM Energy.

Johnson, G.D. and W.P. Erickson. 2004. Analysis of Potential Wildlife/Wind Plant Interactions, Bighorn Site, Klickitat County, Washington. Prepared for CH2M HILL, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. August 2004.

Johnson, G.D., W.P. Erickson, K. Bay, and K. Kronner. 2002. Baseline Ecological Studies for the Klondike Wind Project, Sherman County, Oregon. Final report prepared for Northwestern Wind Power, Goldendale, Washington, by Western EcoSystems Technology, Inc. (WEST) Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. May 29, 2002.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2000a. Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp. http://www.west-inc.com

Johnson, G.D., W.P. Erickson, and J. White. 2003. Avian and Bat Mortality During the First Year of Operation at the Klondike Phase I Wind Project, Sherman County, Oregon. March 2003. Technical report prepared for Northwestern Wind Power, Goldendale, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. http://www.west-inc.com

Johnson, G.D., J. Jeffrey, J. Baker, and K. Bay. 2007. Baseline Avian Studies for the Windy Flats Wind Energy Project, Klickitat County, Washington. Prepared for Windy Point Partners, LLC., by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. May 29, 2007.

Johnson, G.D., D.P. Young, W.P. Erickson, C.E. Derby, M.D. Strickland, and R.E. Good. 2000b. Wildlife Monitoring Studies, SeaWest Windpower Plant, Carbon County, Wyoming, 1995-1999. Final report prepared for SeaWest Energy Corporation, San Diego, California, and the Bureau of Land Management, Rawlins, Wyoming, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 9, 2000. http://www.west-inc.com and http://www.west-inc.com/reports/fcr_final_baseline.pdf

Kerlinger, P. 1997. A Study of Avian Fatalities at the Green Mountain Power Corporation's Searsburg, Vermont Windpower Facility - 1997. Prepared for Vermont Department of Public Service, Green Mountain Power Corporation, National Renewable Energy Laboratory and Vermont Environmental Research Associates. 12 pp.

Kerlinger, P. 2005. Summary of Bird Studies and Collision Rates at Wind Power Projects. Rebuttal testimony of Paul Kerlinger for the East Haven Windfarm. February 9, 2005. http://easthavenwindfarm.com/filing/feb/ehwf-pk-reb1.pdf

Kerlinger, P., L. Culp, and R. Curry. 2005. Post-Construction Avian Monitoring Study for the High Winds Wind Power Project, Solano County, California. Year One Report. Prepared for High Winds, LLC and FPL Energy.

Kerlinger, P., R. Curry, L. Culp, A. Jain, C. Wilkerson, B. Fischer, and A. Hasch. 2006. Post-Construction Avian and Bat Fatality Monitoring for the High Winds Wind Power Project, Solano County, California: Two Year Report. Prepared for High Winds LLC, FPL Energy by Curry and Kerlinger, LLC. April 2006.

Kronner, K., B. Gritski, and S. Downes. 2008. Big Horn Wind Power Project Wildlife Fatality Monitoring Study: 2006−2007. Final report prepared for PPM Energy and the Big Horn Wind Project Technical Advisory Committee by Northwest Wildlife Consultants, Inc. (NWC), Mid-Columbia Field Office, Goldendale, Washington. June 1, 2008.

Larsen, J.K. and J. Madsen. 2000. Effects of Wind Turbines and Other Physical Elements on Field Utilization by Pink-Footed Geese (*Anser brachyrhynchus*): A Landscape Perspective. Landscape Ecology 15: 755-764.

Lawrence, E.S., S. Painter, and B. Little. 2007. Responses of Birds to the Windfarm at Blyth Harbour, Northumberland, UK. *In*: Birds and Windfarms: Risk Assessment and Mitigation. M. J. de Lucas, G. F. E. Janss, and M. Ferrer, eds. Quercus, Madrid, Spain. Pp. 47-69.

Leddy, K.L. 1996. Effects of Wind Turbines on Nongame Birds in Conservation Reserve Program Grasslands in Southwestern Minnesota. M.S. Thesis. South Dakota State University, Brookings. 61 pp.

Leddy, K.L., K.F. Higgins, and D.E. Naugle. 1999. Effects of Wind Turbines on Upland Nesting Birds in Conservation Reserve Program Grasslands. Wilson Bulletin 111(1): 100-104.

Mabey, S. and E. Paul. 2007. Impact of Wind Energy and Related Human Activities on Grassland and Shrub-Steppe Birds. A Critical Literature Review Prepared for the National Wind Coordinating Committee (NWCC) and The Ornithological Council. 183 pp. http://www.nationalwind.org/pdf/IMPACTOFWINDENERGYANDRELATEDHUMANACTIVITIESONGRASSLANDANDSHRUB-STEPPEBIRDS.pdf

Madders, M. and D.P. Whitfield. 2006. Upland Raptors and the Assessment of Wind Farm Impacts. Ibis 148: 43-56.

Migratory Bird Treaty Act (MBTA). 1918. 16 United States Code § 703-712. July 13, 1918.

National Research Council (NRC). 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press. Washington, D.C. www.nap.edu

National Wind Coordinating Committee (NWCC). 2004. Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions. Fact Sheet. 2nd Edition. November 2004. http://www.nationalwind.org/publications/default.htm

Nicholson, C.P. 2003. Buffalo Mountain Windfarm Bird and Bat Mortality Monitoring Report: October 2001 - September 2002. Tennessee Valley Authority, Knoxville, Tennessee. February 2003.

North Dakota (ND) GAP Analysis. 2004. North Dakota GAP Analysis Project. Data available from http://gapanalysis.nbii.gov/portal/server.pt

North Dakota (ND) Outdoors. 2004. 100 Species of Conservation Prioity. Introduction by S. Dyke, species profiles by S. Hagen and P. Isakson. July 2004. http://gf.nd.gov/conservation/levels-list.html

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2004. Ecological Baseline Studies for the Roosevelt Wind Project, Klickitat County, Washington. Final Report. Prepared by NWC, Pendleton, Oregon, and WEST, Inc., Cheyenne, Wyoming. September 2004.

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2005a. Ecological Baseline Studies and Wildlife Impact Assessment for the White Creek Wind Power Project, Klickitat County, Washington. Prepared for Last Mile Electric Cooperative, Goldendale, Washington, by Northwest Wildlife Consultants, Inc., Goldendale, Washington, and Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. January 12, 2005.

Northwest Wildlife Consultants, Inc. (NWC) and Western Ecosystems Technology, Inc. (WEST). 2005b. Wildlife Baseline Study for the Leaning Juniper Wind Power Project, Gilliam County, Oregon. Prepared for PPM Energy, Portland, Oregon and CH2M HILL, Portland, Oregon by NWC, Pendleton, Oregon, and WEST, Inc., Cheyenne, Wyoming. November 3, 2005.

Northwest Wildlife Consultants, Inc. (NWC) and Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Monitoring Report for the Klondike II Wind Power Project. Sherman County, Oregon. Prepared for PPM Energy, Portland, Oregon. Managed and conducted by NWC, Pendleton, Oregon. Analysis conducted by WEST, Cheyenne, Wyoming. July 17, 2007.

Orloff, S. and A. Flannery. 1992. Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas, 1989-1991. Final Report P700-92-001 to Alameda, Contra Costa, and Solano Counties, and the California Energy Commission, Sacramento, California, by Biosystems Analysis, Inc., Tiburon, California. March 1992.

Pedersen, M.B. and E. Poulsen. 1991. Impact of a 90m/2mw Wind Turbine on Birds - Avian Responses to the Implementation of the Tjaereborg Wind Turbine at the Danish Wadden Sea. Dansek Vildundersogelser 47: 1-44. Miljoministeriet & Danmarks Miljoundersogelser.

Prange, H. 2003. North American Crane Working Group Meeting, 2003. Personal communication.

Reynolds, R.T., J.M. Scott, and R.A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. Condor 82(3): 309-313.

Shaffer, J.A. and D.H. Johnson. 2007. Effects of Wind Developments on Grassland Birds in Native Habitats in the Northern Great Plains. Presented at the 2007 International Meeting of The Wildlife Society, Tucson, Arizona.

URS Corporation, Western EcoSystems Technology, Inc. (WEST), and Northwest Wildlife Consultants, Inc. (NWC). 2001. Avian Baseline Study for the Stateline Project. Prepared for FPL Energy Vansycle, LLC, Juno Beach, Florida.

US Fish and Wildlife Service (USFWS). 2003. Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines. May 13, 2003. USFWS. Washington, D.C. http://www.fws.gov/habitatconservation/wind.pdf

US Fish and Wildlife Service (USFWS). 2004. Prairie Grouse Leks and Wind Turbines: US Fish and Wildlife Service Justification for a 5-Mile Buffer from Leks; Additional Grassland Songbird Recommendations. An unpublished briefing paper.

Usgaard, R.E., D.E. Naugle, R.G. Osborn, and K.F. Higgins. 1997. Effects of Wind Turbines on Nesting Raptors at Buffalo Ridge in Southwestern Minnesota. Proceedings of the South Dakota Academy of Science 76: 113-117.

Walker, D., M. McGrady, A. McCluskie, M. Madders, and D.R.A. McLeod. 2005. Resident Golden Eagle Ranging Behaviour Before and After Construction of a Windfarm in Argyll. Scottish Birds 25: 24-40. http://www.natural-research.org/projects/documents/SB25-EAGLESDOC.pdf

Western Ecosystems Technology, Inc. (WEST). 2005a. Ecological Baseline Study at the Elkhorn Wind Power Project. Exhibit A. Final report prepared for Zilkha Renewable Energy, LLC., Portland, Oregon, by WEST, Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005b. Ecological Baseline Study for the Proposed Reardon Wind Project, Lincoln County, Washington. Draft Final Report. Prepared for Energy Northwest, Richland, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 2005.

Western EcoSystems Technology, Inc. (WEST). 2005c. Wildlife and Habitat Baseline Study for the Proposed Biglow Canyon Wind Power Project, Sherman County, Oregon. March 2004 - August 2005. Prepared for Orion Energy LLC., Oakland, California. October, 2005. WEST. Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2006a. Diablo Winds Wildlife Monitoring Progress Report, March 2005 - February 2006. Technical report submitted to FPL Energy and Alameda County California. WEST. Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2006b. Wildlife Baseline Study for the North Valley County Wind Project: Summary of Results from 2006 Wildlife Surveys. Prepared for POWER Engineers, Boise, Idaho, and Wind Hunter, LLC., Grapevine, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. December 8, 2006.

Western EcoSystems Technology, Inc. (WEST). 2007. Wildlife and Habitat Baseline Study for the Vantage Wind Power Project, Kittitas County, Washington. Draft report prepared for Invenergy by Western EcoSystems Technology, Inc. (WEST), Cheyenne Wyoming and Walla Walla, Washington. June 2007.

Western EcoSystems Technology, Inc. (WEST) and Colorado Plateau Research Station (CPRS). 2006. Avian Studies for the Proposed Sunshine Wind Park, Coconino County, Arizona. Prepared for Sunshine Arizona Wind Energy, LLC., Flagstaff, Arizona, by WEST, Cheyenne, Wyoming, and the CPRS, Northern Arizona University, Flagstaff, Arizona. May 2006.

Western EcoSystems Technology, Inc. (WEST), EDAW, Inc., and Bloom Biological, Inc. 2007. Baseline Avian Use and Risk Assessment for the Homestead Wind Energy Project, Kern County, California. 2005 – 2006. Prepared for Horizon Wind Energy by Western EcoSystems Technology, Inc. (WEST), EDAW, Inc., San Diego, California, and Bloom Biological, Inc., Santa Anna, California. April 19, 2007.

Whitfield, D.P. and M. Madders. 2006. A Review of the Impacts of Wind Farms on Hen Harriers *Circus cyaneus* and an Estimation of Collision Avoidance Rates. Natural Research Information Note 1 (revised). Natural Research Ltd., Banchory, United Kingdom.

Winkelman, E. 1990. Impact of the Wind Park near Urk, Netherlands, on Birds: Bird Collision Victims and Disturbance of Wintering Fowl. International Ornithological Congress 20: 402-403.

Woodward-Clyde International-Americas, (WCIA) and Western EcoSystems Technology, Inc. (WEST). 1997. Avian Baseline Study for the Vansycle Ridge Project - Vansycle Ridge, Oregon and Wildlife Mortality Studies, Vansycle Wind Project, Washington. Prepared for ESI Vansycle Partners, L.P., North Palm Beach, Florida.

Young, D.P. Jr., W.P. Erickson, K. Bay, J. Jeffrey, E.G. Lack, R.E. Good, and H.H. Sawyer. 2003a. Baseline Avian Studies for the Proposed Hopkins Ridge Wind Project, Columbia County, Washington. Final Report, March 2002 - March 2003. Prepared for RES North America, LLC., Portland, Oregon, by Western EcoSystems Technology, Inc.(WEST), Cheyenne, Wyoming. April 30, 2003.

Young, D.P. Jr., W.P. Erickson, K. Bay, J. Jeffrey, E.G. Lack, and H.H. Sawyer. 2003b. Baseline Avian Studies for the Proposed Desert Claim Wind Power Project, Kittitas County, Washington. Final Report. Prepared for Desert Claim Wind Power, LLC, Ellensburg, Washington, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 2003.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, K. Bay, and M. Bourassa. 2005. Eurus Combine Hills Turbine Ranch. Phase 1 Post Construction Wildlife Monitoring Final Report February 2004 February 2005. Technical report for Eurus Energy America Corporation and the Combine Hills Technical Advisory Committee, Umatilla County, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, K. Bay, R.E. Good, and E.G. Lack. 2003c. Avian and Sensitive Species Baseline Study Plan and Final Report. Eurus Combine Hills Turbine Ranch, Umatilla County, Oregon. Technical report prepared for Eurus Energy America Corporation, San Diego, California and Aeropower Services, Inc., Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. March 10, 2003.

Young, D.P. Jr., W.P. Erickson, J. Jeffrey, and V.K. Poulton. 2007a. Puget Sound Energy, Hopkins Ridge Wind Project Phase 1, Post-Construction Avian and Bat Monitoring, First Annual Report, January - December 2006. Technical report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, for Puget Sound Energy.

Young, D.P. Jr., G.D. Johnson, V.K. Poulton, and K. Bay. 2007b. Ecological Baseline Studies for the Hatchet Ridge Wind Energy Project, Shasta County, California. Prepared for Hatchet Ridge Wind, LLC, Portland, Oregon by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 31, 2007. http://www.co.shasta.ca.us/Departments/Resourcemgmt/drm/Hatchet%20Ridge/DEIR/App_C-1.pdf

Young, D.P. Jr., V.K. Poulton, and K. Bay. 2007c. Ecological Baseline Studies Report. Proposed Dry Lake Wind Project, Navajo County, Arizona. Prepared for PPM Energy, Portland, Oregon, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. July 1, 2007.

Table 1. The land cover types, coverage, and composition within the Wilton Expansion Wind Resource Area

Habitat	Acres	% Composition
Cropland	25,795.6	55.2
Planted Grassland	10,594.9	22.7
Native Grassland	8,472.4	18.1
Wetland/Water	847.2	1.8
Shrubland	533.4	1.1
Woodland	362.4	0.8
Developed	69.9	0.2
Barren	63.3	0.1
Total	**46,739.1**	**100**

Data from the North Dakota GAP Analysis (NDGAP 2004).

Table 2. Summary of species richness (species/plot[a]/20-min survey), and sample size by season and overall during fixed-point bird use surveys at the Wilton Wind Resource Area, September 17, 2008 – June 25, 2009.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Fall	8	144	25	0.51	0.14
Spring	11	198	62	1.39	0.93
Summer	4	72	45	2.51	1.82
Overall	**23**	**414**	**76**	**1.21**	**0.75**

[a] 800-m radius for large birds and 100-m radius for small birds

Table 3. Total number of individuals and groups for each bird type and species, by season and overall, during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area , September 17, 2008 - June 25, 2009.

		Fall		Spring		Summer		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**4**	**183**	**33**	**896**	**14**	**21**	**51**	**1,100**
black tern	*Chlidonias niger*	0	0	0	0	1	1	1	1
double-crested cormorant	*Phalacrocorax auritus*	1	1	0	0	2	2	3	3
Franklin's gull	*Larus pipixcan*	0	0	4	39	0	0	4	39
horned grebe	*Podiceps auritus*	0	0	1	1	0	0	1	1
pied-billed grebe	*Podilymbus podiceps*	0	0	2	2	0	0	2	2
ring-billed gull	*Larus delawarensis*	0	0	9	37	10	16	19	53
sandhill crane	*Grus canadensis*	3	182	17	817	0	0	20	999
unidentified gull		0	0	0	0	1	2	1	2
Waterfowl		**0**	**0**	**102**	**659**	**63**	**179**	**165**	**838**
American wigeon	*Anas americana*	0	0	0	0	4	6	4	6
blue-winged teal	*Anas discors*	0	0	9	30	9	22	18	52
bufflehead	*Bucephala albeola*	0	0	1	1	0	0	1	1
Canada goose	*Branta canadensis*	0	0	9	338	5	14	14	352
canvasback	*Aythya valisineria*	0	0	3	27	7	32	10	59
gadwall	*Anas strepera*	0	0	5	15	4	4	9	19
greater white-fronted goose	*Anser albifrons*	0	0	1	55	0	0	1	55
green-winged teal	*Anas crecca*	0	0	2	6	0	0	2	6
lesser scaup	*Aythya affinis*	0	0	5	24	2	8	7	32
mallard	*Anas platyrhynchos*	0	0	36	79	20	68	56	147
northern pintail	*Anas acuta*	0	0	11	20	4	8	15	28
northern shoveler	*Anas clypeata*	0	0	10	30	6	12	16	42
redhead	*Aythya americana*	0	0	5	26	2	5	7	31
ring-necked duck	*Aythya collaris*	0	0	3	6	0	0	3	6
snow goose	*Chen caerulescens*	0	0	1	1	0	0	1	1
unidentified duck		0	0	1	1	0	0	1	1

Table 3. Total number of individuals and groups for each bird type and species, by season and overall, during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area , September 17, 2008 - June 25, 2009.

		Fall		Spring		Summer		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Shorebirds		**5**	**35**	**28**	**43**	**17**	**20**	**50**	**98**
common snipe	*Gallinago gallinago*	0	0	0	0	3	4	3	4
greater yellowlegs	*Tringa melanoleuca*	0	0	1	3	2	3	3	6
killdeer	*Charadrius vociferus*	3	10	20	24	6	6	29	40
marbled godwit	*Limosa fedoa*	0	0	1	2	2	3	3	5
solitary sandpiper	*Tringa solitaria*	1	13	0	0	0	0	1	13
unidentified dowitcher		0	0	1	3	0	0	1	3
unidentified sandpiper		1	12	1	2	0	0	2	14
unidentified shorebird		0	0	1	5	0	0	1	5
upland sandpiper	*Bartramia longicauda*	0	0	2	2	4	4	6	6
Wilson's phalarope	*Phalaropus tricolor*	0	0	1	2	0	0	1	2
Rails/Coots		**0**	**0**	**2**	**2**	**6**	**13**	**8**	**15**
American coot	*Fulica americana*	0	0	2	2	6	13	8	15
Raptors		**26**	**29**	**52**	**56**	**31**	**33**	**109**	**118**
Accipiters		*2*	*2*	*3*	*3*	*0*	*0*	*5*	*5*
Cooper's hawk	*Accipiter cooperii*	2	2	1	1	0	0	3	3
northern goshawk	*Accipiter gentilis*	0	0	1	1	0	0	1	1
sharp-shinned hawk	*Accipter striatus*	0	0	1	1	0	0	1	1
Buteos		*13*	*16*	*26*	*30*	*21*	*23*	*60*	*69*
red-tailed hawk	*Buteo jamaicensis*	13	16	24	28	19	19	56	63
Swainson's hawk	*Buteo swainsoni*	0	0	2	2	2	4	4	6
Northern Harrier		*8*	*8*	*16*	*16*	*9*	*9*	*33*	*33*
northern harrier	*Circus cyaneus*	8	8	16	16	9	9	33	33
Falcons		*0*	*0*	*2*	*2*	*0*	*0*	*2*	*2*
American kestrel	*Falco sparverius*	0	0	2	2	0	0	2	2
Owls		*1*	*1*	*0*	*0*	*0*	*0*	*1*	*1*
unidentified owl		1	1	0	0	0	0	1	1

Table 3. Total number of individuals and groups for each bird type and species, by season and overall, during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area , September 17, 2008 - June 25, 2009.

		Fall		**Spring**		**Summer**		**Total**	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Other Raptors		*2*	*2*	*5*	*5*	*1*	*1*	*8*	*8*
unidentified hawk		2	2	5	5	1	1	8	8
Vultures		**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
turkey vulture	*Cathartes aura*	0	0	1	1	0	0	1	1
Upland Gamebirds		**21**	**48**	**56**	**64**	**44**	**52**	**121**	**164**
gray partridge	*Perdix perdix*	1	9	0	0	0	0	1	9
ring-necked pheasant	*Phasianus colchicus*	17	32	52	60	43	50	112	142
sharp-tailed grouse	*Tympanuchus phasianellus*	3	7	3	3	1	2	7	12
wild turkey	*Meleagris gallopavo*	0	0	1	1	0	0	1	1
Doves/Pigeons		**7**	**23**	**12**	**18**	**23**	**31**	**42**	**72**
mourning dove	*Zenaida macroura*	4	4	10	15	23	31	37	50
rock pigeon	*Columba livia*	3	19	2	3	0	0	5	22
Large Corvids		**10**	**20**	**19**	**42**	**5**	**7**	**34**	**69**
American crow	*Corvus brachyrhynchos*	10	20	19	42	5	7	34	69
Passerines		**18**	**95**	**196**	**353**	**135**	**155**	**349**	**603**
American goldfinch	*Carduelis tristis*	0	0	2	4	1	1	3	5
American robin	*Turdus migratorius*	1	1	2	2	1	1	4	4
American tree sparrow	*Spizella arborea*	1	1	0	0	0	0	1	1
barn swallow	*Hirundo rustica*	0	0	6	7	8	10	14	17
bobolink	*Dolichonyx oryzivorus*	0	0	6	6	15	18	21	24
Brewer's blackbird	*Euphagus cyanocephalus*	0	0	0	0	2	3	2	3
brown-headed cowbird	*Molothrus ater*	0	0	8	16	7	9	15	25
chipping sparrow	*Spizella passerina*	0	0	1	7	0	0	1	7
clay-colored sparrow	*Spizella pallida*	0	0	7	21	17	18	24	39
cliff swallow	*Petrochelidon pyrrhonota*	0	0	1	2	0	0	1	2
common grackle	*Quiscalus quiscula*	2	5	8	11	3	3	13	19
dark-eyed junco	*Junco hyemalis*	1	1	0	0	0	0	1	1
eastern kingbird	*Tyrannus tyrannus*	0	0	1	1	8	10	9	11

Table 3. Total number of individuals and groups for each bird type and species, by season and overall, during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area , September 17, 2008 - June 25, 2009.

		Fall		Spring		Summer		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
European starling	*Sturnus vulgaris*	0	0	1	3	0	0	1	3
grasshopper sparrow	*Ammodramus savannarum*	0	0	3	3	6	6	9	9
horned lark	*Eremophila alpestris*	0	0	39	84	4	4	43	88
lark sparrow	*Chondestes grammacus*	0	0	0	0	1	2	1	2
loggerhead shrike	*Lanius ludovicianus*	1	1	0	0	0	0	1	1
northern rough-winged swallow	*Stelgidopteryx serripennis*	0	0	1	1	1	1	2	2
red-winged blackbird	*Agelaius phoeniceus*	2	60	23	73	22	26	47	159
savannah sparrow	*Passerculus sandwichensis*	0	0	5	7	0	0	5	7
song sparrow	*Melospiza melodia*	2	16	1	1	2	2	5	19
tree swallow	*Tachycineta bicolor*	0	0	2	2	0	0	2	2
unidentified meadowlark		5	6	0	0	0	0	5	6
unidentified sparrow		1	2	9	11	0	0	10	13
vesper sparrow	*Pooecetes gramineus*	2	2	5	5	2	2	9	9
western kingbird	*Tyrannus verticalis*	0	0	2	4	10	13	12	17
western meadowlark	*Sturnella neglecta*	0	0	63	82	25	26	88	108
Other Birds		**2**	**2**	**1**	**1**	**1**	**1**	**4**	**4**
hairy woodpecker	*Picoides villosus*	1	1	0	0	0	0	1	1
northern flicker	*Colaptes auratus*	0	0	1	1	1	1	2	2
yellow-shafted flicker	*Colaptes auratus*	1	1	0	0	0	0	1	1
Overall		**93**	**435**	**502**	**2,135**	**339**	**512**	**934**	**3,082**

Table 4a. Mean bird use (number of birds/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

	Use			% Composition			% Frequency		
Species/Type	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
Waterbirds	**1.27**	**4.53**	**0.29**	**54.1**	**50.3**	**5.9**	**2.8**	**11.1**	**16.7**
black tern	0	0	0.01	0	0	0.3	0	0	1.4
double-crested cormorant	0.01	0	0.03	0.3	0	0.6	0.7	0	2.8
Franklin's gull	0	0.20	0	0	2.2	0	0	2.0	0
horned grebe	0	0.01	0	0	0.1	0	0	0.5	0
pied-billed grebe	0	0.01	0	0	0.1	0	0	1.0	0
ring-billed gull	0	0.19	0.22	0	2.1	4.5	0	4.0	12.5
sandhill crane	1.26	4.13	0	53.8	45.9	0	2.1	5.6	0
unidentified gull	0	0	0.03	0	0	0.6	0	0	1.4
Waterfowl	**0**	**3.33**	**2.49**	**0**	**37.0**	**50.3**	**0**	**20.2**	**27.8**
American wigeon	0	0	0.08	0	0	1.7	0	0	4.2
blue-winged teal	0	0.15	0.31	0	1.7	6.2	0	4.5	11.1
bufflehead	0	0.01	0	0	0.1	0	0	0.5	0
Canada goose	0	1.71	0.19	0	19.0	3.9	0	3.5	5.6
canvasback	0	0.14	0.44	0	1.5	9.0	0	1.5	9.7
gadwall	0	0.08	0.06	0	0.8	1.1	0	2.0	5.6
greater white-fronted goose	0	0.28	0	0	3.1	0	0	0.5	0
green-winged teal	0	0.03	0	0	0.3	0	0	1.0	0
lesser scaup	0	0.12	0.11	0	1.3	2.2	0	2.5	2.8
mallard	0	0.40	0.94	0	4.4	19.1	0	15.2	22.2
northern pintail	0	0.10	0.11	0	1.1	2.2	0	5.6	5.6
northern shoveler	0	0.15	0.17	0	1.7	3.4	0	5.1	6.9
redhead	0	0.13	0.07	0	1.5	1.4	0	2.5	2.8
ring-necked duck	0	0.03	0	0	0.3	0	0	1.5	0
snow goose	0	0.01	0	0	0.1	0	0	0.5	0
unidentified duck	0	0.01	0	0	0.1	0	0	0.5	0

Table 4a. Mean bird use (number of birds/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

	Use			% Composition			% Frequency		
Species/Type	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
Shorebirds	**0.24**	**0.22**	**0.28**	**10.4**	**2.4**	**5.6**	**3.5**	**12.6**	**22.2**
common snipe	0	0	0.06	0	0	1.1	0	0	4.2
greater yellowlegs	0	0.02	0.04	0	0.2	0.8	0	0.5	2.8
killdeer	0.07	0.12	0.08	3.0	1.3	1.7	2.1	10.1	8.3
marbled godwit	0	0.01	0.04	0	0.1	0.8	0	0.5	2.8
solitary sandpiper	0.09	0	0	3.8	0	0	0.7	0	0
unidentified dowitcher	0	0.02	0	0	0.2	0	0	0.5	0
unidentified sandpiper	0.08	0.01	0	3.6	0.1	0	0.7	0.5	0
unidentified shorebird	0	0.03	0	0	0.3	0	0	0.5	0
upland sandpiper	0	0.01	0.06	0	0.1	1.1	0	1.0	5.6
Wilson's phalarope	0	0.01	0	0	0.1	0	0	0.5	0
Rails/Coots	**0**	**0.01**	**0.18**	**0**	**0.1**	**3.7**	**0**	**1.0**	**8.3**
American coot	0	0.01	0.18	0	0.1	3.7	0	1.0	8.3
Raptors	**0.20**	**0.28**	**0.46**	**8.6**	**3.1**	**9.3**	**18.1**	**22.7**	**31.9**
Accipiters	*0.01*	*0.02*	*0*	*0.6*	*0.2*	*0*	*1.4*	*1.5*	*0*
Cooper's hawk	0.01	0.01	0	0.6	0.1	0	1.4	0.5	0
northern goshawk	0	0.01	0	0	0.1	0	0	0.5	0
sharp-shinned hawk	0	0.01	0	0	0.1	0	0	0.5	0
Buteos	*0.11*	*0.15*	*0.32*	*4.7*	*1.7*	*6.5*	*9.0*	*12.6*	*23.6*
red-tailed hawk	0.11	0.14	0.26	4.7	1.6	5.3	9.0	11.6	20.8
Swainson's hawk	0	0.01	0.06	0	0.1	1.1	0	1.0	2.8
Northern Harrier	*0.06*	*0.08*	*0.13*	*2.4*	*0.9*	*2.5*	*5.6*	*7.1*	*11.1*
northern harrier	0.06	0.08	0.13	2.4	0.9	2.5	5.6	7.1	11.1
Falcons	*0*	*0.01*	*0*	*0*	*0.1*	*0*	*0*	*1.0*	*0.0*
American kestrel	0	0.01	0	0	0.1	0	0	1.0	0
Owls	*0.01*	*0*	*0*	*0.3*	*0*	*0*	*0.7*	*0*	*0*
unidentified owl	0.01	0	0	0.3	0	0	0.7	0	0

Table 4a. Mean bird use (number of birds/plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

	Use			% Composition			% Frequency		
Species/Type	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
Other Raptors	*0.01*	*0.03*	*0.01*	*0.6*	*0.3*	*0.3*	*1.4*	*2.5*	*1.4*
unidentified hawk	0.01	0.03	0.01	0.6	0.3	0.3	1.4	2.5	1.4
Vultures	**0**	**0.01**	**0**	**0**	**0.1**	**0**	**0**	**0.5**	**0**
turkey vulture	0	0.01	0	0	0.1	0	0	0.5	0
Upland Gamebirds	**0.33**	**0.32**	**0.72**	**14.2**	**3.6**	**14.6**	**14.6**	**22.7**	**54.2**
gray partridge	0.06	0	0	2.7	0	0	0.7	0	0
ring-necked pheasant	0.22	0.30	0.69	9.5	3.4	14.0	11.8	21.2	52.8
sharp-tailed grouse	0.05	0.02	0.03	2.1	0.2	0.6	2.1	1.5	1.4
wild turkey	0	0.01	0	0	0.1	0	0	0.5	0
Doves/Pigeons	**0.16**	**0.09**	**0.43**	**6.8**	**1.0**	**8.7**	**4.9**	**6.1**	**27.8**
mourning dove	0.03	0.08	0.43	1.2	0.8	8.7	2.8	5.1	27.8
rock pigeon	0.13	0.02	0	5.6	0.2	0	2.1	1.0	0
Large Corvids	**0.14**	**0.21**	**0.10**	**5.9**	**2.4**	**2.0**	**6.9**	**9.1**	**6.9**
American crow	0.14	0.21	0.10	5.9	2.4	2.0	6.9	9.1	6.9
Overall	**2.35**	**8.99**	**4.94**	**100**	**100**	**100**			

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

	Use			% Composition			% Frequency		
Species/Type	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
Passerines	**0.66**	**1.78**	**2.15**	**97.9**	**99.7**	**99.4**	**12.5**	**56.6**	**91.7**
American goldfinch	0	0.02	0.01	0	1.1	0.6	0	1.0	1.4
American robin	0.01	0.01	0.01	1.0	0.6	0.6	0.7	1.0	1.4
American tree sparrow	0.01	0	0	1.0	0	0	0.7	0	0
barn swallow	0	0.04	0.14	0	2.0	6.4	0	3.0	11.1
bobolink	0	0.03	0.25	0	1.7	11.5	0	3.0	19.4
Brewer's blackbird	0	0	0.04	0	0	1.9	0	0	2.8
brown-headed cowbird	0	0.08	0.13	0	4.5	5.8	0	4.0	9.7
chipping sparrow	0	0.04	0	0	2.0	0	0	0.5	0
clay-colored sparrow	0	0.11	0.25	0	5.9	11.5	0	3.5	23.6
cliff swallow	0	0.01	0	0	0.6	0	0	0.5	0
common grackle	0.03	0.06	0.04	5.2	3.1	1.9	1.4	4.0	4.2
dark-eyed junco	0.01	0	0	1.0	0	0	0.7	0	0
eastern kingbird	0	0.01	0.14	0	0.3	6.4	0	0.5	11.1
European starling	0	0.02	0	0	0.8	0	0	0.5	0
grasshopper sparrow	0	0.02	0.08	0	0.8	3.8	0	1.5	8.3
horned lark	0	0.42	0.06	0	23.7	2.6	0	17.2	5.6
lark sparrow	0	0	0.03	0	0	1.3	0	0	1.4
loggerhead shrike	0.01	0	0	1.0	0	0	0.7	0	0
northern rough-winged swallow	0	0.01	0.01	0	0.3	0.6	0	0.5	1.4
red-winged blackbird	0.42	0.37	0.36	61.9	20.6	16.7	1.4	10.1	26.4
savannah sparrow	0	0.04	0	0	2.0	0	0	2.5	0
song sparrow	0.11	0.01	0.03	16.5	0.3	1.3	1.4	0.5	2.8
tree swallow	0	0.01	0	0	0.6	0	0	1.0	0
unidentified meadowlark	0.04	0	0	6.2	0	0	3.5	0	0
unidentified sparrow	0.01	0.06	0	2.1	3.1	0	0.7	4.5	0

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

	Use			% Composition			% Frequency		
Species/Type	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**
vesper sparrow	0.01	0.03	0.03	2.1	1.4	1.3	1.4	2.5	2.8
western kingbird	0	0.02	0.18	0	1.1	8.3	0	1.0	13.9
western meadowlark	0	0.41	0.36	0	23.2	16.7	0	29.8	33.3
Other Birds	**0.01**	**0.01**	**0.01**	**2.1**	**0.3**	**0.6**	**1.4**	**0.5**	**1.4**
hairy woodpecker	0.01	0	0	1.0	0	0	0.7	0	0
northern flicker	0	0.01	0.01	0	0.3	0.6	0	0.5	1.4
yellow-shafted flicker	0.01	0	0	1.0	0	0	0.7	0	0
Overall	**0.67**	**1.79**	**2.17**	**100**	**100**	**100**			

Table 5. Flight height characteristics by bird type during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009. Large bird observations were limited to within 800-m and small birds were limited to within 100-m.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight Height Categories 0-35 m	35-130 m	>130 m
Large Birds							
Waterbirds	39	1,067	89.67	97.0	7.6	39.6	52.9
Waterfowl	51	450	30.35	53.7	13.1	82.9	4.0
Shorebirds	12	50	4.83	51.0	100	0	0
Rails/Coots	0	0	0	0	0	0	0
Raptors	73	76	34.93	64.4	56.6	43.4	0
Accipiters	*3*	*3*	*33.33*	*60.0*	*66.7*	*33.3*	*0*
Buteos	*32*	*35*	*57.03*	*50.7*	*25.7*	*74.3*	*0*
Northern Harrier	*30*	*30*	*11.80*	*90.9*	*93.3*	*6.7*	*0*
Falcons	*1*	*1*	*3.00*	*50.0*	*100*	*0*	*0*
Owls	*1*	*1*	*3.00*	*100*	*100*	*0*	*0*
Other Raptors	*6*	*6*	*44.17*	*75.0*	*33.3*	*66.7*	*0*
Vultures	1	1	30.00	100	100	0	0
Upland Gamebirds	16	36	6.00	22.0	94.4	5.6	0
Doves/Pigeons	26	51	12.62	70.8	70.6	29.4	0
Large Corvids	19	43	27.05	62.3	46.5	53.5	0
Overall	**237**	**1,774**	**36.38**	**71.7**	**18.3**	**48.9**	**32.8**
Small Birds							
Passerines	133	296	5.41	49.1	99.0	1.0	0
Other Birds	1	1	18.00	25.0	100	0	0
Overall	**134**	**297**	**5.50**	**48.9**	**99.0**	**1.0**	**0**

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 35-130 m (114-427 ft) above ground level (AGL).

Table 6a. Relative exposure index and flight characteristics of large bird species during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
sandhill crane	15	2.26	97.5	42.1	0.93	41.4
Canada goose	7	0.75	92.6	93.3	0.65	93.3
greater white-fronted goose	1	0.12	100	100	0.12	100
red-tailed hawk	30	0.15	52.4	75.8	0.06	54.5
American crow	19	0.16	62.3	53.5	0.05	39.5
rock pigeon	5	0.06	100	68.2	0.04	0
ring-billed gull	18	0.12	98.1	21.2	0.02	21.2
mallard	25	0.32	29.3	18.6	0.02	20.9
unidentified hawk	6	0.02	75.0	66.7	0.01	66.7
northern pintail	7	0.06	28.6	37.5	0.01	62.5
sharp-tailed grouse	4	0.03	66.7	25.0	0.01	0
northern harrier	30	0.08	90.9	6.7	<0.01	0
northern shoveler	5	0.09	21.4	22.2	<0.01	22.2
Cooper's hawk	3	0.01	100	33.3	<0.01	33.3
double-crested cormorant	1	0.01	33.3	100	<0.01	0
Swainson's hawk	2	0.01	33.3	50.0	<0.01	100
snow goose	1	<0.01	100	100	<0.01	100
ring-necked pheasant	11	0.33	13.4	0	0	0
canvasback	0	0.13	0	0	0	0
mourning dove	21	0.11	58.0	0	0	0
blue-winged teal	5	0.11	15.4	0	0	12.5
killdeer	7	0.09	40.0	0	0	0
Franklin's gull	4	0.08	100	0	0	0
lesser scaup	0	0.07	0	0	0	0
redhead	0	0.07	0	0	0	0
gadwall	0	0.04	0	0	0	0
unidentified sandpiper	1	0.04	85.7	0	0	0

Table 6a. Relative exposure index and flight characteristics of large bird species during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
solitary sandpiper	1	0.04	100	0	0	0
American coot	0	0.03	0	0	0	0
gray partridge	1	0.03	100	0	0	0
American wigeon	0	0.01	0	0	0	0
upland sandpiper	0	0.01	0	0	0	0
greater yellowlegs	0	0.01	0	0	0	0
green-winged teal	0	0.01	0	0	0	0
ring-necked duck	0	0.01	0	0	0	0
marbled godwit	1	0.01	20.0	0	0	0
unidentified shorebird	1	0.01	100	0	0	0
common snipe	0	0.01	0	0	0	0
unidentified dowitcher	1	0.01	100	0	0	0
unidentified gull	0	<0.01	0	0	0	0
American kestrel	1	<0.01	50.0	0	0	0
pied-billed grebe	0	<0.01	0	0	0	0
Wilson's phalarope	0	<0.01	0	0	0	0
unidentified owl	1	<0.01	100	0	0	0
black tern	1	<0.01	100	0	0	0
bufflehead	0	<0.01	0	0	0	0
horned grebe	0	<0.01	0	0	0	0
northern goshawk	0	<0.01	0	0	0	0
sharp-shinned hawk	0	<0.01	0	0	0	0
turkey vulture	1	<0.01	100	0	0	0
unidentified duck	0	<0.01	0	0	0	0
wild turkey	0	<0.01	0	0	0	0

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 6b. Relative exposure index and flight characteristics for small birds during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
western meadowlark	21	0.23	28.7	9.7	0.01	9.7
red-winged blackbird	24	0.39	66.0	0	0	0
horned lark	16	0.19	33.0	0	0	0
clay-colored sparrow	1	0.09	35.9	0	0	0
brown-headed cowbird	4	0.05	40.0	0	0	0
bobolink	12	0.05	58.3	0	0	0
song sparrow	1	0.05	78.9	0	0	0
common grackle	9	0.04	78.9	0	0	0
western kingbird	11	0.04	82.4	0	0	0
barn swallow	13	0.04	94.1	0	0	0
unidentified sparrow	8	0.03	76.9	0	0	0
eastern kingbird	2	0.02	18.2	0	0	0
vesper sparrow	0	0.02	0	0	0	0
grasshopper sparrow	0	0.02	0	0	0	0
unidentified meadowlark	1	0.02	16.7	0	0	0
chipping sparrow	1	0.01	100	0	0	0
savannah sparrow	0	0.01	0	0	0	0
American goldfinch	3	0.01	100	0	0	0
American robin	1	0.01	25.0	0	0	0
Brewer's blackbird	1	0.01	66.7	0	0	0
European starling	0	0.01	0	0	0	0
lark sparrow	0	<0.01	0	0	0	0
northern flicker	1	<0.01	50.0	0	0	0
northern rough-winged swallow	1	<0.01	50.0	0	0	0
cliff swallow	1	<0.01	100	0	0	0
tree swallow	2	<0.01	100	0	0	0
American tree sparrow	0	<0.01	0	0	0	0

Table 6b. Relative exposure index and flight characteristics for small birds during fixed-point bird use surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
dark-eyed junco	0	<0.01	0	0	0	0
hairy woodpecker	0	<0.01	0	0	0	0
loggerhead shrike	0	<0.01	0	0	0	0
yellow-shafted flicker	0	<0.01	0	0	0	0

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 7. Summary of sensitive species observed at the Wilton Expansion Wind Resource Area during fixed-point bird use surveys (FP) and as incidental wildlife observations (Inc.), September 17, 2008 – June 25, 2009.

Species	Scientific Name	Status	FP		Inc.		Total	
			# of grps	# of obs	# of grps	# of obs	# of grps	# of obs
canvasback	*Aythya valisineria*	S2	10	59	0	0	10	59
northern harrier	*Circus cyaneus*	S2	33	33	10	10	43	43
Franklin's gull	*Larus pipixcan*	S1	4	39	0	0	4	39
redhead	*Aythya americana*	S2	7	31	0	0	7	31
northern pintail	*Anas acuta*	S2	15	28	0	0	15	28
bobolink	*Dolichonyx oryzivorus*	S2	21	24	0	0	21	24
sharp-tailed grouse	*Tympanuchus phasianellus*	S2	7	12	3	8	10	20
grasshopper sparrow	*Ammodramus savannarum*	S1	9	9	0	0	9	9
upland sandpiper	*Bartramia longicauda*	S1	6	6	0	0	6	6
Swainson's hawk	*Buteo swainsoni*	S1	4	6	0	0	4	6
marbled godwit	*Limosa fedoa*	S1	3	5	0	0	3	5
loggerhead shrike	*Lanius ludovicianus*	S2	1	1	1	1	2	2
bald eagle	*Haliaeetus leucocephalus*	S2	0	0	1	2	1	2
Wilson's phalarope	*Phalaropus tricolor*	S1	1	2	0	0	1	2
black tern	*Chlidonias niger*	S1	1	1	0	0	1	1
ferruginous hawk	*Buteo regalis*	S1	0	0	1	1	1	1
horned grebe	*Podiceps auritus*	S1	1	1	0	0	1	1
Total	**17 Species**		**123**	**257**	**16**	**22**	**139**	**279**

S1= level one species, or species of greatest conservation need, S2= level two species, or species in need of conservation but supported by other wildlife programs. (Data from ND Outdoors 2004).

Table 8. Incidental wildlife observed while conducting surveys at the Wilton Expansion Wind Resource Area, September 17, 2008 - June 25, 2009.

Species	Scientific Name	# grps	# obs
sandhill crane	*Grus canadensis*	6	620
mallard	*Anas platyrhynchos*	3	404
Canada goose	*Branta canadensis*	6	116
American crow	*Corvus brachyrhynchos*	17	59
unidentified hawk		19	19
red-tailed hawk	*Buteo jamaicensis*	15	17
ring-billed gull	*Larus delawarensis*	3	12
northern harrier	*Circus cyaneus*	10	10
sharp-tailed grouse	*Tympanuchus phasianellus*	3	8
turkey vulture	*Cathartes aura*	2	6
great horned owl	*Bubo virginianus*	3	3
tundra swan	*Cygnus columbianus*	1	3
American kestrel	*Falco sparverius*	2	2
unidentified gull		2	2
bald eagle	*Haliaeetus leucocephalus*	1	2
barn owl	*Tyto alba*	1	1
ferruginous hawk	*Buteo regalis*	1	1
loggerhead shrike	*Lanius ludovicianus*	1	1
rough-legged hawk	*Buteo lagopus*	1	1
unidentified owl		1	1
wild turkey	*Meleagris gallopavo*	1	1
Bird Subtotal	**21 Species**	**99**	**1,289**
white-tailed deer	*Odocoileus virginianus*	15	164
coyote	*Canis latrans*	5	6
white-tailed jack rabbit	*Lepus townsendii*	2	2
fox squirrel	*Sciurus niger*	1	1
thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	1	1
Mammal Subtotal	**5 Species**	**24**	**174**

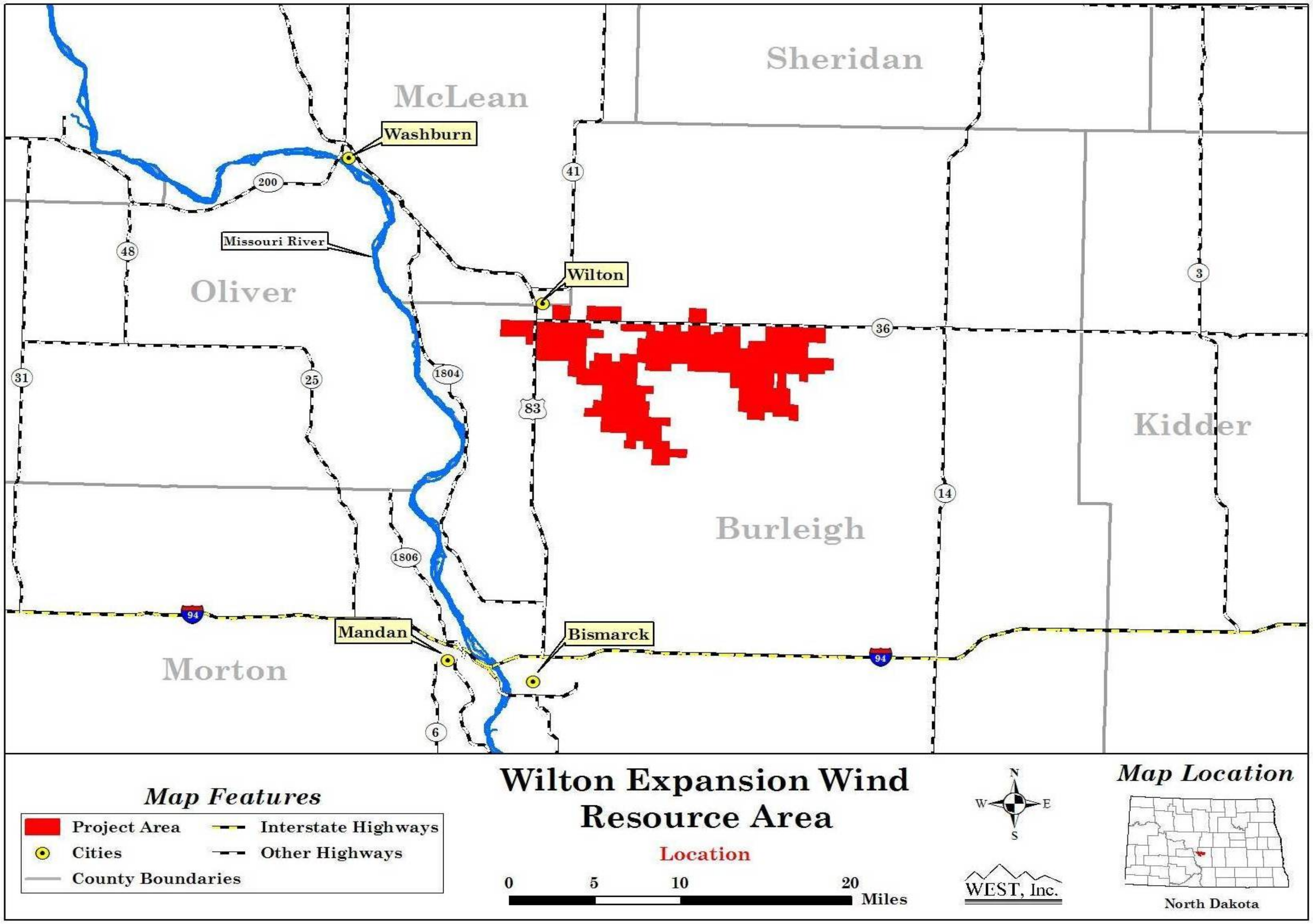


Figure 1. Location of the Wilton Expansion Wind Resource Area.

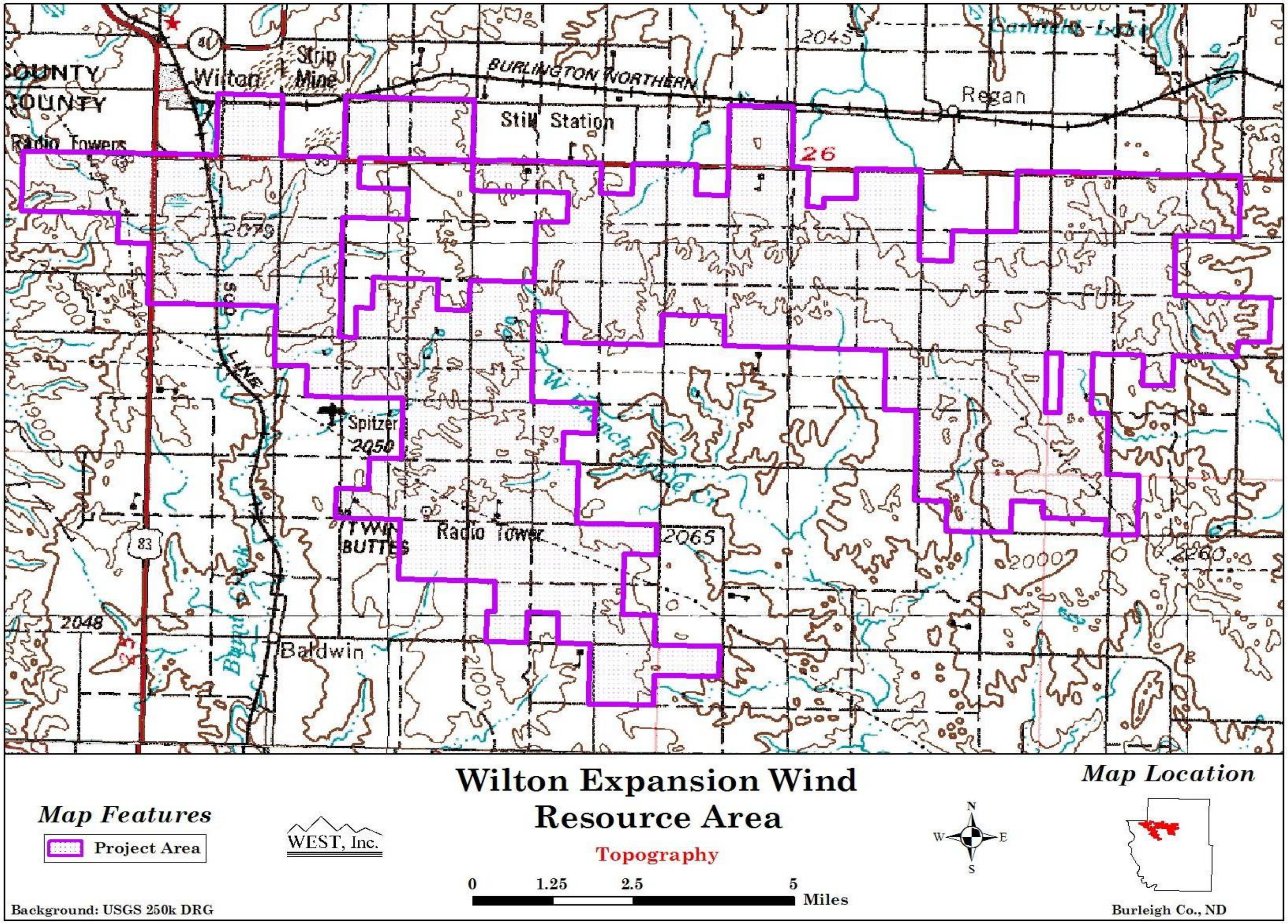


Figure 2. Overview of the Wilton Expansion Wind Resource Area.

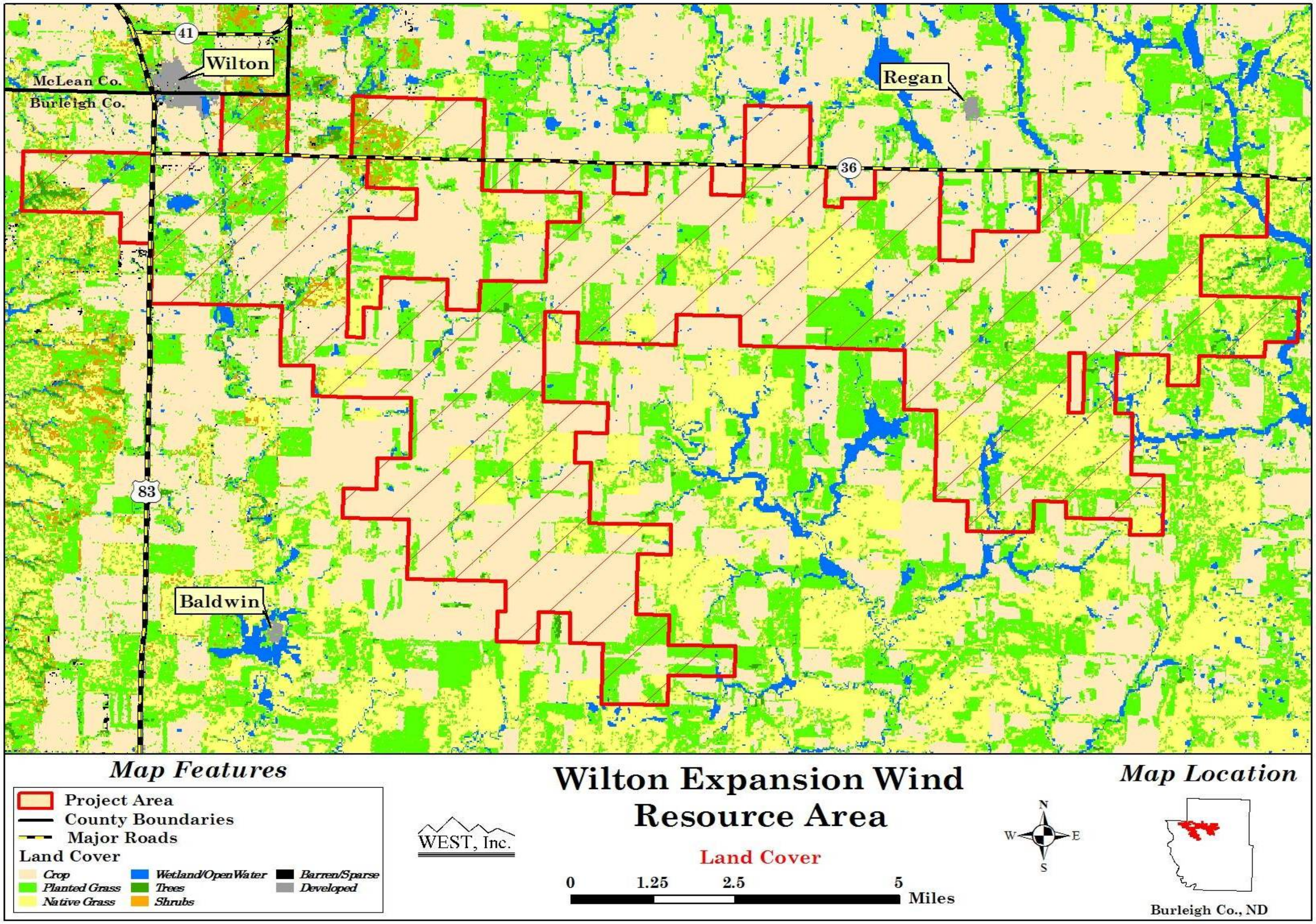


Figure 3. The land cover types and coverage within the Wilton Expansion Wind Resource Area (NDGAP 2004).

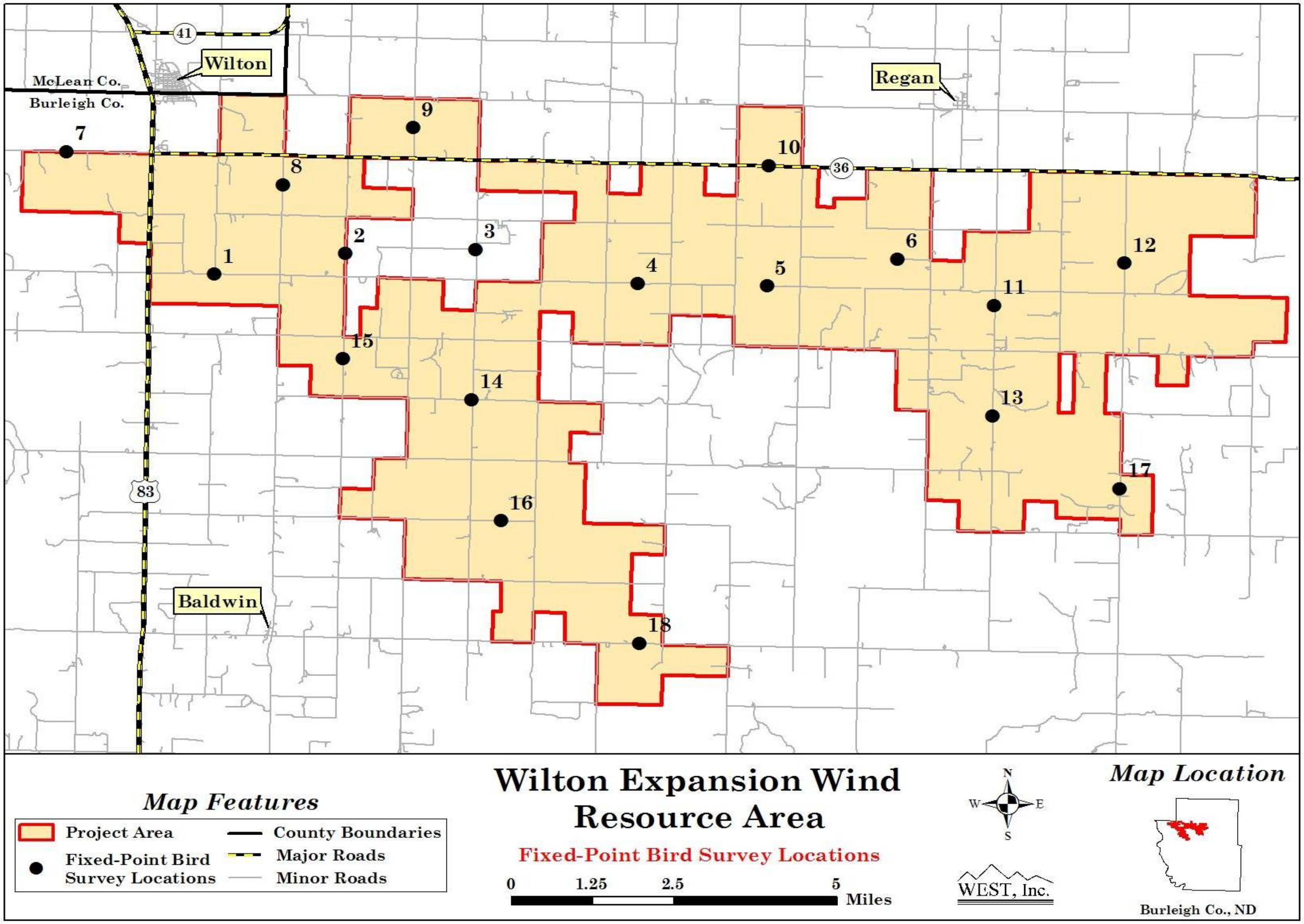


Figure 4. Fixed-point bird use survey points at the Wilton Expansion Wind Resource Area.

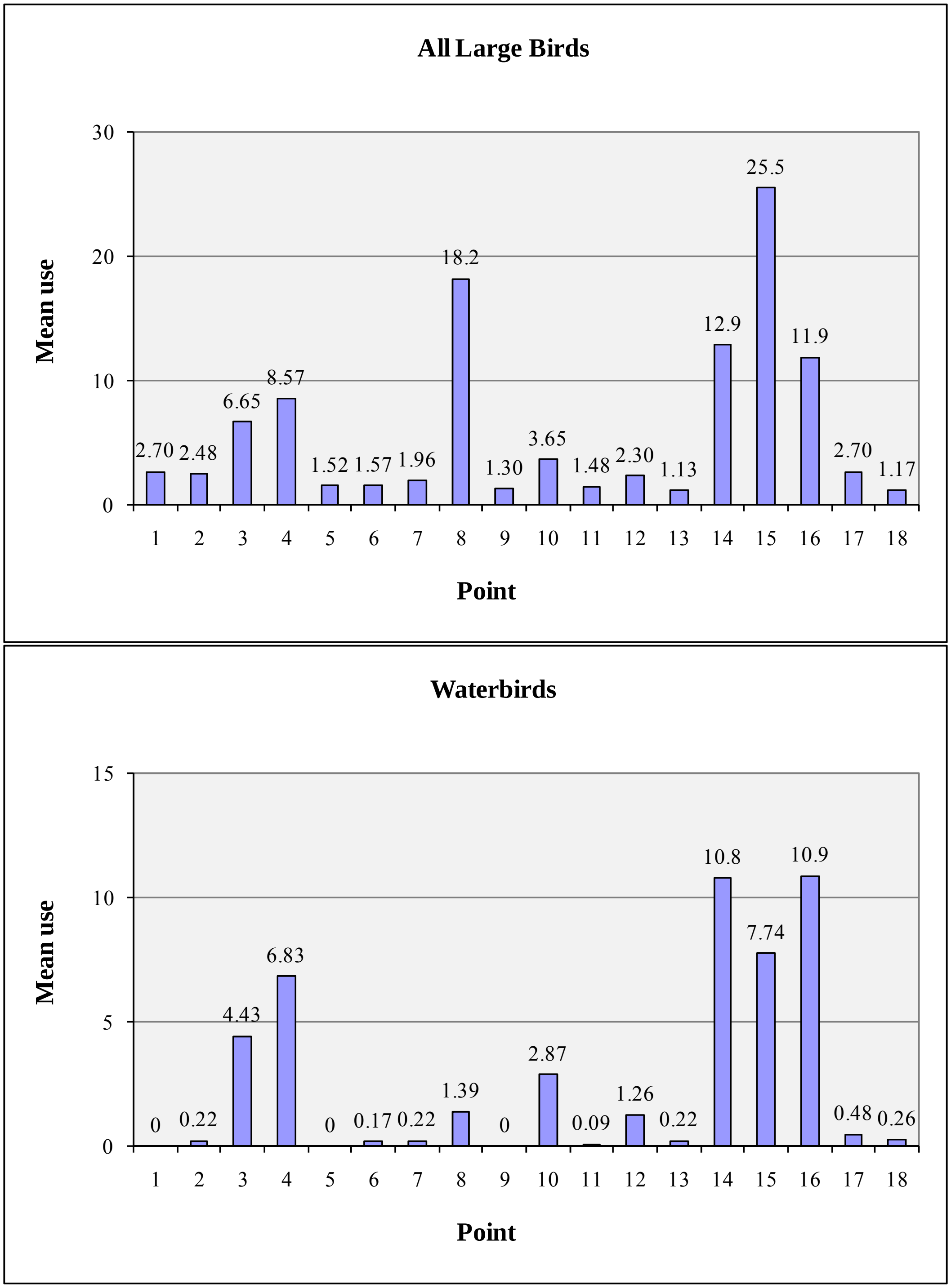
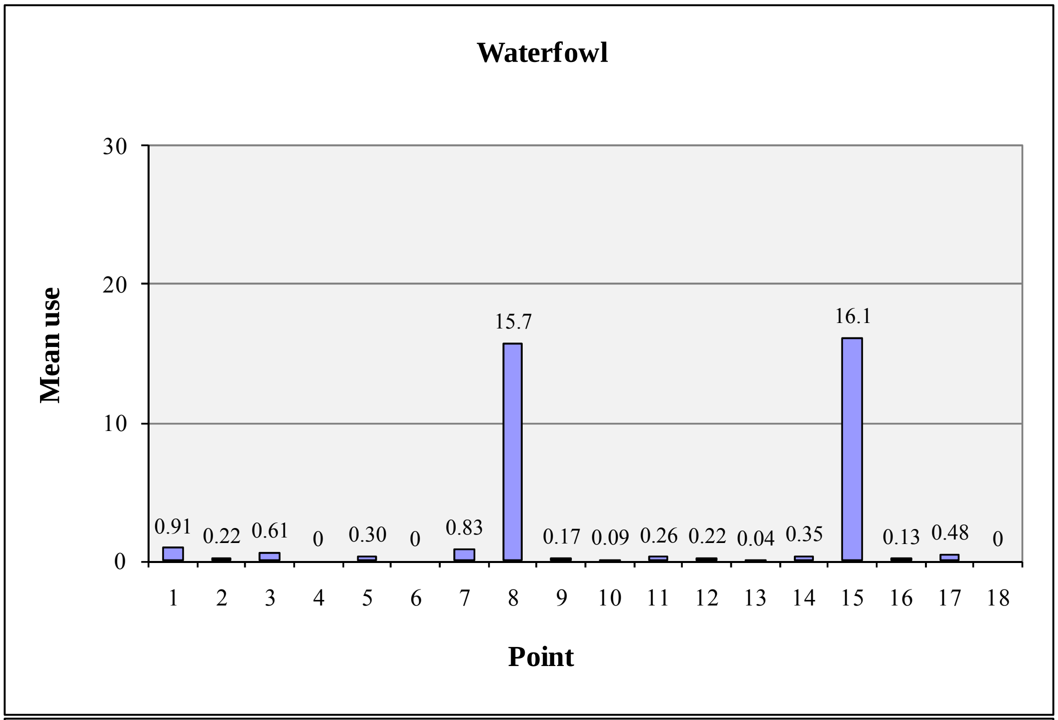


Figure 5. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



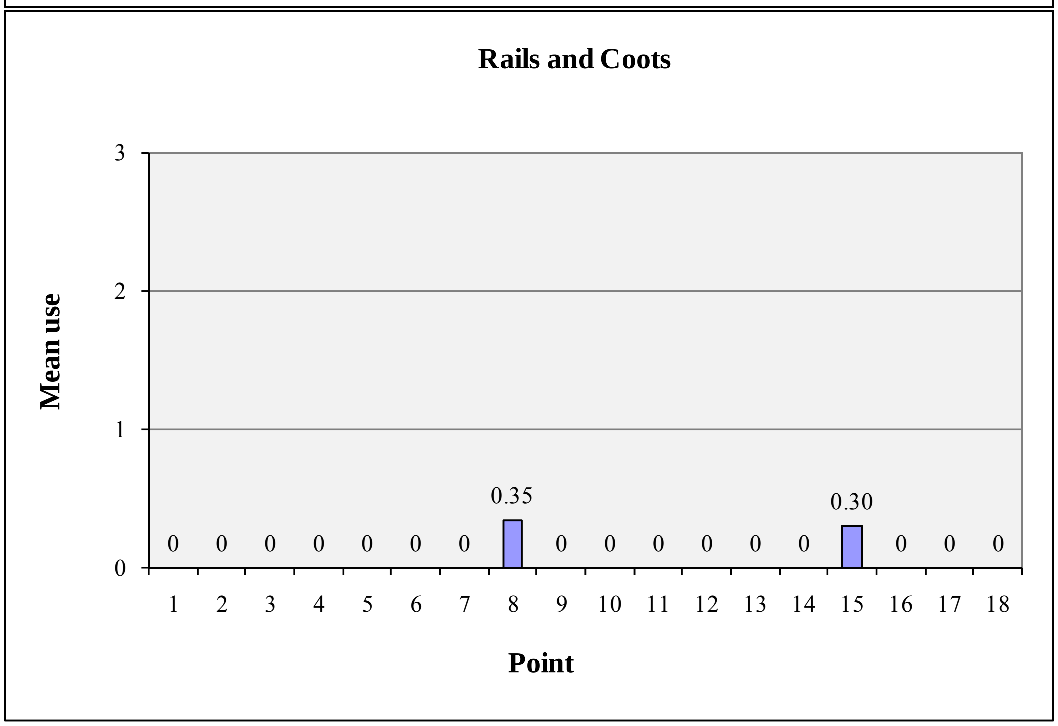
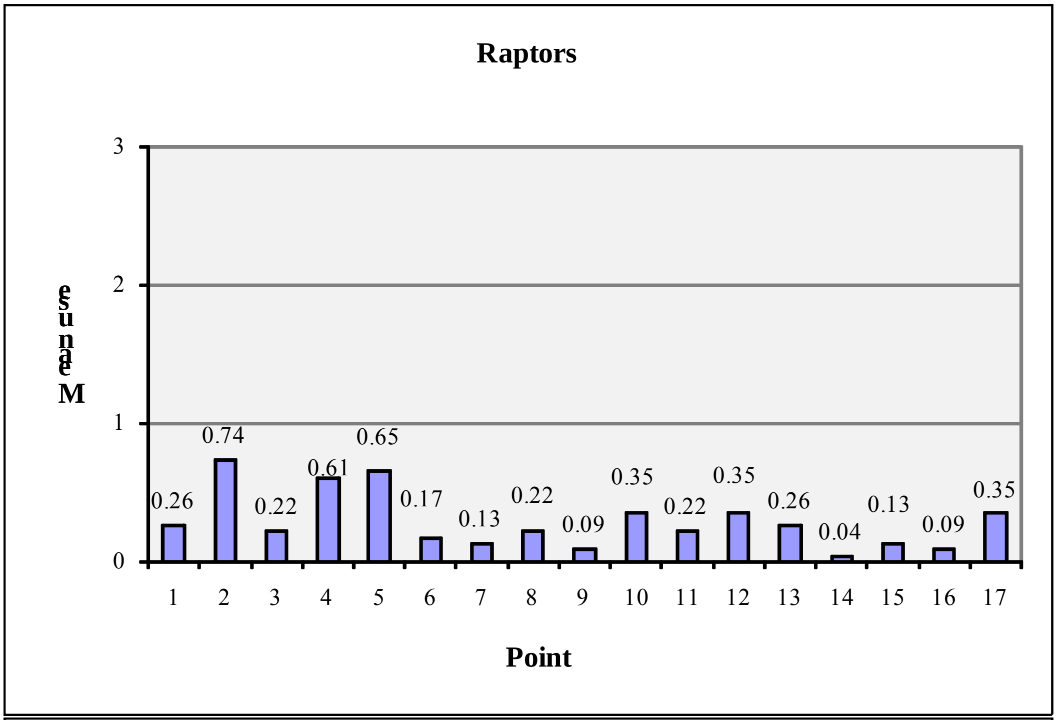


Figure 5 (*continued)*. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



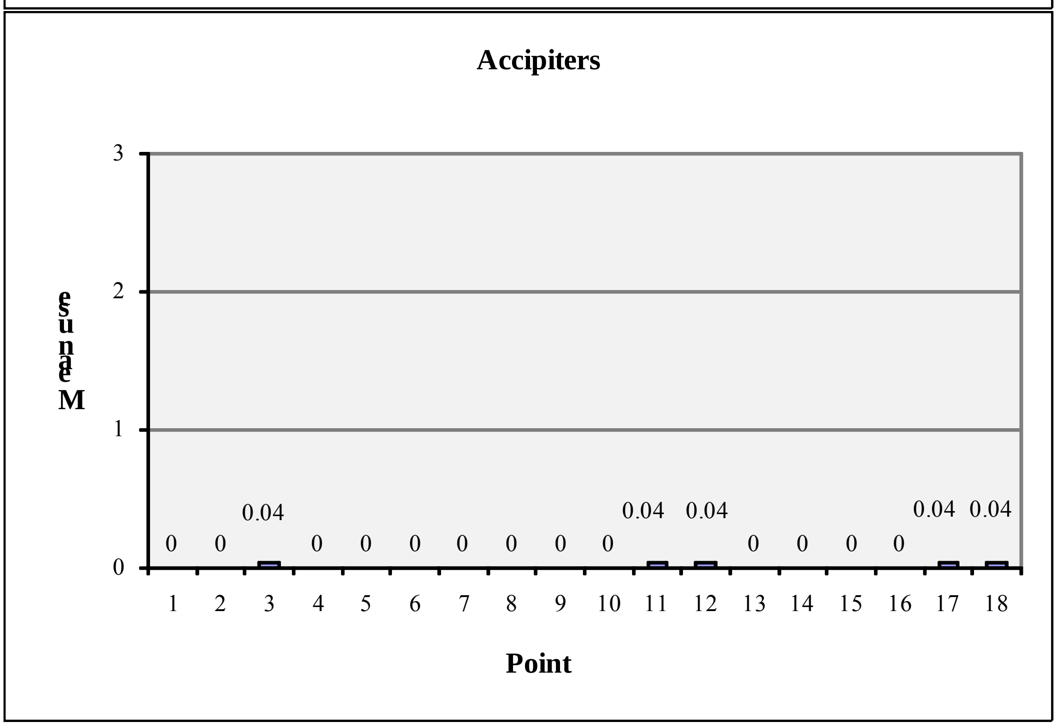
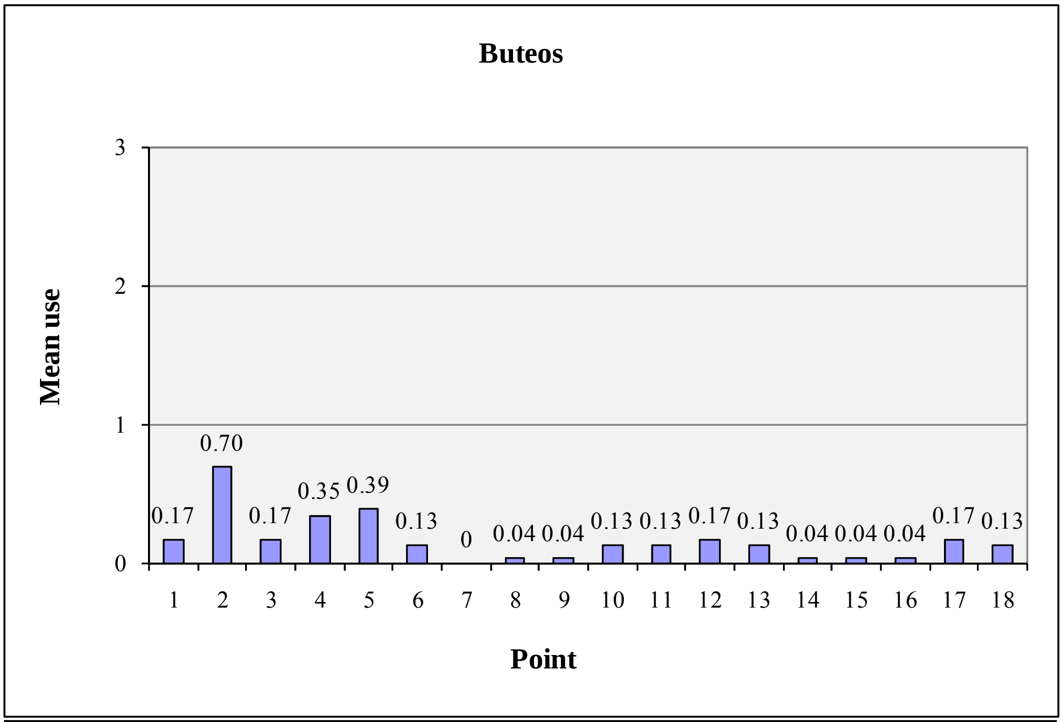


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



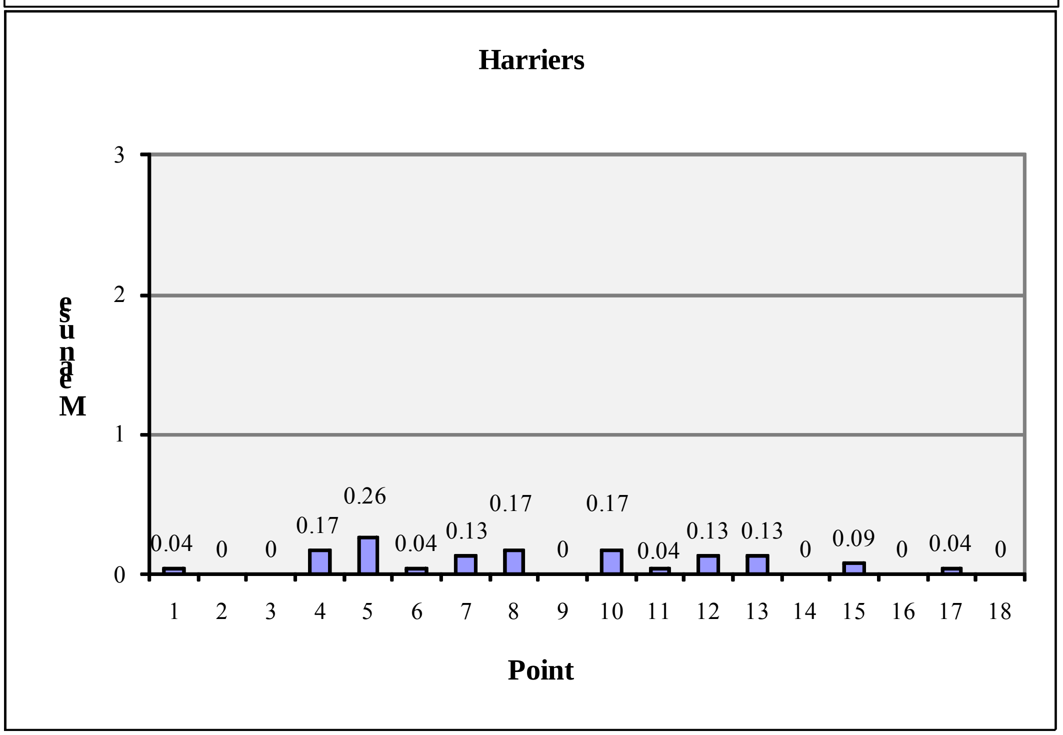
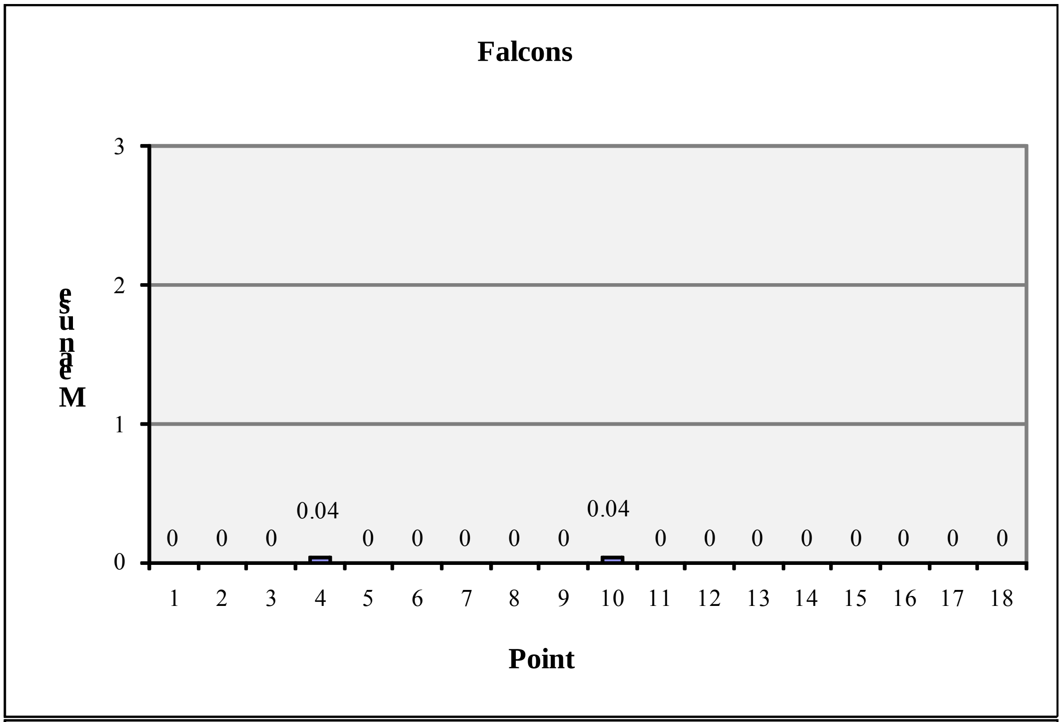


Figure 5 (*continued)*. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



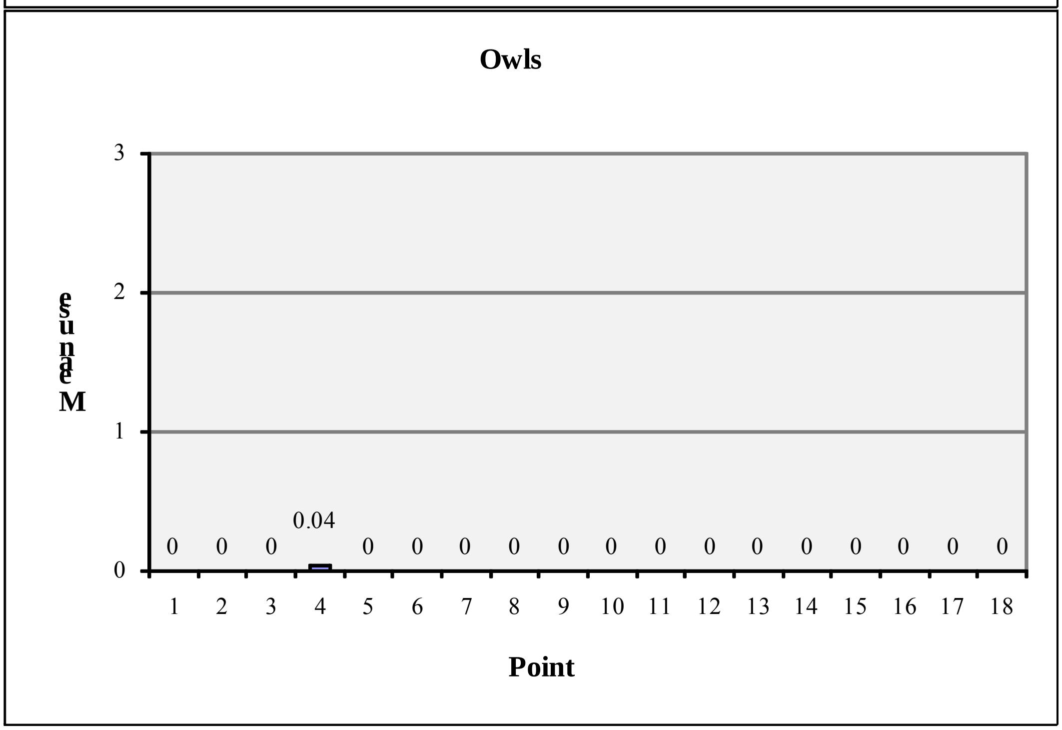
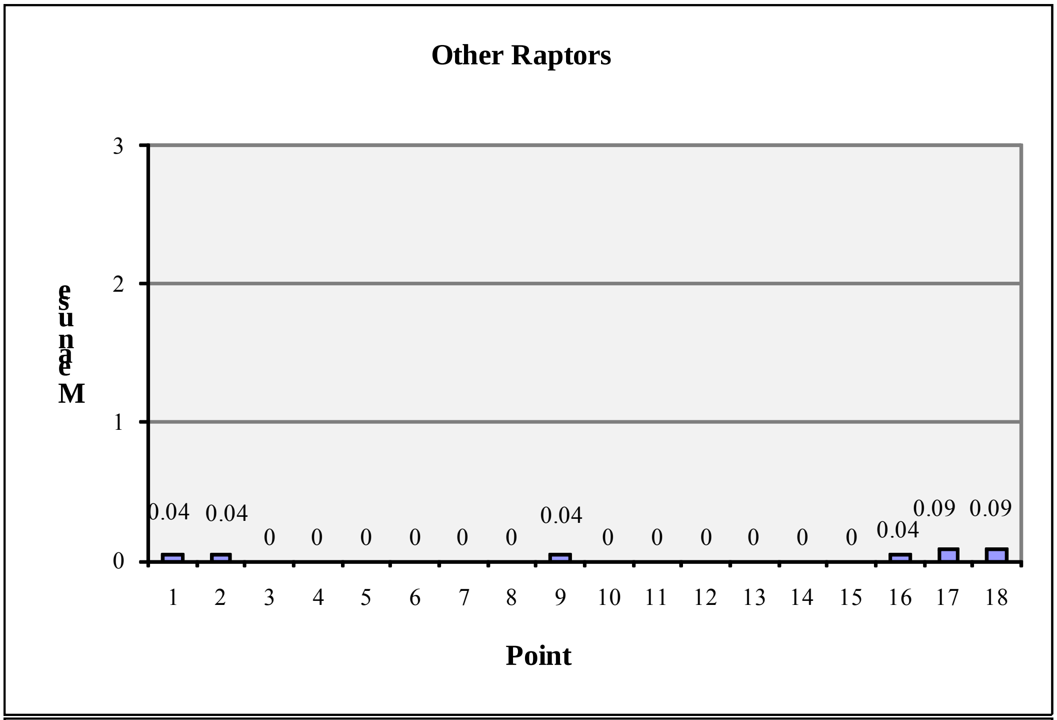


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



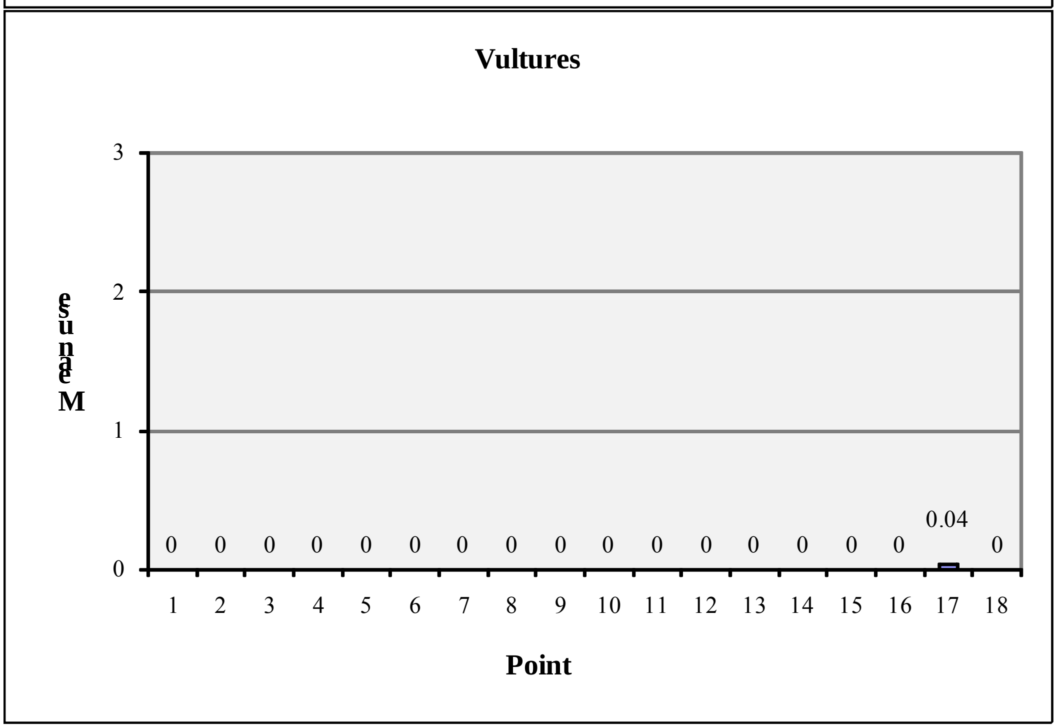
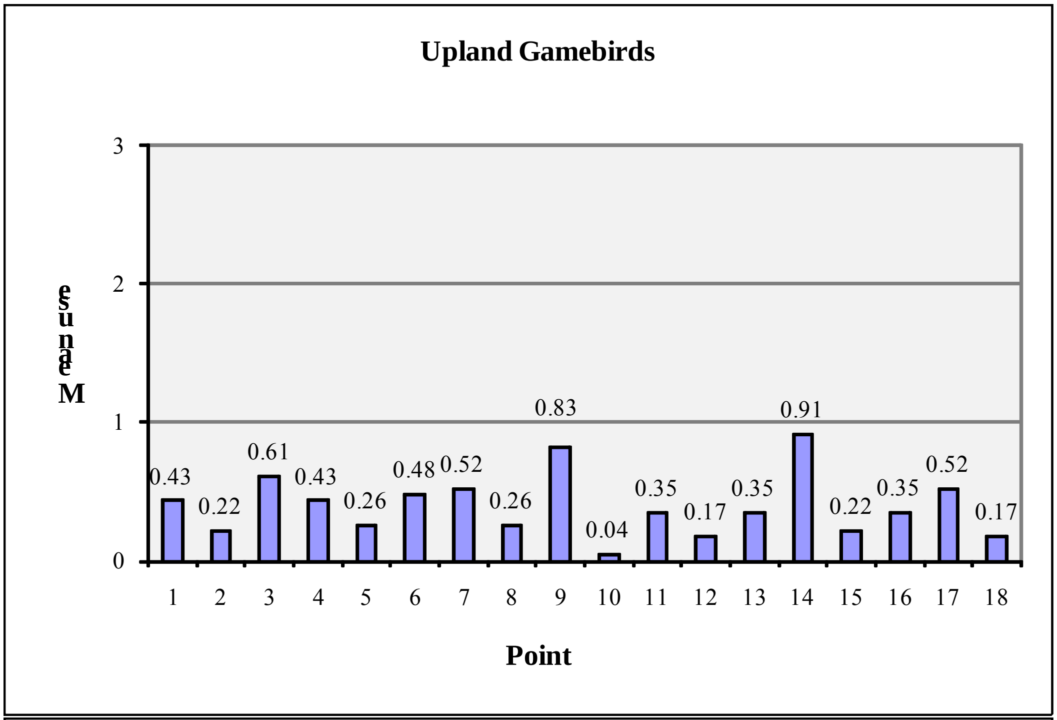


Figure 5 (*continued)*. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.



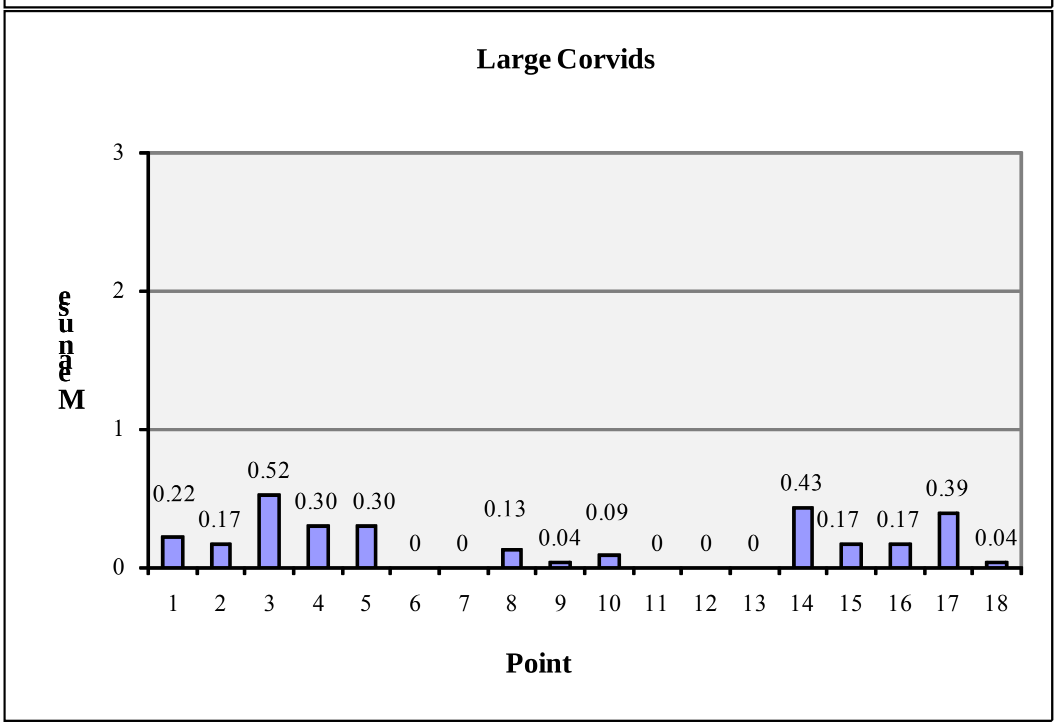


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area.

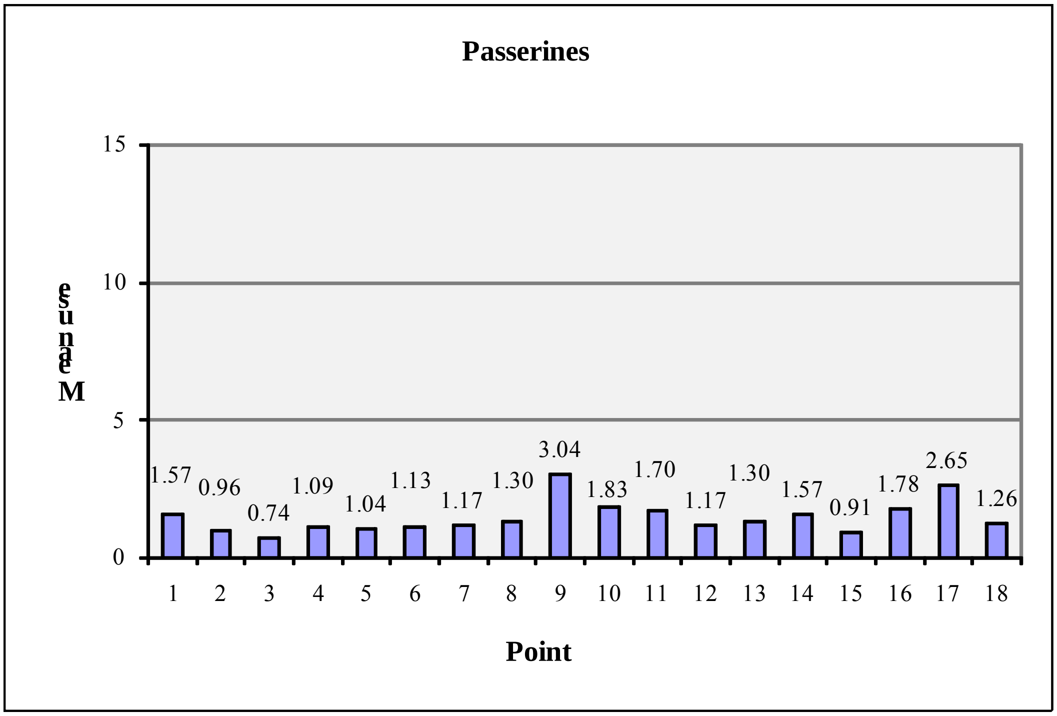


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds, major bird types, and raptor sub-types at the Wilton Expansion Wind Resource Area. Passerine observations were focused within a 100-m viewshed.

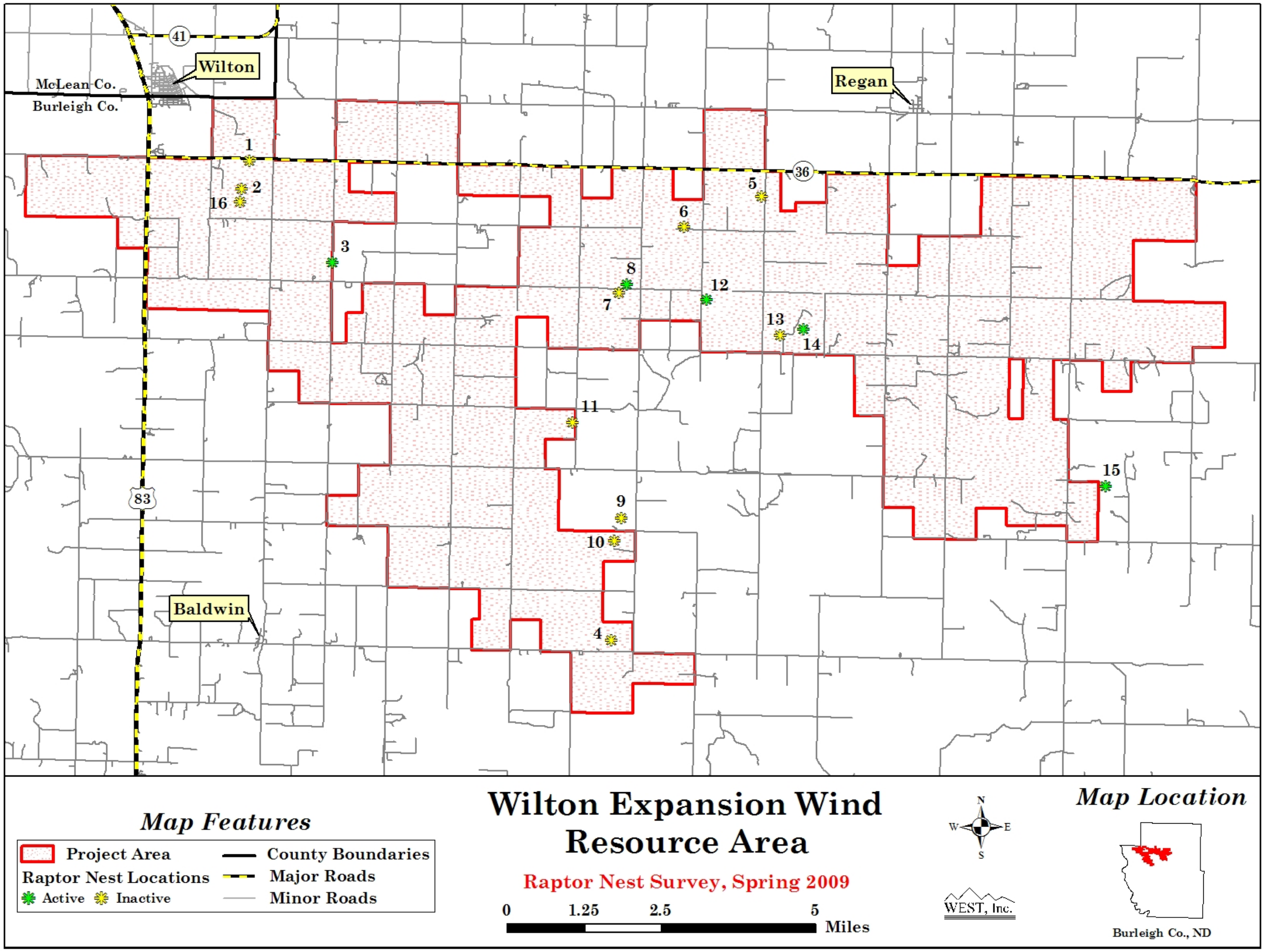


Figure 6. Location of raptor nests at the Wilton Expansion Wind Resource Area.

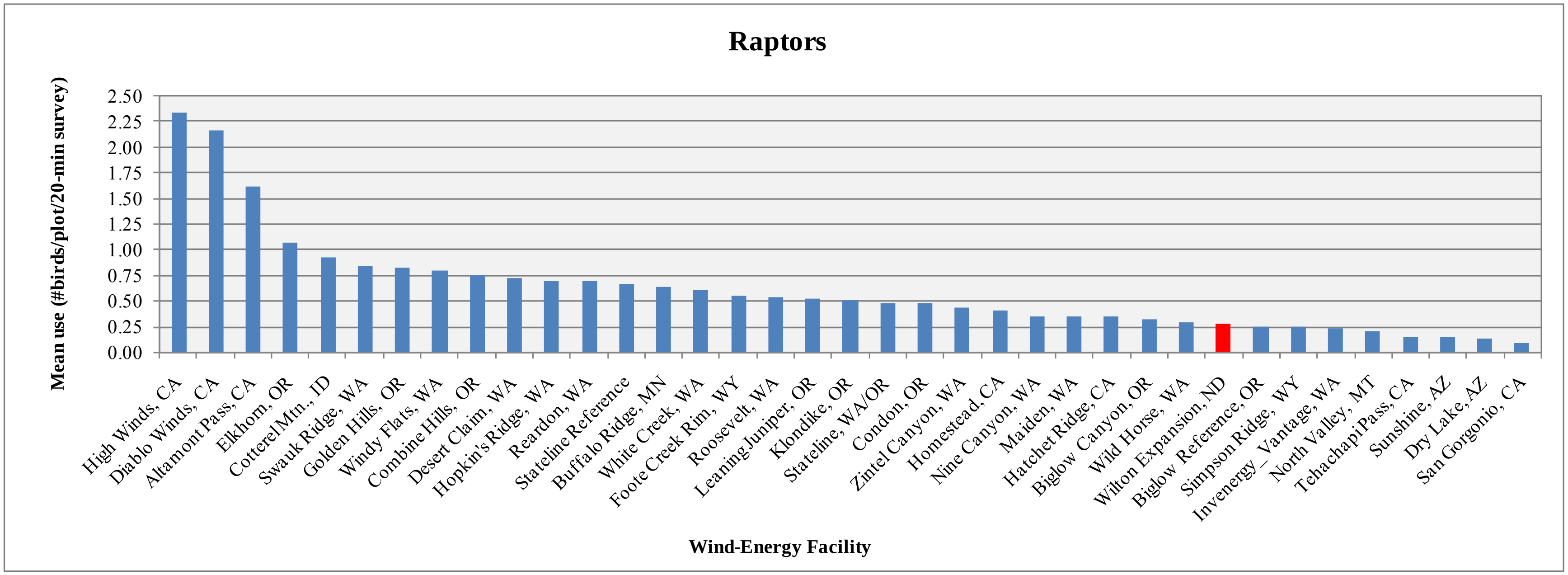
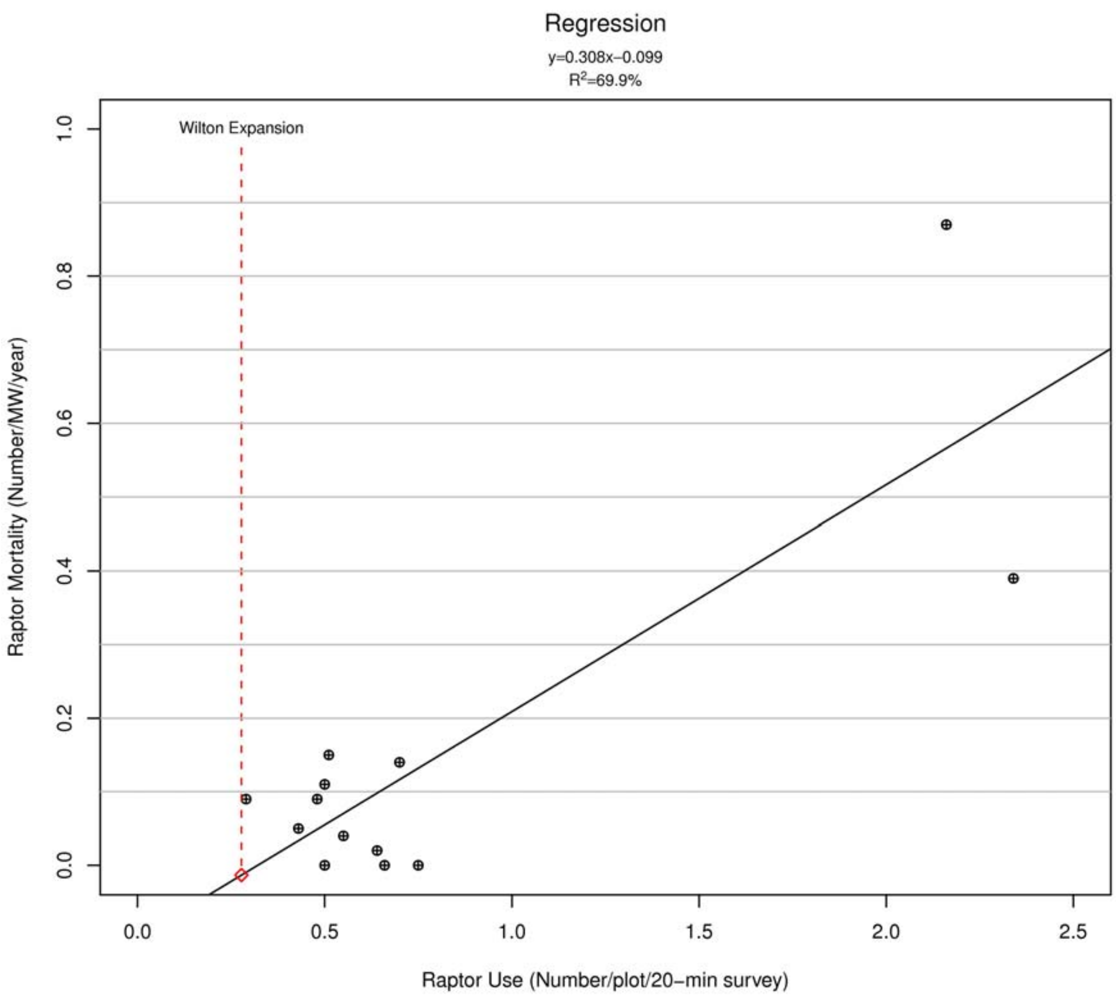


Figure 7. Comparison of annual raptor use between the Wilton Expansion Wind Resource Area and other US wind-energy facilities.

Data from the following sources:

Wilton Expansion, ND	This study.				
High Winds, CA	Kerlinger et al. 2005	Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b
Diablo Winds, CA	WEST 2006a	Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b
Altamont Pass, CA	Erickson et al. 2002b	White Creek, WA	NWC and WEST 2005a	Biglow Canyon, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Foote Creek Rim, WY	Erickson et al. 2002b	Wild Horse, WA	Erickson et al. 2003a
Cotterel Mtn., ID	Cooper et al. 2004	Roosevelt, WA	NWC and WEST 2004	Biglow Reference, OR	WEST 2005c
Swauk Ridge, WA	Erickson et al. 2003b	Leaning Juniper, OR	NWC and WEST 2005b	Simpson Ridge, WY	Johnson et al. 2000b
Golden Hills, OR	Jeffrey et al. 2008	Klondike, OR	Johnson et al. 2002	Invenergy_Vantage, WA	WEST 2007
Windy Flats, WA	Johnson et al. 2007	Stateline, WA/OR	Erickson et al. 2002b	North Valley, MT	WEST 2006b
Combine Hills, OR	Young et al. 2003c	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Erickson et al. 2002b
Desert Claim, WA	Young et al. 2003b	Zintel Canyon, WA	Erickson et al. 2002a	Sunshine, AZ	WEST and the CPRS 2006
Hopkin's Ridge, WA	Young et al. 2003a	Homestead, CA	WEST et al. 2007	Dry Lake, AZ	Young et al. 2007c
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001b	San Gorgonio, CA	Erickson et al. 2002b



Overall Raptor Use 0.28
Predicted Fatality Rate 0.01/MW/year
90.0% Prediction Interval (0, 0.25/MW/year)

Figure 8. Regression analysis comparing raptor use estimations versus estimated raptor mortality.

Data from the following sources:

Study and Location	Raptor Use	Source	Raptor Mortality	Source
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003c	0.00	Young et al. 2005
Diablo Winds, CA	2.161	WEST 2006a	0.87	WEST 2006a
Foote Creek Rim, WY	0.55	Erickson et al. 2002b	0.04	Erickson et al. 2002b
High Winds, CA	2.34	Kerlinger et al. 2005	0.39	Kerlinger et al. 2006
Hopkins Ridge, WA	0.70	Young et al. 2003a	0.14	Young et al. 2007a
Klondike II, OR	0.50	Johnson 2004	0.11	NWC and WEST 2007
Klondike, OR	0.50	Johnson et al. 2002	0.00	Johnson et al. 2003
Stateline, WA/OR	0.48	Erickson et al. 2002b	0.09	Erickson et al. 2002b
Vansycle, OR	0.66	WCIA and WEST 1997	0.00	Erickson et al. 2002b
Wild Horse, WA	0.29	Erickson et al. 2003a	0.09	Erickson et al. 2008
Zintel, WA	0.43	Erickson et al. 2002a	0.05	Erickson et al. 2002b
Bighorn, WA	0.51	Johnson and Erickson 2004	0.15	Kronner et al. 2008

DRAFT
NATIVE PRAIRIE SURVEY
BALDWIN WIND ENERGY CENTER
BURLEIGH COUNTY
NORTH DAKOTA

PREPARED FOR

NEXTera ENERGY RESOURCES

Prepared by

TETRA TECH EC, INC.

October 2009

Executive Summary

NextEra Energy Resources, LLC (NextEra Energy), is planning to develop a wind energy conversion facility in south-central North Dakota. The Baldwin Wind Energy Center (hereafter, Project Area) is located on 14,294 acres of private land in Burleigh County, North Dakota. Although there are no federal or state regulations explicitly protecting native prairie, the North Dakota Game and Fish Department (NDGFD) and the U.S. Fish and Wildlife Service (USFWS) highlighted the significance of native prairie in their responses to inquiry letters with respect to development in the region, and recommended avoiding areas of native prairie to the extent possible. NextEra Energy is committed to environmental due diligence and contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct a survey for native prairie and to evaluate the potential presence of habitat for the Dakota skipper (*Hesperia dacotae*), a species of butterfly which is currently classified as a federal candidate species.

To achieve these goals, a field biologist conducted ground surveys of the 14,294-acre Project Area from September 18 to 21, 2009, based on August 3, 2009 boundaries. The field biologist classified 2,964 acres (21 percent of the total Project Area) as native prairie and 351 acres (2 percent of the total Project Area) as tame grasslands; the remaining acreage consists primarily of agricultural croplands. Large contiguous areas of native prairie were found in the central portions of the Project Area. Tame grasslands were found primarily in the northwest portion of the Project Area. Grasslands (both native and tame) are more fragmented and less abundant in the remainder of the Project Area.

The Dakota skipper may occur within the Project Area. The field biologist classified 132 acres of grasslands within the Project Area as excellent and 1,026 acres as good Dakota skipper habitat. This is approximately 8 percent of total Project Area, (29 percent of the total grassland habitat identified by the biologist).

The proposed turbine layout dated September 9, 2009 included 66 1.5-MW GE wind turbines and 8 alternative locations. Under this proposed configuration, 11 turbines (17 percent) would be placed within native prairie. Two of the proposed turbines fall within excellent Dakota skipper habitat and 6 lie within good Dakota skipper habitat. The USFWS indicated that one wetland easement is located in the Project Area, but would not be impacted according to the current Project layout, dated September 9, 2009.

Baldwin Wind Energy Center Recommendations

Conversion of native prairie to other land uses, fragmentation, and overgrazing by cattle has resulted in continent wide losses of native prairie habitat. Loss of native prairie may affect ecosystem function and wildlife species that are dependent on the native plants for food, cover, and breeding habitat. In order to decrease the loss of native prairie habitat the following is recommended:

- Native prairie and Dakota skipper habitat surveys should be conducted on any additional acreage added to the Project Area.
- To the greatest extent possible, minimize impacts to native prairie by siting turbines in cultivated areas, existing rights-of-way or altered landscapes.
- If turbines are to be placed in native prairie, avoid large contiguous tracts, if possible. Placement of turbines in native prairie that is less suitable for wildlife such as those classified as fair/poor for the Dakota skipper, those that do not contain permanent or semi-permanent wetlands, areas with a history of fire suppression and grazing regimes, or areas encroached by non-native species, is preferred.
- If turbines or roads are to be placed in areas identified in this report as either excellent or good habitat for the Dakota skipper, presence/absence surveys for the species should be conducted.

- If native vegetation is disturbed or removed during construction of roads, turbines, or during on-going maintenance activities, these areas should be reseeded or planted with native material.
- If construction activities require the use of straw bales, particularly in areas identified as native prairie in this report, the use of certified weed-free straw is recommended.
- Invasive species monitoring should be conducted and control measures implemented to prevent the spread of these species to uninfected areas.

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1. Introduction

NextEra Energy Resources, LLC (NextEra Energy), is planning to develop a wind energy conversion facility in south-central North Dakota (Figure 1). The Baldwin Wind Energy Center (hereafter, Project Area) is located on 14,294 acres of private land in Burleigh County, North Dakota. The results presented in this report are inclusive of the entire 14,294-acre Project Area, based on August 3, 2009 boundaries. According to the turbine layout dated August 9, 2009, three alternate turbines were added after the survey was complete and are therefore outside of the survey area. The Project Area currently encompasses land that consists primarily of agricultural crops and grasslands (both tame grasslands and native prairie). Although there are no federal or state regulations explicitly protecting native prairie, the North Dakota Game and Fish Department (NDGFD) and the U.S. Fish and Wildlife Service (USFWS) both highlight the significance of native prairie. According to the USFWS indicated native prairie has significant natural resource values including some of the following:

- Provides habitat for a number of migratory and resident grassland birds whose populations are declining.
- Provides nesting habitat for millions of waterfowl.
- Contains 200-300 plant species, which provide genetic diversity important to agriculture and medicine.
- Provides habitat for thousands of insects, including the Dakota skipper (*Hesperia dacotae*), a candidate species for listing under the Endangered Species Act (ESA), and other butterflies (e.g., regal fritillary (*Speyeria idalia*) and tawny crescent (*Phyciodes batesii maconensis*)).
- Crucial for soil and water conservation.
- Provides recreational opportunities, including hunting, bird watching, wildlife observation and hiking.

The Project Area is located in the Missouri Coteau region of the Northwestern Glaciated Plains (U.S. Geological Survey [USGS] 2008). The Northwestern Glaciated Plains ecoregion marks the western most extent of continental glaciation and is characterized by significant surface irregularity and high concentrations of wetlands. The wetlands of the Missouri Coteau and the neighboring prairie pothole region are the major waterfowl production areas in North America. Land use on the coteau is a mixture of tilled agriculture in flatter areas and grazing lands on steeper slopes. Native prairie, characterized by western wheatgrass (*Pascopyrum smithii*), big bluestem (*Andropogon gerardii*), needle-and-thread grass (*Stipa comata*), and green needlegrass (*Stipa viridula*), remains on unbroken areas.

Native prairies, which are areas of untilled grassland dominated by non-introduced species or areas of previously broken grassland that have reverted back to native vegetation, are found throughout North Dakota. In contrast, tame grasslands (e.g., pasturelands) are comprised primarily of non-native species. Native prairie further differs from tame grassland in that native prairies are found primarily on unbroken soil whereas tame grasslands occur on tilled soils that have been planted. Since settlement in the 1800s, North Dakota has lost approximately 80 percent of the native prairies with most remaining areas being found in the arid western portions of the state (North Dakota Parks and Recreation Department undated).

Native prairie may be used in several ways on the landscape. Most native prairie in private holdings is used for cattle ranching and is managed as rangeland. On rangeland, the soil is not tilled and fire is often used to suppress the growth of woody species (Hagen et al. 2005); other forms of management (e.g., seeding, fertilizing) are less common. Native prairie may also be placed in conservation easements or held privately or publicly as grassland preserves or wildlife refuges. Preserves and refuges can be difficult to visually distinguish from rangeland because the same types of management (i.e., fire and grazing) are often applied.

Native prairie serves as a vital ecological resource by improving water quality, providing erosion control, and supporting a diverse population of plants and animals; however, due to the prairies' fertile soils and predominantly flat topography, many prairies have been converted to agricultural lands. The widespread loss of prairies makes them an ecosystem of conservation concern and one of the most endangered ecosystems in North America (Samson et al. 2004). Additional factors that have altered the ecology of prairie ecosystems include colonization of non-native plant species, loss of native grazers (e.g., bison), altered fire regime, and fragmentation in the form of urban development. The lack of fire coupled with overgrazing can reduce the value of prairies to wildlife because these factors may result in the conversion of prairie to shrubland or woodland, which may not be utilized by grassland species (Grant et al. 2004, Reinking 2006).

Native prairie serves as vital habitat for the Dakota skipper (*Hesperia dakotae*), a species of butterfly which is currently classified as a candidate species for listing under the ESA. The Dakota skipper is classified as a candidate species because, although its historic range once consisted of vast, unfragmented native prairie in north-central U.S. and south-central Canada, its current range is now limited to scattered remnants of high quality native prairie in Minnesota, North and South Dakota, and southern Manitoba (USFWS 2002). The Dakota skipper population has declined due to sensitivity to disturbances, such as grazing and fire. The Dakota skipper's classification as a federal candidate species does not currently entitle it to legal protection under the ESA; however, if a candidate species becomes listed as threatened or endangered, then protection for that species is mandated under the ESA.

One additional concern about the conversion of native prairie is the potential impacts on breeding migratory waterfowl. Native prairie provides suitable stopover habitat during migration and upland nesting cover for such waterfowl species as northern pintail (*Anas acuta*), blue-winged teal (*Anas discors*), and mallard (*Anas platyrhynchos*). The prairie region of the northern Great Plains is one of the most important areas for duck reproduction in North America (Samson et al. 1998, Jones-Farrand et al. 2007). The region produces, on average, 50 percent of the primary species of game ducks on the continent (Smith 1995). Twelve of the 34 species of North American ducks are common breeders in the region (Samson et al. 1998, Jones-Farrand et al. 2007). For seven species — mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), blue-winged teal (*Anas discors*), northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), redhead (*Aythya americana*), and canvasback (*Aythya valisineria*) — the prairie region accounts for more than 60 percent of the breeding population (Smith 1995). The region is also a major migration corridor during fall and spring for other ducks, geese, shorebirds and other waterbirds (Skagen and Knopf 1994, Samson et al. 1998, Jones-Farrand et al. 2007). Although construction of a wind energy facility differs from wholesale conversion of grassland to agricultural croplands, disturbances of native prairies, particularly those that surround permanent or semi-permanent wetlands (prairie potholes), have the potential to affect these important breeding and migratory stopover areas.

The USFWS administers Waterfowl Production Areas (WPAs), as well as wetland and grassland easements, throughout North Dakota. The Long Lake Wetland Management District of the USFWS manages the various easements that are potentially located in and adjacent to the Project Area. Wetland easements are legal agreements with landowners that permanently protect wetlands from being drained, burned, leveled or filled. Grassland easements are legal agreements with landowners that permanently protect grassland vegetation, especially native prairie, from being destroyed, developed or converted into cropland. If construction activities or turbines disturb WPAs, grassland easements, or wetland basins within wetland easements, the USFWS will require a permit application and an Environmental Assessment.

NextEra Energy is committed to environmental due diligence and therefore contracted Tetra Tech EC (hereafter, Tetra Tech) to conduct a native prairie survey for the Project Area and to determine the extent of native prairie that may be used by the Dakota skipper.

2. Methods

A field biologist conducted field surveys from September 18 to 21, 2009. These dates fall within the appropriate time of year to identify plant species due to their flowering seasons and to assess grazing intensity. In order to systematically identify areas of native prairie, the field biologist visually assessed each square mile (section) of land within the Project Area by making roadside stops and walking surveys to delineate and describe all grassland habitat. In many areas, one square-mile sections of land were bordered by county roads or section-line two-track trails, which made them easy to evaluate. Roadside stops were made when needed (e.g., change in habitat, change in land use, or limited view), which was generally once each quarter-mile. Whenever possible, walking surveys were done within representative areas of each grassland parcel. Large contiguous tracts of grassland that could not be identified from roads were accessed on foot, resulting in almost complete coverage of the original Project Area.

When grasslands were encountered during field surveys, the field biologist determined if the grasslands were native prairie or tame grasslands. Native prairie was defined as that which had never been tilled ("broken") or planted to crops or introduced plants. Tame grassland was defined as grassland created by planting native or non-native plant species (other than cropland or hay). The field biologist determined grassland type based on several visual cues including the following: dominant visible plant species, particularly the proportion of native to non-native dominant species in core areas away from fence lines; frequency of typical native prairie species that are not as common or not present at all in tilled and seeded pastureland compared to native prairie; topography (feasibility of being tilled); presence of piles of rocks (which indicate clearing of rock from an area in preparation for cultivation); and vegetation obviously growing in rows (indicating prior tilling and seeding). The biologist also noted any obvious uses of the grassland parcel and the predominant type of grassland community (herbaceous-perennial; herbaceous-annual; woody encroached). Areas of presumably unbroken soil that retained native prairie plants were classified as native prairie, and may have included rangelands, conservation easements, or other types of reserves (Appendix 1, Photo1). Areas that appeared to have been tilled and were comprised of mostly non-native species were classified as tame grasslands (Appendix 2, Photo 2). Two common practices sometimes made these distinctions difficult in the field. Overseeding involves directly seeding introduced plants to native prairie sod (without completely breaking/tilling the soil); parcels that appeared to have been overseeded were considered native prairie. Haying native prairie or tame grassland is also common (Appendix 2, Photo 3); hayland that was dominated by grasses was considered tame grassland or native prairie as appropriate, whereas hayland obviously planted to legumes such as alfalfa (*Medicago sativa*) or sweetclover (*Melilotus* sp.) were not considered grassland.

The field biologist also evaluated grasslands to determine their suitability as habitat for the Dakota skipper. The criteria used during classification were the current grazing intensity, the overall quality and diversity of the native prairie within the grassland, and the presence of key plant species which the Dakota skipper depends upon (e.g., bluestem [*Andropogon* spp.], coneflower [*Echinacea* spp.], and camas [*Zygadenus* sp.]). Excellent habitat was defined as grasslands, both tame grassland and native prairie, where only light grazing had occurred and at least 1 key plant species was present; good habitat was defined as grasslands, both tame grassland and native prairie, with moderate grazing and where key plant species were either present or not; and poor habitat was defined as grasslands, both tame grasslands and native prairie, where heavy grazing had occurred and key plant species were either present or not. The field biologist recorded grazing intensity by estimating the percentage of vegetation grazed in broad classes: 0-25 percent (light), 25-50 percent (moderate), 50-75 percent (heavy), and 75-100 percent (overgrazed). The habitat types and quality classifications were delineated by the field biologist on aerial photographs of each section of land. The locations of grasslands and habitat quality were then digitized from the aerial photographs using ArcGIS 9.3.

3. Results

A total of 2,964 acres (21 percent of the total Project Area) was classified as native prairie, and 351 acres (2 percent of the total Project Area) were classified as tame grasslands (Figure 2). Large contiguous areas of native prairie were found in the central portions of the Project Area. Tame grasslands were found primarily in the northwest portion of the Project Area. Grasslands (both native and tame) are more fragmented and less abundant in the remainder of the Project Area.

A total of 14 grass (21 percent non-native), 5 tree and shrub (0 percent non-native) and 53 forb (17 percent non-native) species were identified in native prairies within the Project Area (Table 1). Five grass (80 percent non-native), 2 tree and shrub (50 percent non-native) and 16 forb (69 percent non-native) species were identified in tame grasslands within the Project Area (Table 2). None of the plant species detected within the Project Area are listed as federally endangered or threatened.

The North Dakota Department of Agriculture (NDDA) defines two categories of invasive species: 1) “noxious weeds,” any plants that have been designated as injurious to public health, livestock, land or other property 2) “invasive species,” species that are non-native and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (NDDA 2003). Four species listed as North Dakota State Noxious Weeds were found within the Project Area (see Table 1 for scientific names): absinthe wormwood, Canada thistle, field bindweed, and leafy spurge (North Dakota Century Code 2003). An additional 7 species listed as North Dakota State Invasive Species were found within the Project Area: black medic, crested wheatgrass, field sow thistle, Kentucky bluegrass, Siberian elm, smooth brome, and yellow sweet clover.

A total of 132 acres of grasslands were classified as excellent habitat for the Dakota skipper (Figure 3). This is approximately 3 percent of the total grassland habitat present within Project Area and 8 percent of the total Project Area. An additional 1,026 acres of grassland were classified as good Dakota skipper habitat, or approximately 26 percent of the total grassland habitat. In total, slightly less than one-third (29 percent) of grassland habitat within the Project Area was classified as either excellent or good skipper habitat. Small areas of excellent skipper habitat classified are located in the north-central and southwestern portions of the Project Area.

The proposed turbine layout dated September 9, 2009 included 66 1.5-MW GE wind turbines and 8 alternative locations. Under the proposed configuration, 17 percent of these turbines would be placed within native prairie (11 turbines). Two (3 percent) of the proposed turbines fall within excellent Dakota skipper habitat and 6 (9 percent) lie within good Dakota skipper habitat (Figure 3).

4. Discussion

Prairies are an ecosystem of conservation concern (Samson et al. 2004) and the NDGFD and the USFWS highlighted the significance of native prairie in North Dakota. Native prairie comprises 21 percent of the Project Area and, and under the current configuration, 17 percent of turbines would be located within native prairie. The USFWS has recommended that:

- Priority should be given to siting turbines on tame, planted, or seeded grasslands in preference to unbroken native prairie.
- Turbines shall be sited as close to existing roads or the edge of the grassland tract as practical. Buried transmission lines, electric lines, and other cables shall be co-located on the access road when practical (USFWS 2003).

Maintaining unfragmented areas of native prairie in the Project Area may be of greatest benefit to wildlife in general. Raptors, such as short-eared owl and ferruginous hawk, benefit from large areas of prairie for nesting (Blair and Schitoskey 1982, Holt and Leasure 1993) as do waterfowl (Klett et al. 1988). Large expanses of native prairie provide suitable nesting habitat for songbirds and lower rates of brood parasitism by brown-headed cowbirds have been observed within larger tracts of prairie (Shaffer et al. 2003, Davis et al. 2006). Although some mammal species such as deer thrive in altered landscapes, others, such as swift fox, may require areas of unfragmented native prairie (Kamler et al. 2003). Areas of native prairie that also contain wetlands within the Project Area could provide important breeding and stopover habitat for various waterfowl and shorebird species, such as those creeks and streams present throughout the Project Area.

Within the Project Area, four noxious weeds (absinthe wormwood, Canada thistle, field bindweed, and leafy spurge) were located in native prairie and tame grasslands. North Dakota law (NDCC § 63-01.1-01) requires North Dakota landowners and other persons in charge of or in possession of land to eradicate or control the spread of noxious weeds. County and city weed boards enforce the existing statute through inspections, issuance of notice to control and follow-up re-inspections. If unhandled by the landowner or other persons in charge of or in possession of infested land, the weed boards have the authority to control weeds on the land in question and charge the landowner the cost of control through levying additional real estate taxes upon the landowner the following year (North Dakota Weed Control Association 2008). Depending upon their management goals, the landowners are responsible for invasive species management. Construction activities within the Project Area could spread these species into areas currently not occupied; therefore, coordination with local agencies is recommended in order to develop best management practices aimed at preventing the spread of noxious weeds and invasive species.

Given the moderate availability of Dakota skipper habitat within the Project Area, any reduction of native prairie, especially to habitats classified as excellent or good, is likely to have an impact to local Dakota skipper populations, if present. No legal protection is currently provided to the Dakota skipper as a candidate species under the ESA, but efforts should be made to avoid impacts to this species that may result in its listing. Limiting impacts to Dakota skipper habitat, which coincides with limiting impacts to native prairie overall, may result in a more positive review from agencies if the species does become listed under the ESA. If turbines need to be placed within native prairie due to design or engineering limitations, then efforts should be made to avoid those that were classified as excellent or good habitat for the Dakota skipper. If unavoidable, native prairie classified as excellent or good habitat that are to be developed should have Dakota skipper presence/absence surveys to determine presence of the species and to identify possible mitigation measures.

If wind turbines are sited in grassland easements or wetland basins within wetland easements, the USFWS will require a permit application and an Environmental Assessment. In their response to an inquiry letter with respect to development at this location, the USFWS indicated that one wetland easement is located in the Project Area, but would not be impacted according to the current Project layout, dated September 9, 2009 (Figure 4).

5. Recommendations

Conversion of native prairie to other land uses, fragmentation, and overgrazing by cattle has resulted in continent wide losses of native prairie habitat. Loss of native prairie may affect ecosystem function and wildlife species that are dependent on the native plants for food, cover, and breeding habitat. In order to decrease the loss of native prairie habitat the following is recommended:

- Native prairie and Dakota skipper habitat surveys should be conducted on any additional acreage added to the Project Area.
- To the greatest extent possible, minimize impacts to native prairie by siting turbines in cultivated areas or altered landscapes.
- If turbines are to be placed in native prairie, avoid large contiguous tracts, if possible. Placement of turbines in native prairie that is less suitable for wildlife such as those classified as fair/poor for the Dakota skipper, those that do not contain permanent or semi-permanent wetlands, areas with a history of fire suppression and grazing regimes, or areas encroached by non-native species, is preferred.
- If turbines or roads are to be placed in areas identified in this report as either excellent or good habitat for the Dakota skipper, presence/absence surveys for the species should be conducted.
- If native vegetation is disturbed or removed during construction of roads, turbines, or during on-going maintenance activities, these areas should be reseeded or planted with a comparable native grass/forb seed mixture. If possible, obtain seed stock from nurseries within 250 miles of the Project Area to insure the particular cultivars are well adapted to the local climate.
- If construction activities require the use of straw bales, particularly in areas identified as native prairie in this report, the use of certified weed free straw is recommended.
- Noxious weed and Invasive species monitoring should be conducted and control measures implemented to prevent the spread of these species to uninfected areas.

6. References

Blair, C.L., and F. Schitoskey Jr. 1982. Breeding biology and diet of the Ferruginous Hawk in South Dakota. Wilson Bulletin 94:46-54.

Davis, S.K., R.M. Brigham, T.L. Shaffer, and P.C. James. 2006. Mixed-grass passerines exhibit weak and variable responses to patch size. Auk 123:807-821.

Grant, T.A., E. Madden, and G.B. Berkey. 2004. Tree and shrub invasion in northern mixed-grass prairie: Implications for breeding grassland birds. Wilson Bulletin 32:807-818.

Hagen, S.K., P.T. Isakson, and S.R. Dyke. 2005. North Dakota Comprehensive Wildlife Conservation Strategy. North Dakota Game and Fish Department. Bismarck, ND..http://www.gf.nd.gov/conservation/cwcs.html.

Holt, D.W., and S.M. Leasure. 1993. Short-eared Owl (*Asio flammeus*). In The Birds of North America, No. 62 (A. Poole and F. Gill, editors). The Birds of North America, Inc., Philadelphia, PA

Jones-Farrand, D.T., D.H. Johnson, L.W. Burger, Jr., and M.R. Ryan. 2007. Grassland Establishment for Wildlife Conservation. Pages 25-43 in Fish and Wildlife Response to Farmbill Conservation Practices. Technical Review 07-1.

Kamler, J.F., W.B. Ballard, E.B. Fish, P.R. Lemons, K. Mote, and C.C. Perchellet. 2003. Habitat use, home ranges, and survival of swift foxes in a fragmented landscape: conservation implications. Journal of Mammalogy 84:989-995.

Klett, A.T., T.L. Shaffer, and D.H. Johnson. 1988. Duck nest success in the prairie pothole region. Journal of Wildlife Management 52:431-440.

North Dakota Department of Agriculture (NDDA). 2003. Invasive Species Web-based Manual. Available online at http://www.agdepartment.com/noxiousweeds/index.asp. Accessed 21 October 2009.

North Dakota Century Code. 2003. *Noxious weed control*. State of North Dakota. Available online at http://www.agdepartment.com/Programs/Plant/Noxious Weeds.html. Accessed 21 October 2009.

North Dakota Parks and Recreation Department. No Date. North Dakota prairie: our natural heritage. North Dakota Parks and Recreation Department, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Jamestown, ND. Available online at http://www.npwrc.usgs.gov/resource/habitat/heritage/index.htm. Accessed 21 October 2009.

North Dakota Weed Control Association. 2008. North Dakota Noxious Weed Law enforcement procedures. Available online at http://ndweeds.homestead.com/. Accessed 21 October 2009.

Reinking, D.L. 2006. Fire in the tallgrass prairie – Balance of burning for the birds. Birding Jan/Feb: 33-38.

Samson, F.B., F.L. Knopf, and W.R. Ostlie. 2004. Great Plains ecosystems: Past, present and future. Wildlife Society Bulletin 32:6-15.

Samson, F.B., F.L. Knopf, and W.R. Ostlie. 1998. Regional trends of biological resources--grasslands. Pages 437-472 in M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, editors. Status and trends of the nation's biological resources. Volume 2. U.S. Department of the Interior, Geological Survey, Reston, Virginia.

Shaffer, J.A., C.M. Goldade, M.F. Dinkins, D.H. Johnson, L.D. Igl, and B.R. Euliss. 2003. Brown-headed Cowbirds in grasslands: Their habitats, hosts, and response to management. Prairie Naturalist 35:145-186.

Skagen, S.K., and F.L. Knopf. 1994. Migrating shorebirds and habitat dynamics at a prairie wetland complex. Wilson Bulletin 106:91-105.

Smith, G.W. 1995. A critical review of aerial and ground surveys of breeding waterfowl in North America. National Biological Service Biological Science Report 5.

U.S. Department of Agriculture – Farm Service Agency (USDA-FSA). 2007. United States Department of Agriculture – Farm Services Agency website. http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=landing. Accessed 21October 2009.

U.S. Fish and Wildlife Service (USFWS). 2002. Status Assessment and Conservation Guidelines, Dakota skipper.

U.S. Fish and Wildlife Service (USFWS). 2003. Interim guidance on avoiding and minimizing wildlife impacts from wind turbines. Available online at: http://www.fws.gov/habitatconservation/wind.htm. Accessed 21 October 2009.

U.S. Geological Survey (USGS). 2007. Ecoregions of North Dakota and South Dakota. Northern Prairie Wildlife Research Center. Available online at: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/nodak.htm. Accessed October 21, 2009.

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Peer Review	Date
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Technical Review	Date
Peter Omdal	N/A
GIS Technician	Date

Table 1. Plant species observed in native prairie within the Baldwin Wind Energy Center with non-native species in bold.

Forbs			
Scientific name	**English name**	**Scientific name**	**English name**
Achillea millefolium L.	yarrow	*Helianthus rigidus* (Cass.) Desf.	stiff sunflower
Ambrosia psilostachya DC.	western ragweed	*Hordeum jubatum* L.	foxtail barley
Anemone cylindrica A. Gray	candle anemone	*Lactuca oblongifolia* Nutt.	blue lettuce
Antennaria neglecta Green	field pussy-toes	*Liatrus liguliststylis* (A. Nels.) K. Schum.	northern plains blazing star
***Artemisia absinthium* L.**	**absinthe wormwood***	*Liatris punctata* Hook.	dotted blazing star
Artemisia dracunculus L.	silky wormwood	*Linum rigidum* Pursh.	stiffstem flax
Artemisia frigida Willd.	fringed sagewort	*Lygodesmia juncea* (Pursh) Hook.	skeleton weed
Artemisia ludoviciana Nutt.	white sagewort	***Medicago lupulina* L.**	**black medic†**
Aster ericoides L.	heath aster	***Medicago sativa* L.**	**alfalfa**
Aster oblongifolius Nutt.	aromatic aster	***Melilotus officinalis* (L.) Pall.**	**yellow sweet clover†**
Calylophus serrulatus (Nutt.) Raven	plains yellow primrose	*Monarda fistulosa* L.	wild bergamot
Chrysopsis villosa (Pursh) Nutt.	hairy gold aster	*Oenothera biennis* L.	common evening primrose
***Cirsium arvense* (L.) Scop.**	**Canada thistle***	*Oxytropis lambertii* Pursh	purple locoweed
Cirsium flodmanii (Rydb.) Arthur	Flodman's thistle	*Phlox hoodii* Rich.	Hood's phlox
Cirsium undulatum (Nutt.) Spreng.	wavy-leaf thistle	*Potentilla pensylvanica* L.	Pennsylvania cinquefoil
Comandra umbellata (L.) Nutt.	bastard toadflax	*Psoralea argophylla* Pursh	silver-leaf scurf pea
***Conyza canadensis* (L.) Cronq.**	**horseweed**	*Ratibida columnifera* (Nutt.) Woot. & Standl.	prairie coneflower
Dalea purpurea Vent.	purple prairie clover	*Solidago canadensis* L.	Canada goldenrod
Echinacea angustifolia DC.	purple coneflower	*Solidago missouriensis* Nutt.	prairie goldenrod
Erigeron strigosis Muhl. Ex Willd.	daisy fleabane	*Solidago mollis* Bartl.	soft goldenrod
***Euphorbia esula* L.**	**leafy spurge***	*Solidago nemoralis* Ait.	gray goldenrod
Gaura coccinea Pursh	scarlet gaura	*Solidago ptarmicoides* (Nees) Boivin	sneezewort aster
Glycyrrhiza lepidota Pursh.	wild licorice	*Solidago rigida* L.	rigid goldenrod
Grindelia squarrosa (Pursh) Dun.	curly-top gumweed	***Sonchus arvensis* L.**	**field sow thistle†**
Gutierrezia sarothrae (Pursh) Britt. & Rusby	broom snakeweed	***Tragopogon dubius* Scop.**	**goat's beard**
Haplopappus spinulosus (Pursh) DC.	cutleaf ironplant	*Viola pedatifida* G. Don	prairie violet
Helianthus maximilianii Schrad.	Maximilian sunflower		

Table 1. Plant species observed in native prairie within the Baldwin Wind Energy Center with non-native species in bold.

Grasses			
Scientific name	**English name**	**Scientific name**	**English name**
Agropyron caninum (L.) Beauv. subsp. *majus* (Vasey)C.L.Hitchc.	slender wheatgrass	***Bromus inermis* Leyss.**	**smooth brome†**
***Agropyron cristatum* (L.) Gaertn.**	**crested wheatgrass†**	*Calamovilfa longifolia* (Hook.) Scribn.	prairie sandreed
Agropyron smithii Rydb.	western wheatgrass	*Koeleria pyramidata* (Lam.) Beauv.	Junegrass
Andropogon gerardii Vitman	big bluestem	***Poa pratensis* L.**	**Kentucky bluegrass†**
Andropogon scoparius Michx.	little bluestem	*Stipa comata* Trin. & Rupr.	needle-and-thread
Aristida purpurea Nutt.	three-awn	*Stipa spartea* Trin.	porcupine-grass
Bouteloua gracilis (H.B.K.) Lag. ex. Griffiths	blue grama	*Stipa viridula* Trin.	green needlegrass
Trees and Shrubs			
Scientific name	**English name**	**Scientific name**	**English name**
Amelanchier sp.	Juneberry/service-berry species	*Rosa arkansana* Porter	prairie wildrose
Amorpha canescens Pursh	leadplant	*Symphoricarpos occidentalis* L.	western snowberry
Juniperus horizontalis Moench.	creeping juniper		

- * Indicates species found on the North Dakota's Noxious Weed List.
- † Indicates species considered invasive in North Dakota.
- Nomenclature follows Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas.

Table 2. Plant species observed in tame grasslands within the Baldwin Wind Energy Center with non-native species in bold.

Forbs			
Scientific name	**English name**	**Scientific name**	**English name**
***Artemisia absinthium* L.**	**absinthe wormwood***	***Malva* sp.**	**mallow species**
Artemisia ludoviciana Nutt.	white sagewort	***Medicago lupulina* L.**	**black medic†**
Asclepias syriaca L.	common milkweed	***Medicago sativa* L.**	**alfalfa**
Aster ericoides L.	heath aster	***Melilotus alba* Medic.**	**white sweet clover**
***Astragalus cicer* L.**	**Cicer milkvetch**	*Solidago mollis* Bartl.	soft goldenrod
Chenopodium sp.	goosefoot/lamb's-quarter species	***Sonchus arvensis* L.**	**field sow thistle†**
***Cirsium arvense* (L.) Scop.**	**Canada thistle***	***Tragopogon dubius* Scop.**	**goat's beard**
***Convolvulus arvensis* L.**	**field bindweed***	***Trifolium* sp.**	**clover species**
Grasses			
Scientific name	**English name**	**Scientific name**	**English name**
***Agropyron cristatum* (L.) Gaertn.**	**crested wheatgrass†**	***Poa pratensis* L.**	**Kentucky bluegrass†**
***Agropyron intermedium* (Host) Beauv.**	**intermediate wheatgrass**	*Stipa viridula* Trin.	green needlegrass
***Bromus inermis* Leyss.**	**smooth brome†**		
Trees and Shrubs			
Scientific name	**English name**	**Scientific name**	**English name**
Symphoricarpos occidentalis L.	western snowberry	***Ulmus pumila* L.**	**Siberian elm†**

- * Indicates species found on the North Dakota's Noxious Weed List.
- † Indicates species considered invasive in North Dakota.
- Nomenclature follows Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas.

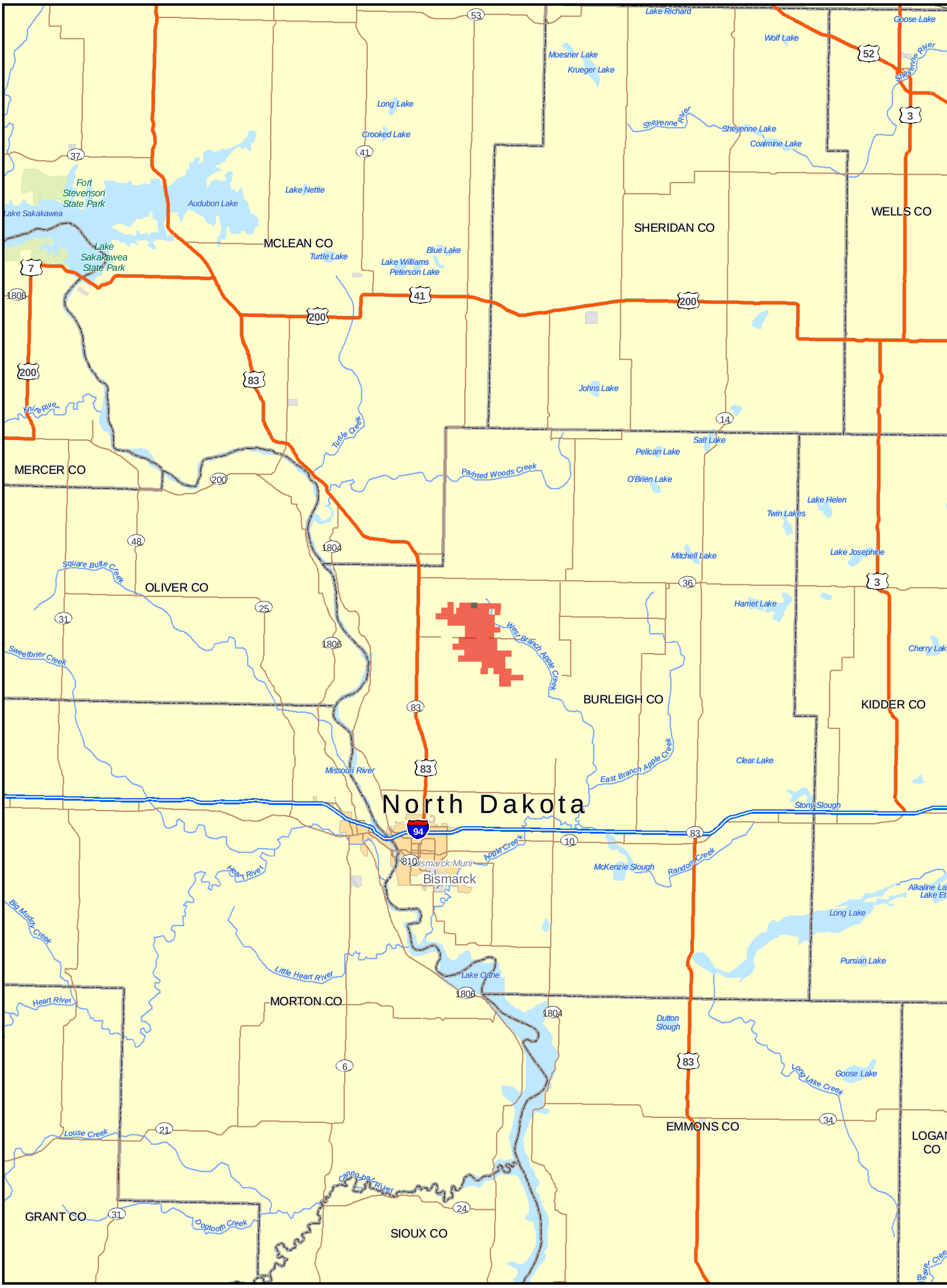


Figure 1.
Wind Resource Area Vicinity Map
Baldwin Wind Energy Center

Burleigh County, ND
October 26, 2009

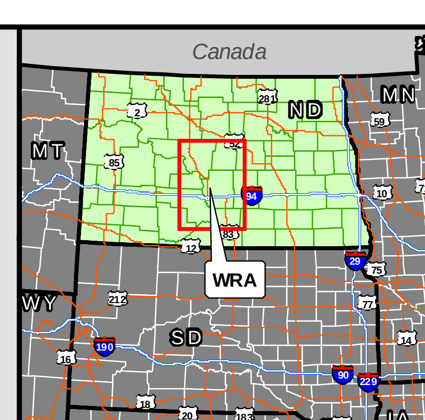
NEXTera ENERGY

1:500,000
NAD 1983 UTM 14

W E S

Project Boundary 8/3/09
Boundary Expansion 9/10/09
State Boundary
County Boundary
River/Stream
Lake/Reservoir
Interstate
Federal Highway
Major Road

0 2 4 6 8 10
Miles



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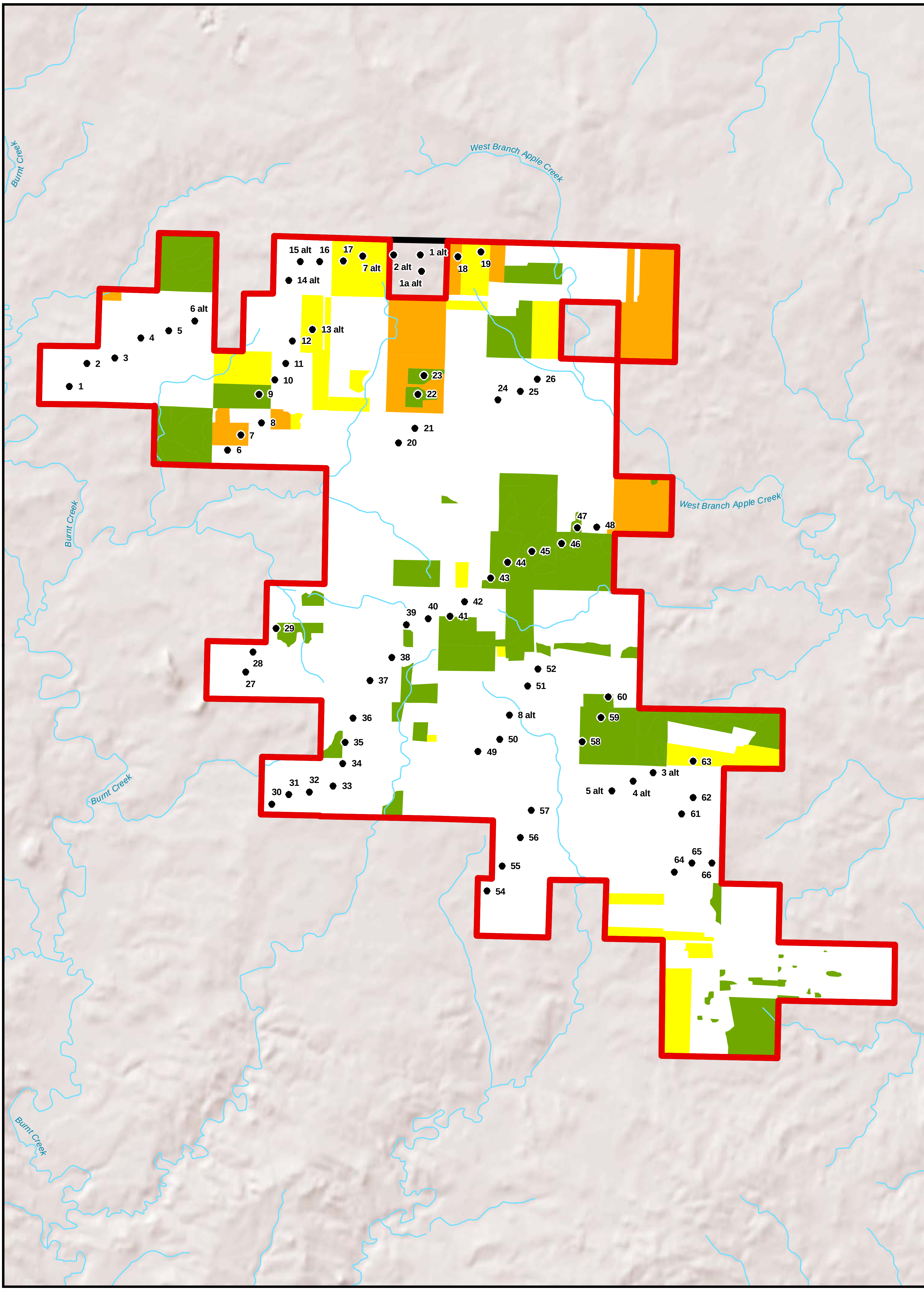


Figure 2.
Native Prairie
and Tame Grasslands
Baldwin Wind Energy Center

Burleigh County, ND
October 26, 2009

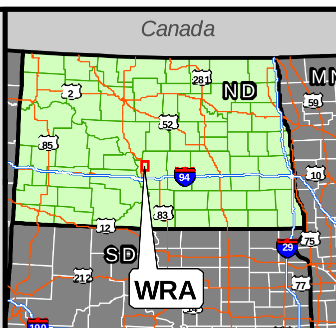
1:50,000
NAD 83 UTM 14

Turbine 9/9/09
Project Boundary 8/3/09
Boundary Expansion 9/10/09
River/Stream
Lake/Reservoir

Cover Type
Native
Tame
Hay
Other

Miles
0 0.5 1 2

Areas outside of the project boundary were not surveyed.



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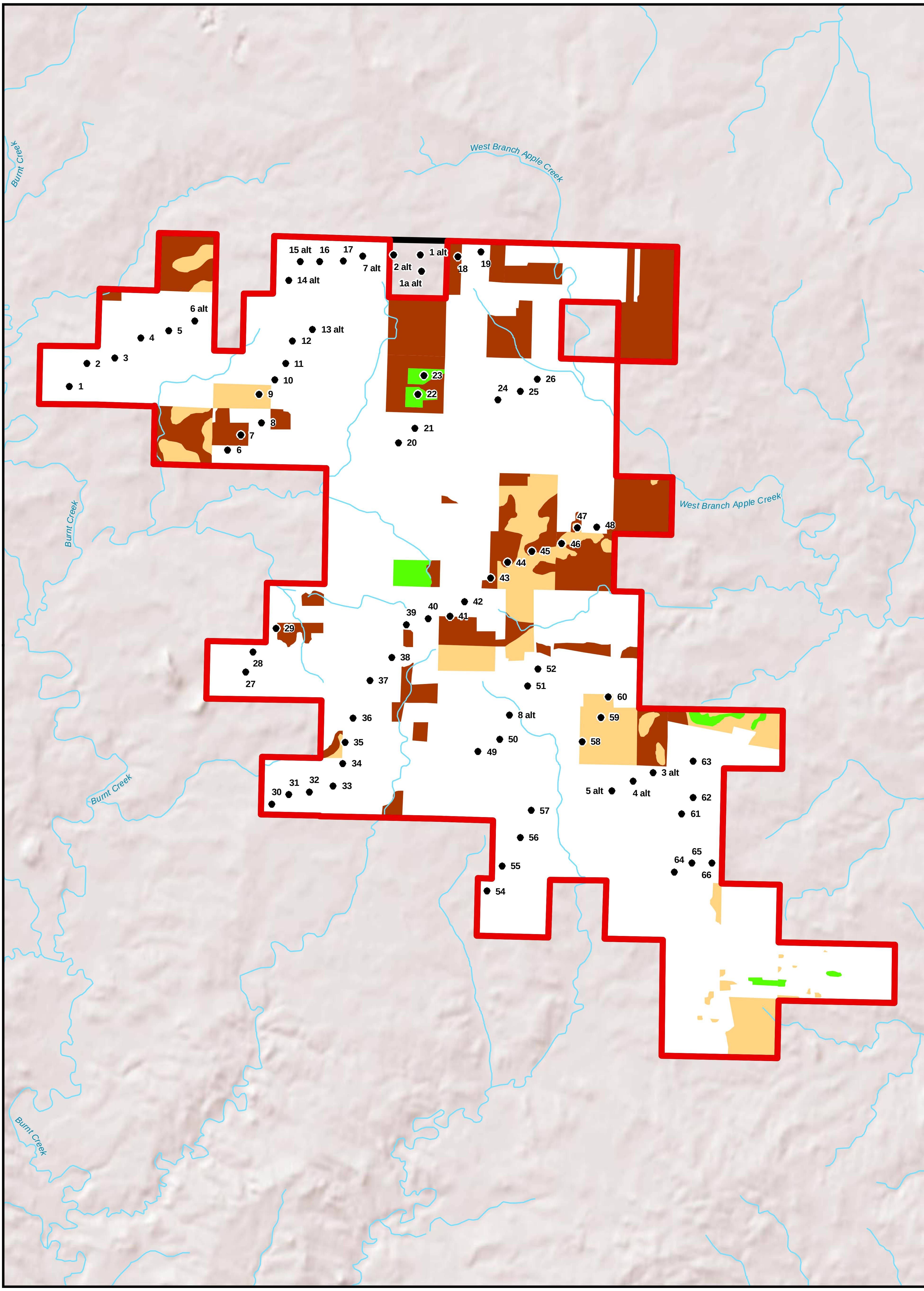


Figure 3.
Potential Dakota Skipper Native Prairie Habitat
Baldwin Wind Energy Center

Burleigh County, ND
October 26, 2009

1:50,000
NAD 83 UTM 14

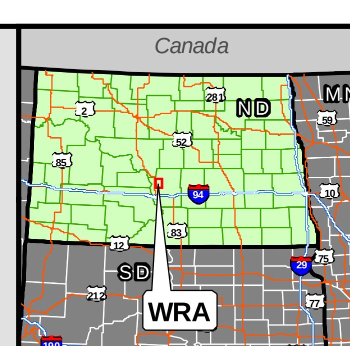
- Turbine 9/9/09
- Project Boundary 8/3/09
- Boundary Expansion 9/10/09
- River/Stream
- Lake/Reservoir

Miles: 0, 0.5, 1, 2

Cover Rank of Native Prairie

- Excellent/Likely
- Good/Possible
- Poor/Unlikely
- Other

Areas outside of the project boundary were not surveyed.



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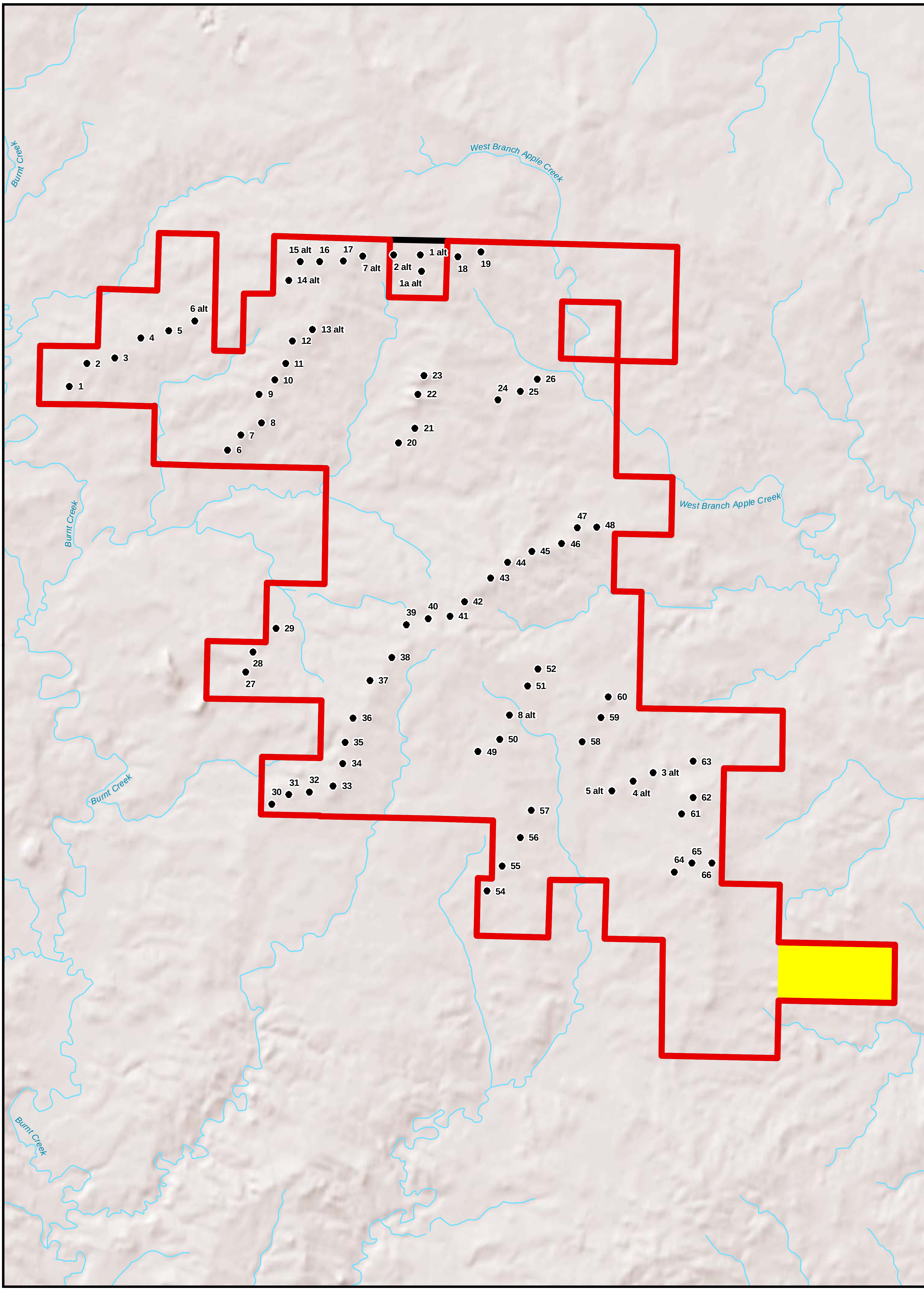


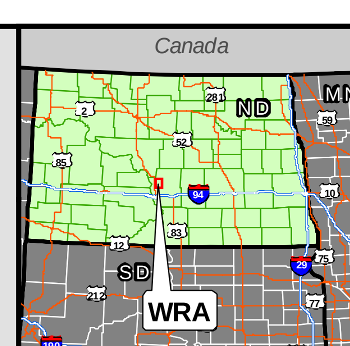
Figure 4.
US Fish and Wildlife Service Easements
Baldwin Wind Energy Center

Burleigh County, ND
October 26, 2009

1:50,000
NAD 83 UTM 14

Turbine 9/9/09
Project Boundary 8/3/09
Boundary Expansion 9/10/09
Wetland Easement
River/Stream
Lake/Reservoir

Miles
0 0.5 1 2



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APPENDIX 1: Site Photographs.

Photo 1: Remnant native prairie on steep hilltops. High diversity of native species with abundant cover of little bluestem (*Andropogon scoparius*) and purple coneflower (*Echinacea angustifolia*).

Photo 2: Native prairie of moderate native species diversity and some woody encroachment in low areas.


Photo 3: Tame grassland or grass-dominated hayland.


Photo 4: Tame grassland. Dense cover of intermediate wheatgrass (*Agropyron intermedium*), smooth brome (*Bromus inermis*), and Kentucky bluegrass (*Poa pratensis*).

APPENDIX 2: Turbines in the Baldwin Energy Center located in native prairie or tame grasslands.

Turbine Number	Easting	Northing	Grassland Type	Skipper Habitat Rank
7	369212	5216434	Tame	Poor/Unlikely
9	369471	5217003	Native	Good/Possible
18	372247	5218928	Tame	Poor/Unlikely
22	371688	5217003	Native	Excellent/Likely
23	371770	5217271	Native	Excellent/Likely
43	372705	5214438	Native	Poor/Unlikely
44	372940	5214657	Native	Poor/Unlikely
45	373278	5214810	Native	Poor/Unlikely
46	373695	5214919	Native	Good/Possible
47	373914	5215142	Native	Good/Possible
58	373977	5212153	Native	Good/Possible
59	374244	5212490	Native	Good/Possible
60	374348	5212781	Native	Good/Possible

Jurisdiction Determination Report
for the
Baldwin Wind Energy Center Project

Baldwin Wind Energy Center, LLC
Burleigh County, North Dakota

Prepared for:

NEXTera ENERGY RESOURCES

Prepared by:

TETRA TECH EC, INC.
133 Federal Street
Boston, MA 02110

December 2009

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FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

1987 USACE Wetland Delineation Manual	1987 Manual
Above Mean Sea Level	AMSL
Area of Investigation	AOI
Code of Federal Regulations	CFR
Clean Water Act	CWA
Baldwin Wind Energy Center	Project
Baldwin Wind Energy, LLC	Baldwin Wind
Environmental Protection Agency	EPA
Geographic Information System	GIS
Global Positioning System	GPS
Horizontal Directional Drilling	HDD
Identification Number	ID
Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region	Great Plains Regional Supplement
Jurisdictional Determination	JD
Megawatt	MW
National Wetlands Inventory	NWI
Nationwide Permit	NWP
Natural Resource Conservation Service	NRCS
NextEra Energy Resources, LLC	NextEra Energy
Ordinary High Water Mark	OHWM
Relatively Permanent Water	RPW
Routine Wetland Delineation	RWD
Tetra Tech EC, Inc.	Tetra Tech
Traditional Navigable Water	TNW
Underground Electrical	UE
United States Army Corps of Engineers	USACE
United States Geological Survey	USGS
Waters of the United States	Waters

1.0 INTRODUCTION

Baldwin Wind Energy, LLC (Baldwin Wind), a wholly owned subsidiary of NextEra Energy Resources, LLC (NextEra Energy) proposes to construct a wind energy facility near the town of Baldwin in Burleigh County, North Dakota (**Figure 1**). Tetra Tech EC, Inc. (Tetra Tech) was retained by Baldwin Wind to perform routine wetland delineations (RWD) at the Baldwin Wind Energy Center (Project). The Project will consist of 66 GE 1.5 megawatt (MW) turbines with a nameplate generating capacity of approximately 99 MW. A total of 75 turbine locations (66 turbine locations and 9 alternate locations) were investigated by Tetra Tech during the RWD, as were private turbine access roads, underground electrical (UE) collector lines, an equipment laydown yard and junction boxes.

This report provides a description of wetlands and surface water bodies identified within the Area of Investigation (AOI), as defined by the Project layout provided to Tetra Tech on September 9, 2009. The following AOI was used to evaluate potential impacts associated with construction and operation of the project:

- a 250-foot radius around turbine pads;
- a 250-foot wide area (125 feet on either side of centerline) around private access roads;
- a 66-foot wide area (33 feet on either side of centerline) around public roads;
- a 250-foot wide area (125 feet on either side of centerline) around UE Collector Lines; and
- a 3.8-acre substation.

This report includes a description of the Project area, methods used to delineate wetlands, field survey results, and references used to support the conclusions. This report also provides information that was used to determine jurisdiction of wetlands and waterbodies. Appendices include detailed aerial and topographic views, field data forms, Jurisdictional Determination (JD) Forms, and site photographs.

1.1 Site Visit and Regulatory Framework

The purpose of the site visit was to determine if any jurisdictional wetlands areas are within the boundaries of the Project area. The Project area is defined as the land falling within the Project boundary as shown on **Figure 1**. Jurisdictional areas are those that meet the definition of Waters of the United States (”Waters”) in the United States Army Corps of Engineers (USACE) regulations referenced in 33 Code of Federal Regulations [CFR] 328.3(a) for the purposes of Section 404 of the Clean Water Act (CWA). These jurisdictional areas are regulated by the USACE and the United States Environmental Protection Agency (EPA). Several classes of water bodies are subject to federal jurisdiction under the CWA, including traditional navigable waters (TNWs); non-navigable tributaries of TNWs that are relatively permanent waters (RPWs); and wetlands that directly abut RPWs (USACE Regulatory Guidance Letter 07-01).

In the absence of adjacent wetlands, lateral jurisdiction over nontidal waters extends to the ordinary high water mark (OHWM). The definition of the OHWM is “that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas” (33 CFR 328.3(e)).

2.0 SITE DESCRIPTIONS AND LOCATION

The Project will be constructed in portions of 12 sections of land in Crofte Township and 15 sections of land in Ecklund Township, as shown in **Figure 1** and as described in **Table 1**.

Table 1
Township, Range and Sections Within Project Area

Township	Range	Township Name	Sections
141N	79W	Crofte	2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15
142N	79W	Ecklund	17, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32, 33, 34, 35
142N	80W	Ecklund	25

The Project is located in Burleigh County in the Missouri Plateau, Unglaciated, and Missouri Plateau, Glaciated, sections of the Great Plains Province of the Interior Plains. It is dominantly unglaciated, but the eastern and northern edges have been glaciated. The area is on an old, moderately dissected, rolling plain with some local badlands, buttes and isolated hills. Terraces are adjacent to broad flood plains along most of the major drainages. Elevation is 1,650 feet Above Mean Sea Level (AMSL) in the east with a gradual slope to about 3,600 feet (AMSL) in the west (USDA 2006).

The Project area is primarily rural agricultural land in private ownership. It is comprised almost entirely of cultivated farm field, interspersed with small scattered woodlots, narrow grassed or vegetated drainages, and fallow areas. Current property use is almost exclusively limited to cultivated fields planted with corn, soybeans, sunflower or wheat and pastures used for cattle grazing. Approximately 90 percent of the land in the Project area is dedicated to corn and wheat production. The majority of cultivated areas have drain tile systems installed to improve agricultural production. Receiving drainages have been channelized, deepened, and/or contoured to accommodate drainage system flows and to facilitate agricultural equipment crossing. Contoured drainage areas typically have a mix of native and non-native grasses and forbs. Untilled/fallow fields have a mixture of grasses, volunteer corn plants, wild carrot, milkweeds, and mustards. Roadside edges consist of mowed and unmowed native and non-native grasses. Similar vegetated buffers exist as narrow riparian strips along creeks and drainage ditches within the cultivated agricultural areas.

Industrial developments in the Project area are limited to overhead and/or underground transmission lines and communication towers. Several transportation corridors occur within the Project area, including state highways, county roads, and other primary and secondary roads. The roads within the Project area include asphalt-paved county and township roads, gravel surfaced roads and two-track grassed farm access roads and trails.

3.0 METHODS

The jurisdictional areas within the AOI used the methods described in the 1987 USACE Wetland Delineation Manual (Environmental Laboratory, 1987) (1987 Manual) and supplemental delineation guidance by the USACE, contained in the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (USACE, 2008) (Great Plains Regional Supplement). These methods incorporate a three-parameter approach using vegetation, soils, and hydrology to identify the presence of wetlands. Off-site desktop determination methods were initially used to identify potential locations of wetlands and waterbodies, and subsequently on-site delineation methods were used to verify wetland locations and to support jurisdictional determinations.

USACE jurisdiction was evaluated using the methodologies cited in the USACE Jurisdictional Determination Form Instruction Guidebook, including the December 2, 2008; USACE/EPA revised Rapanos guidance (USACE/EPA, 2007).

3.1 Desktop Review

Prior to the field reconnaissance, available information was reviewed to identify areas that may exhibit characteristics of jurisdictional areas. This review included analysis of aerial photographs, topographic maps, and soil survey data for Burleigh County. The following sections discuss the data used in the desktop review in more detail.

3.1.1 Aerial Photograph Review

Potential jurisdictional areas were identified based on a review of aerial photography obtained from the United States Geological Survey (USGS) and site-specific flyover aerial photography obtained from Baldwin Wind. The Project layout was overlain onto digital versions of aerial photographs using ESRI Geographic Information System (GIS) software (**Figure 2**).

3.1.2 Topographic/National Wetlands Inventory Map Review

Project facilities were overlain onto digital versions of USGS 7.5-minute topographic maps with perennial, intermittent, and ephemeral streams and drainages using GIS software and are shown in Figure 3. The United States Fish and Wildlife National Wetlands Inventory (NWI) Map for the Project area was obtained from the North Dakota Geological Survey Natural Resources GIS (2008). According to this map, jurisdictional areas are present within the Project area. Some farm or stock ponds are present within the Project area, but they generally support limited amounts of wetland vegetation. The NWI data are presented in **Figure 3**.

3.1.3 Soil Survey Review

Soil survey data for Burleigh County were obtained from the Natural Resource Conservation Service (NRCS) website. These maps depict the distribution of soil series and mapping units. This information was used to study the distribution of hydric soils within the Project area. Soil, as it relates to wetland delineations, must be a hydric soil for the area to qualify as a wetland in accordance with the 1987 Manual. Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (Environmental Laboratory, 1987). Soil types that were identified as hydric soils in the Project area are presented in **Table 2**. The distributions of hydric soils within the Project area are shown in **Figure 4**.

Table 2
Hydric Soils Within Project Area

Map Unit Symbol	Soil Name
337169	Parnell silty clay loam, very poorly drained
337238	Williams loam, rolling
377284	Williams loam, undulating

4.0 ON-SITE RECONNAISSANCE AND DELINEATION

Tetra Tech biologists performed RWDs September 21-23, 2009 to determine the presence and potential impacts to jurisdictional areas. Point-specific field data on soils, vegetation, and hydrology were collected and documented where appropriate. Wetland and RPW boundaries were marked at 50 to 75-foot intervals (depending on the line of sight) with pin flags that were numbered sequentially.

Generally, if a linear feature such as a drainage or grass swale was being investigated, transects were placed perpendicular to the feature at the locations of potential impact from Project facilities. Sampling plots were placed along each transect. These plots were the points in the field at which wetland characteristics were inspected in accordance with the 1987 Manual. Typically, Sample Plot "A" was oriented within the wetland area. This determination was based on local topography, presence of defined bed and bank, undercutting, sediment deposition, presence of standing or flowing water or wetland vegetation. If positive indicators of wetland vegetation, hydrology, and hydric soils as defined by the 1987 Manual were present at Plot "A," data were collected from additional sample plots to determine the transition from wetland to non-wetland habitats. The delineated boundary of each wetland was established at the location where at least one of the above three parameters failed to meet wetland criteria. Sample Plot "B", conversely, was oriented in upland areas.

At each sampling plot, information was collected on soil, vegetation, and hydrologic characteristics. Soils were characterized to a depth of 18 inches using a Munsell Soil Color Chart, visual observation and standard soil texturing methodology to identify hydric or non-hydric soil characteristics as defined in USDA (2006). For each sample, a 12- to 18-inch deep (8 inch diameter) test pit was excavated and allowed to stand for a sufficient duration to allow the surficial groundwater to stabilize. From each test pit, a 2x6x12 inch pedon was extracted from the observation pit wall, split in half, measured, compared to Munsell Soil Color Charts (Gretagmacbeth, 2000), and photographed with scale. Soil logs and photographs were recorded on each data form.

Vegetation within each sample plot was characterized to determine dominance of either hydrophytic or non-hydrophytic vegetation. Dominance was estimated based on the percent aerial coverage within the sample plot within a five-foot radius for herbaceous vegetation and a 30-foot radius for trees and shrubs. Wetland indicator status for all plant species follows Reed (1988) using Region 6 indicators. Hydrology was assessed by evaluating each sample plot for field indicators of wetland hydrology such as inundation, depth to free water in soil pits, soil saturation, water marks, drift lines, oxidized root channels, drainage patterns, and topographic position.

Plot location data were collected using Trimble©, GeoXH™ Global Positioning System (GPS) surveying units equipped with Terra Sync, Version 3.10 software. The Trimble unit uses the Wide Area Augmentation System which is a system of satellites and ground stations that provide GPS signal corrections. The plot locations were collected in Universal Trans Mercator coordinates referenced to the North American Datum 1983 datum.

5.0 RESULTS

Due to the extremely large Project area, the results of the RWDs are discussed by Township name and Section number. Site names are identified with a location identification number (ID) consisting of the first letter in the name of the Township, the Section number in which the specific site is located, followed by a site number. Following this nomenclature system, a location with the ID of E-22-1, for example, would be Ecklund Township, Section 22, Location 1.

Appendix A includes copies of field data sheets and site photographs taken of the investigated wetland resource areas, wetland data plot soil pits, and soil pedons collected to document delineation activities. Aerial photographs and USGS 7.5 Minute topographic maps of each section also are presented in Appendix A. Appendix B includes copies of the USACE JD Forms for jurisdictional areas within the Project area. A summary of investigated areas are presented in **Table 3**. A summary of jurisdictional area impacts is presented in **Table 4**.

5.1 Site Vegetation

Vegetation within the Project area consists of traditional row crop or herbaceous species typical of fallow fields and pastures. Areas identified as non-wetland grass swales are commonly vegetated with a mix of native and non-native grasses and forbs and are generally mowed on an annual basis to limit invasion by shrubs and trees. Wetland areas are vegetated with a variety of wetland plants typical of the central North Dakota ecotone such as a variety of sedge, grass, forb, and shrub and tree species. Dominant vegetation identified at each plot is presented on the field data sheets in **Appendix A**.

5.2 Project Soils

During the review of the soil survey data, three hydric soils were identified as occurring within the Project area. Hydric soils within the Project area are presented in **Table 2** and in **Figure 4**.

5.3 Site Hydrology

The Project area has been subject to historic landform and hydrology modification. Modifications were made to facilitate agricultural commodity production by altering the hydrologic regime with agricultural drain tiles and by altering natural drainage contours. Smaller drainages have been channelized and incised and generally have narrow riparian corridors consisting of native and non-native grasses. Areas of the site in agricultural production have been extensively tiled and drained to facilitate production of row-crops. Many of the upper reaches of drainages have been converted to non-wetland grass swales to control erosion and improve removal of excess soil moisture. Terrace systems designed to slow runoff and prevent erosion are also present within the Project area.

There are no major rivers or TNWs found within the Project area. Unnamed Tributary of Burnt Creek is found in the northwest portion of the site and drains to Burnt Creek then to the Missouri River. Unnamed Tributary of West Branch Apple Creek is found in the eastern portion of the site and drains to Apple Creek then to the Missouri River. Unnamed Tributary of Apple Creek is found in the southern portion of the site and drains to Apple Creek and then to Missouri River. Hydrology within the Project area is presented in **Figure 2** and **3**.

5.4 Wetlands and Streams

During the desktop review, 51 areas that appeared to exhibit wetland characteristics or characteristics of a water of the U.S. were identified. These areas were subsequently investigated during the RWDs conducted September 21-23, 2009. These areas are summarized in **Table 3** and shown in **Figures 2, 3 and 4**. Wetland and riparian communities found in the Project area include emergent and scrub-shrub wetlands, and small, fragmented-mixed deciduous woodlands. The RWDs confirmed the presence of seven areas that met the criteria for definition as a wetland and/or tributary stream. Positive indicators for all three wetland parameters or indications of an OHWM were lacking in the remaining 44 features investigated. Of the seven areas that met the definitive criteria for a wetland or water of the U.S, two were classified as jurisdictional RPW wetland impoundments and one as a jurisdictional nonwetland impoundment. This latter feature occurred adjacent to an unnamed tributary of Burnt Creek, identified as a blue line stream on the USGS topographic map (**Figure 3**). Because a connection or significant nexus to a water of the U.S. was absent, the four remaining wetland features were determined to be isolated and therefore not considered USACE jurisdictional wetlands.

Township 142 N, Range 79 W (Ecklund Township)

Section 20

Location E-20-1

This location is classified as a non wetland impoundment (cattle water hole) adjacent to an unnamed tributary of Burnt Creek that is identified as a blue line stream on the USGS topographic map and was determined to be under the jurisdiction of the USACE. The hydrophytic vegetation associated with this location is primarily herbaceous and is dominated by common dandelion *(Taraxacum officinale)*, switchgrass *(Panicum virgatum)* and spiny cocklebur (*Xanthium spinosum*). The soil at this location has been classified by the NRCS as Arnegard and Grassna silt loams, a non-hydric soil. This location lies within the 250-foot wide AOI for an UE collector line. No physical crossing is planned at this location and no impacts are expected to result from construction activities.

Section 21

Location E-21-2

This location is classified as a jurisdictional RPW wetland impoundment on an unnamed tributary of Burnt Creek. The hydrophytic vegetation associated with this location is primarily herbaceous and is dominated by reed canary grass *(Phalaris arundinacea)*, narrow leaf cattail (*Typha angustifolia*) and prairie cord grass *(Spartina pectinata)*. The soil at this location has been classified by the NRCS as Williams loam, a hydric soil. This location is the proposed location of a buried UE collector line and public road improvement.

Tetra Tech recommends that the UE collector line be installed via Horizontal Directional Drilling (HDD) methodology at this location. Installation via HDD methodology is not a Section 404 regulated activity, and boring would eliminate any potential impacts from the installation of UE collector lines at this location, provided the boring initiated and terminated beyond the delineated boundaries of the drainage.

The width of 266th Avenue NE is thirty-six feet at this location. It appears to be sufficient to facilitate construction activities without widening the existing road surface. Adding gravel to strengthen the road and upgrade its capacity to accommodate construction vehicles should not result in impacts to the jurisdictional drainage provided gravel is prevented from entering the jurisdictional area. For example, this can be accomplished by using proper silt fence deployment and installation as described in section 2.1 of the "North Dakota Guide To Temporary Erosion-Control Measures" manual (North Dakota Department of Health 2001). However, other modifications such as widening of the road to facilitate construction access would result in impacts to this jurisdictional drainage.

Section 28

Location E-28-1

This location is classified as a jurisdictional RPW wetland impoundment on an unnamed tributary of Burnt Creek. The hydrophytic vegetation associated with this location is primarily herbaceous and forested and is dominated by reed canary grass, narrow leaf cattail, meadow willow *(Salix petiolaris)* and bur oak *(Quercus macrocarpa)*. The soil at this location has been classified by the NRCS as Williams loam, a hydric soil. This location is the proposed location of a buried UE collector line and public road improvement.

Tetra Tech recommends that the UE collector line be installed via HDD methodology at this location. Installation via HDD methodology is not a Section 404 regulated activity and boring would eliminate any potential impacts from the installation of UE collector lines at this location provided the boring is initiated and terminated beyond the delineated boundaries of the drainage.

The width of 266th Avenue NE at this location measures 34 feet and appears to be sufficient to facilitate construction activities without widening the existing road surface. Strengthening of the road by adding gravel to upgrade its capacity to accommodate construction vehicles should not result in impacts to the jurisdictional drainage provided gravel is prevented from entering the jurisdictional area. Widening of the road at this location to facilitate construction access would result in impacts to this jurisdictional drainage.

5.5 Conclusions

Tetra Tech identified three locations, E-20-1, E-21-2 and E-28-1, at which proposed Project facilities or activities (turbines, road construction or installation of UE collector lines) are in close proximity to jurisdictional areas. Areas identified as non-wetland grass swales did not possess positive wetland indicators for vegetation, hydrology and/or soils or the characteristics of an RPW; therefore, they did not meet the definition of jurisdictional areas according to the 1987 Manual and Great Plains Regional Supplement or USACE Jurisdictional Determination Form Instructional Guidebook. The majority of locations identified as wetlands are situated adjacent to drainages or streams.

Provided the recommendations for the installation of UE collector lines beneath jurisdictional areas via HDD methodology are followed and that the improvements to 266th Avenue NE at locations E-21-2 and E-28-1 would not involve widening the existing right of way, there would be no impacts to Waters of the U.S. as a result of this Project. The proper installation and maintenance of temporary erosion-control methods as prescribed in the North Dakota Temporary Erosion-control Measures Manual should be sufficient to assure that no impacts are allowed to occur.

As currently designed, and recommendations presented in the avoidance and minimization column of **Table 4**, there will be no permanent impacts to jurisdictional areas identified within the Project Area.

The Project is below the 0.5-acre threshold, making it eligible under the USACE NWP 12 for Utility Line Activities, and is also falls below the 0.1-acre notification and mitigation thresholds of USACE Nationwide Permit (NWP) 12. Application for a Section 404 Permit as well as notification to the USACE- Omaha District office is unnecessary for this project.

6.0 REFERENCES

Brown, Lauren. 1979. *Grasses, An Identification Guide*. Houghton Mifflin Company, New York, NY.

Cowardin, L.M., et al. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Department of the Interior/USFWS/OBS-79/31.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual.* Department of the Army. Technical Report Y-87-1. U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

Knobel, Edward. 1980. *Field Guide to the Grasses, Sedges and Rushes of the United States*. Dover Publications, New York, NY.

Knopf, A.A. 1979. *National Audubon Society Field Guide to North American Wildflowers, Eastern Region*. New York, NY.

Gretagmacbeth 2000 Revised Washable Edition. *Munsell Soil Color Charts*. Gretagmacbeth, New Windsor, NY.

Ladd, Doug and Frank Oberle. 2005. *Tallgrass Prairie Wildflowers, A Field Guide to Common Wildflowers and Plants of the Prairie Midwest*. Falcon Guides, Guilford, CT.

Martin, C.A. 1987. *Weeds*. St. Martins Press, New York, NY.

Newcomb, Lawrence. 1977. *Newcomb's Wildflower Guide*. Little, Brown and Company, New York, NY.

North Dakota Department of Health, Division of Water Quality. A Guide to Temporary Erosion-Control Measures for Contractors, Designers and Inspectors. 2001.

Reed, P.B. 1988. *National List of Plant Species that occur in Wetlands: National Summary*. US Fish & Wildlife Service, Biological Report 88(24).

U.S. Army Corps of Engineers. 2007. *U.S. Army Corps of Engineers Jurisdictional Determination (JD) Form Instructional Guidebook*. Washington, D.C.

U.S. Army Corps of Engineers. 2008. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region*. ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-08-27. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Army Corps of Engineers. 2008. *Revised Guidance Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States, December 2, 2008.*

United States Department of Agriculture, Agricultural Research Service. 1971. *Common Weeds of the United States*. Dover Publications, Inc., New York, NY.

United States Department of Agriculture, Soil Conservation Service. 1991. *Hydric Soils of the United States*. USDA-SCS. Washington, D.C.

United States Department of Agriculture, Natural Resource Conservation Service. 2006a. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Accessed at http://soils.usda.gov/survey/geography/mlra/.

United States Department of Agriculture, Natural Resource Conservation Service. Undated. *Midwestern Wetland Flora, Field Office Guide to Plant Species*. Midwest National Technical Center. Lincoln, NE.

United States Department of Agriculture, Natural Resources Conservation Service. 2009. Plants Database. Accessed at http://plants.usda.gov/. November 11, 2009.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Field Indicators of Hydric Soils in the United States, Version 6.0. G.W. Hurt and L.M. Vasilas (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils. November 11, 2009

U.S. Fish and Wildlife Service. 2008. National Wetlands Inventory. Accessed at http://www.nwi.fws.gov.

Wetland Training Institute, Inc. 1995. *Field Guide for Wetland Delineation, 1987 Corps of Engineers Manual*. Glenwood, NM.

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Table 3 Baldwin Wind Farm Summary of Investigated Areas					
Location ID	Facility Type	Jurisdictional Determination			Area Description
		WofUS (Y/N)	WofUS Type	Jurisdictional Agency	
C-3-1	UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-3-2	Access Road and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-4-1	UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-5-1	Access Road and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-8-1	Access Road	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-8-2	Access Road and UE Collector	N	NA	Non-Jurisdictional	Grove of trees and upland grass field.
C-9-1	Within AOI	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-10-1	Within AOI	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-11-1	UE Collector	N	NA	Non-Jurisdictional	Upland grass field.
C-11-2	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
C-11-3	Access Road and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
C-11-4	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
C-11-5	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-11-6	Access Road and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-11-7	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
C-11-8	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
C-13-1	Access Road and UE Collector	N	NA	Non-Jurisdictional	Isolated, seasonally farmed wetland.
E-19-1	UE Collector	N	NA	Non-Jurisdictional	Isolated herbaceous wetland.
E-19-2	UE Collector	N	NA	Non-Jurisdictional	Isolated herbaceous wetland.
E-20-1	Within AOI	Y	Pond	USACE	Non wetland impoundment adjacent to an unnamed tributary of Brunt Creek that is identified as a blue line stream on the USGS topographic map.
E-20-2	Former Crossing Location	N	NA	Non-Jurisdictional	Deep-water Aquatic Habitat
E-20-3	Within AOI	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-20-4	Within AOI	N	NA	Non-Jurisdictional	Cattle watering whole.
E-21-1	Access Road and UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-21-2	Public Road Improvement and UE Collector	Y	Wetland	USACE	Wetland impoundment. Appears as a intermittent blue line stream on the USGS topographic map.
E-27-1	Within AOI	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-27-2	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-27-3	Access Road and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-28-1	Public Road Improvement and UE Collector	Y	Wetland	USACE	Wetland impoundment. Appears as a intermittent blue line stream on the USGS topographic map.
E-28-2	Access Road	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-28-3	UE Collector	N	NA	Non-Jurisdictional	Old fence line.
E-29-1	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-29-2	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-29-3	Within AOI	N	NA	Non-Jurisdictional	Isolated, non-jurisdictional herbaceous wetland.
E-29-4	Within AOI	N	NA	Non-Jurisdictional	Isolated, non-jurisdictional herbaceous wetland.
E-29-5	Within AOI	N	NA	Non-Jurisdictional	Isolated, non-jurisdictional herbaceous wetland.
E-29-6	UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-29-7	UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-30-1	Public Road Improvement	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-30-2	Public Road Improvement	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.

Table 3 Baldwin Wind Farm Summary of Investigated Areas					
Location ID	Facility Type	Jurisdictional Determination			Area Description
		WofUS (Y/N)	WofUS Type	Jurisdictional Agency	
E-31-1	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-31-2	Public Road Improvement and UE Collector	N	NA	Non-Jurisdictional	Vegetated swale. Appears as a intermittent blue line stream on the USGS topographic map.
E-33-1	UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-33-2	UE Collector	N	NA	Non-Jurisdictional	Nothing evident, farmed and effectively drained.
E-33-3	Within AOI	N	NA	Non-Jurisdictional	Isolated, seasonally farmed wetland.
E-33-4	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-33-5	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-33-6	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-34-1	UE Collector	N	NA	Non-Jurisdictional	Grove of trees located on edge of upland grass field.
E-34-2	UE Collector	N	NA	Non-Jurisdictional	Non-wetland vegetated swale.
E-34-3	Access Road and UE Collector	N	NA	Non-Jurisdictional	Upland grass field.

AOI = Area of Investigation
RPW = Relatively Permanent Water
UE= Underground Electric
USGS = United States Geological Survey
WofUS= waters of the United States

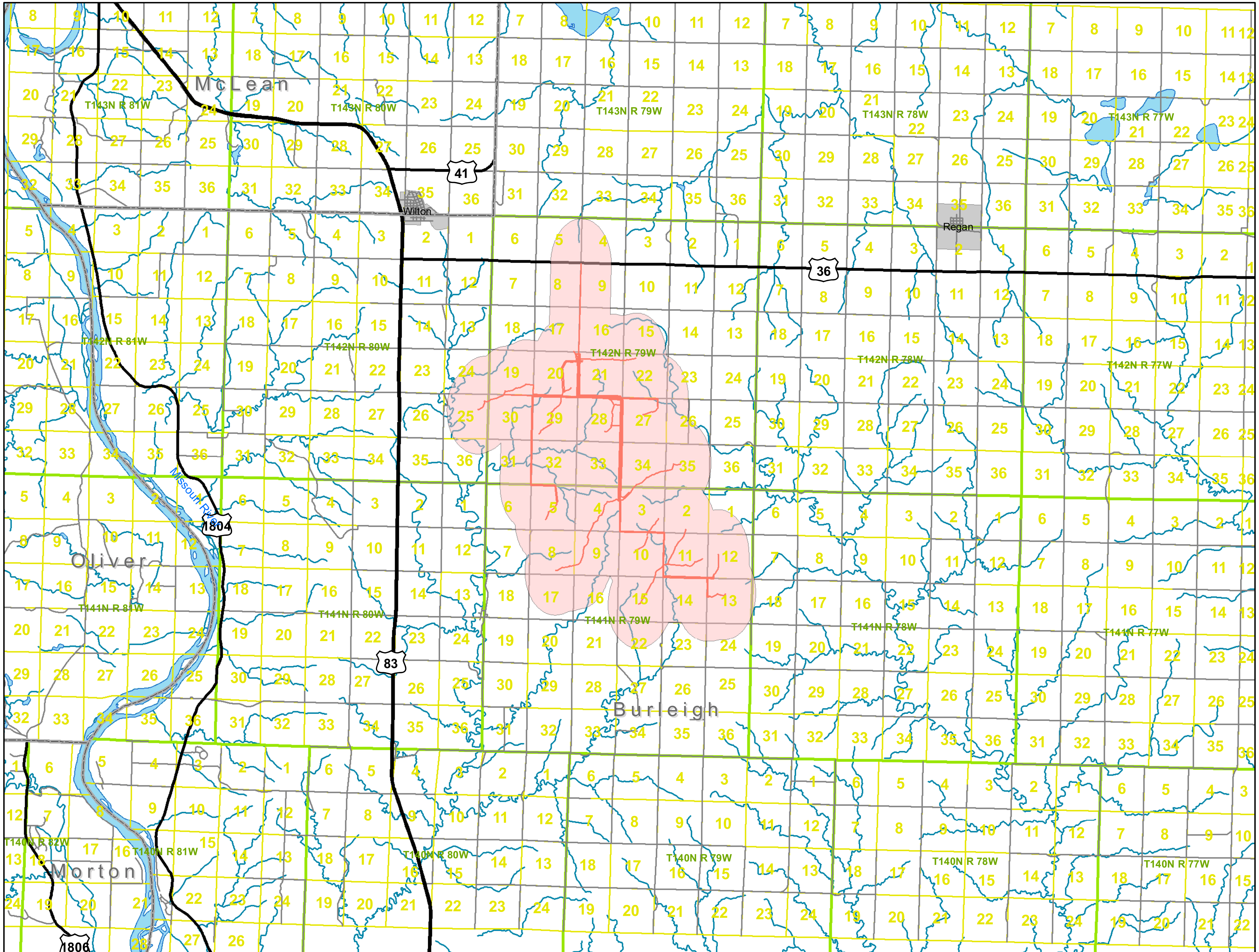
Table 4
Baldwin Wind Farm
Jurisdictional Area Impact Summary

Location ID	County	Water Body Name [1]	Habitat Type	Rapanos Determination [1]	Delineated Area or Width	Facility Type	Wetland Impacts		Jurisdiction	Avoidance/ Minimization	Latitude/Longitude (WGS 84)		UTM Coordinates (Zone 14N, NAD 83)		Drainage Area of Crossing (Sq. Miles)	Documentation
							Estimated Temporary Impacts (sq ft)	Estimated Permanent Impacts (sq ft)			Latitude (N)	Longitude (W)	Easting	Northing		
E-20-1	Burleigh	Wetland adjacent to an Unnamed Tributary of Burnt Creek	Herbaceous Wetland	Wetland	NA	Within AOI	Assumes No Impacts		USACE	This location lies within the 250-foot wide AOI for an UE collector line. No physical crossing is planned at this location and no impacts are expected to result from construction activities.	47.099515	-100.723348	369226.29	5217663.90	0.38	Data Form 1, Photographs, Rapanos Form
E-21-2	Burleigh	Wetland impoundment of an Unnamed Tributary of Burnt Creek	Herbaceous Wetland	Wetland Impoundment	17 Ln Ft	Public Road Improvement	Assumes No Impacts*		USACE	Tetra Tech recommends that the Road Improvement be configured to the minimum practical footprint to minimize impacts to the wetland.	47.099355	-100.697826	371162.63	5217603.75	0.68	Data Form 1, Photographs, Rapanos Form
					163 Ln Ft	UE Collector	Assumes No Impacts			Tetra Tech recommends that collector line be installed using HDD to completely avoid impacts to the wetland.						
E-28-1	Burleigh	Unnamed Tributary of Burnt Creek	Herbaceous Wetland	Wetland Impoundment	41 Ln Ft	Public Road Improvement	Assumes No Impacts*		USACE	Tetra Tech recommends that the Road Improvement be configured to the minimum practical footprint to minimize impacts to the seasonal RPW.	47.098675	-100.697870	371157.60	5217528.30	0.68	Data Form 1, Photographs, Rapanos Form
					70 Ln Ft	UE Collector	Assumes No Impacts			Tetra Tech recommends that collector line be installed using HDD to completely avoid impacts to the seasonal RPW.						
Total Impacts					**Square Feet**		**0**	**0**								
					Acres		**0.00**	**0.00**								

[1] There are no major rivers or TNWs found within the Project area. Unnamed Tributary of Burnt Creek is found in the northwest portion of the site and drains to Burnt Creek then to the Missouri River. Unnamed Tributary of West Branch Apple Creek is found in the eastern portion of the site and drains to Apple Creek then to the Missouri River. Unnamed Tributary of Apple Creek is found in the southern portion of the site and drains to Apple Creek and then to Missouri River.

*Tetra Tech has measured the width of the public road improvement right of way at this location and believes it to be of sufficient width to facilitate construction activities.

HDD = Horizontal Directional Drilling
AOI = Area of Investigation
RPW = Relative Permanent Water
UE= Underground Electric
USACE = United States Army Corps of Engineers



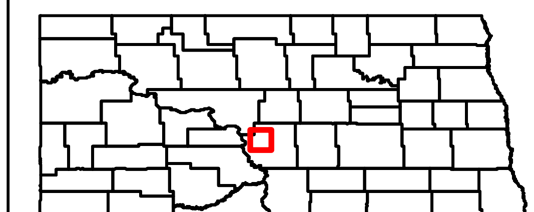
TETRA TECH

Baldwin Wind Energy Center

Burleigh County, North Dakota

October 29, 2009

Figure 1

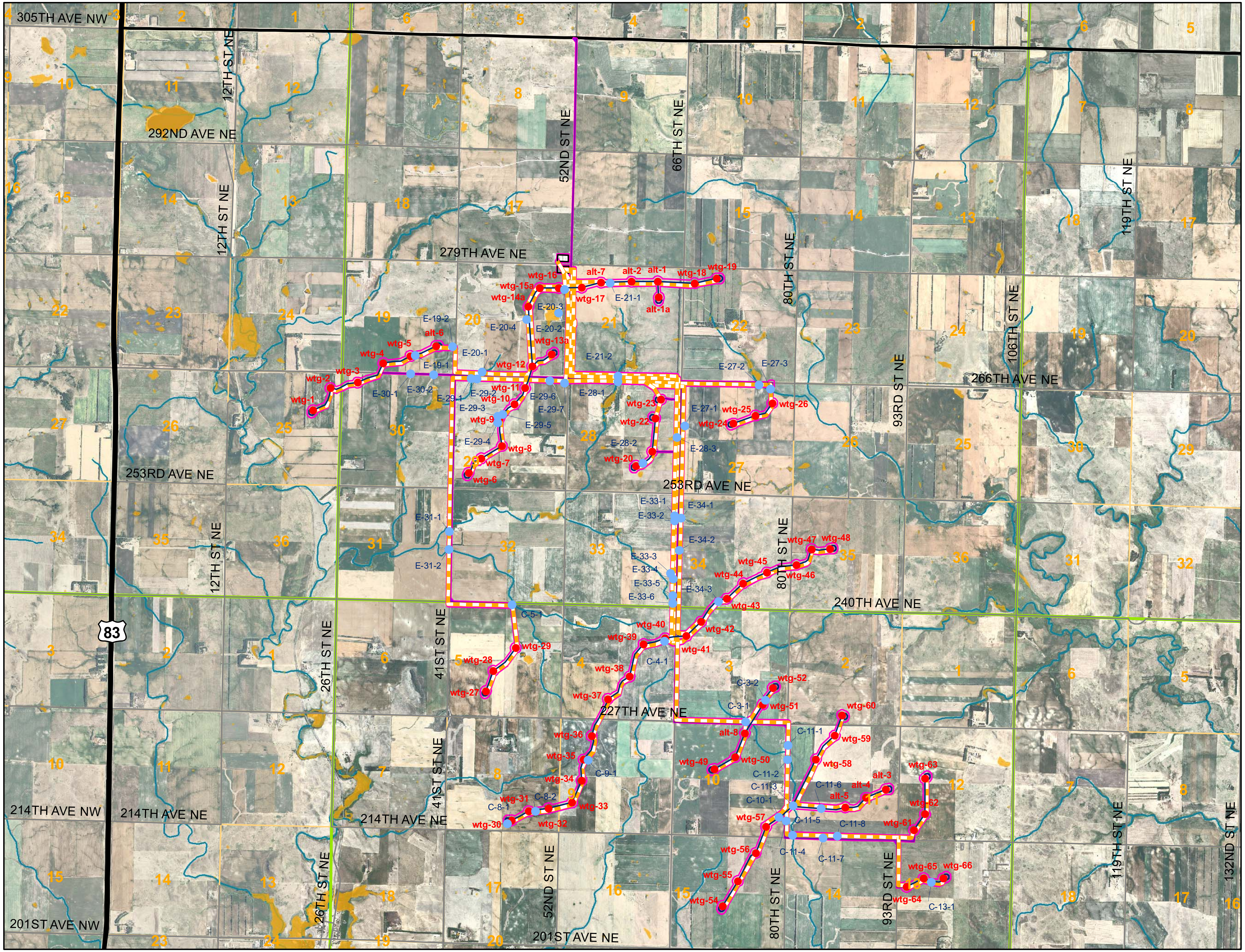


- Highway
- Road
- Municipality
- Township
- County
- Section
- Lake/Pond
- River/Stream
- 1 Mile Buffer
- Array

N W E S

0 1 2 4 Miles

NEXTera ENERGY RESOURCES



TETRA TECH

Baldwin Wind Energy Center

Burleigh County, North Dakota

December 10, 2009

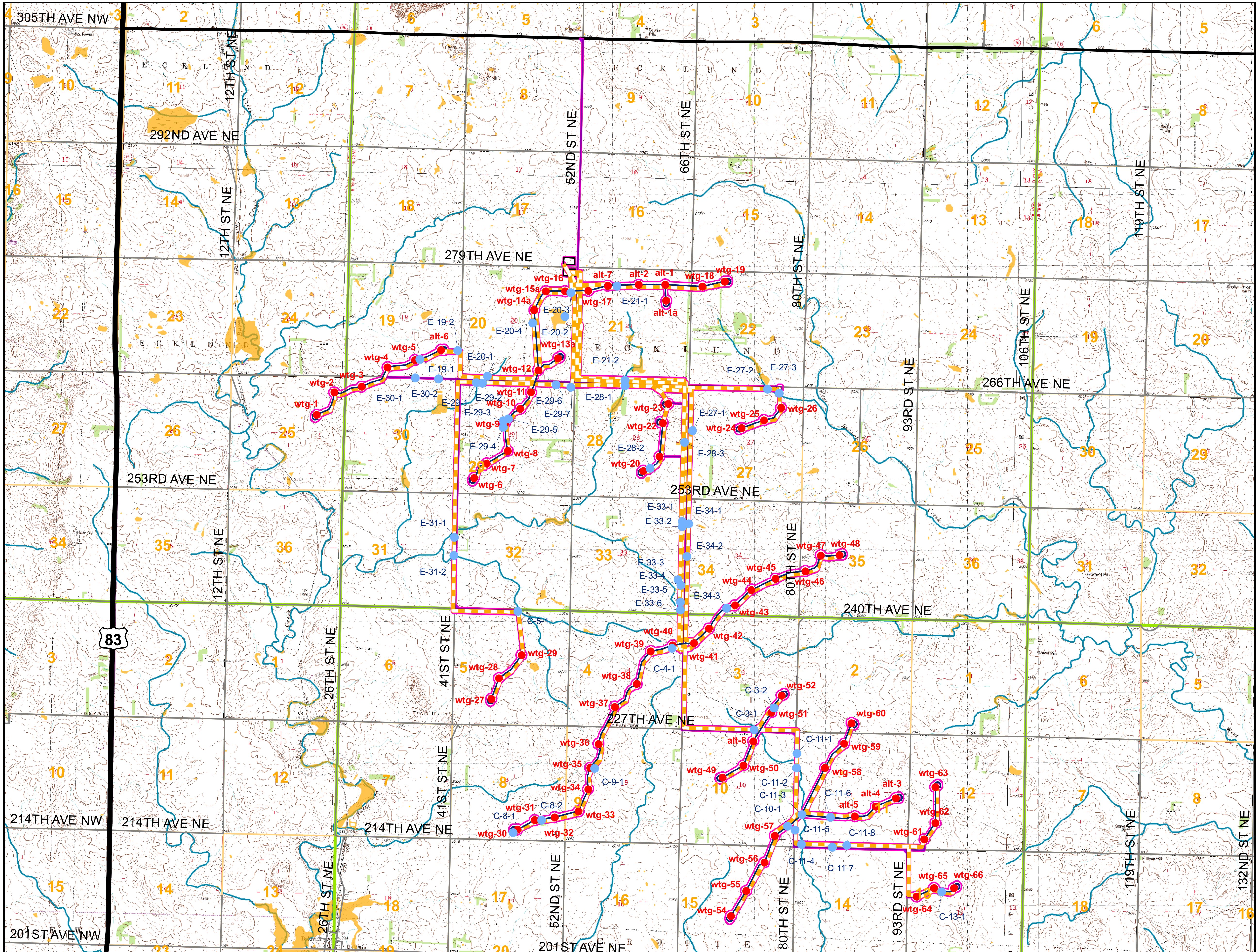
Figure 2

- Crossing Location
- Turbine Location
- Service Road
- Collection
- Access Road
- Turning Radius
- Substation & Laydown
- Area of Investigation
- Highway
- Road
- Township
- Section
- NWI
- Lake/Pond
- River/Stream

0 0.25 0.5 1 Miles

N E S W

NEXTera ENERGY RESOURCES



TETRA TECH

Baldwin Wind Energy Center

Burleigh County, North Dakota

December 10, 2009

Figure 3

- Crossing Location
- Turbine Location
- Service Road
- Collection
- Access Road
- Turning Radius
- Substation & Laydown
- Area of Investigation
- Highway
- Road
- Township
- Section
- NWI
- Lake/Pond
- River/Stream

0 0.25 0.5 1 Miles

N E S W

NEXTera ENERGY RESOURCES

DRAFT

Whooping Crane Likelihood of Occurrence Report

Baldwin Wind Resource Area

Burleigh County, North Dakota

Prepared For:

NextEra Energy Resources, LLC
700 Universe Blvd.
Juno Beach, Florida 33408

Prepared By:

Tetra Tech EC, Inc.
133 Federal Street, 6th Floor
Boston, Massachusetts 02110

November 2009

Executive Summary

The likelihood of whooping cranes occurring in the Baldwin Wind Resource Area (WRA) is low, despite the WRA's position in the central portion of the whooping crane migration corridor. The major factor that contributed to this assessment was the lower proportion of suitable wetland habitat within the WRA than the surrounding area. There were no recorded observations of whooping cranes within the WRA. A total of 79 observations occurred within the 35-mile buffer area around the WRA. The whooping crane observations should be used for general inference regarding use of an area and cannot be used for micrositing features away from whooping crane sightings because some of the observations may lack precise locations.

Avoidance and Minimization Options

The two most likely impacts of wind development on whooping cranes are: 1) direct mortality of whooping cranes due to collisions with transmission lines, turbines, or other facilities; or 2) whooping cranes' avoidance of the area around the facility. Given the low likelihood of occurrence based on historic recorded occurrences of whooping cranes within and in proximity to the WRA and the low proportion of suitable whooping crane stopover habitat, Tetra Tech EC, Inc. recommends the following avoidance and minimization option:

- If WRA facilities are not already engineered to prevent perching by birds, anti-perching devices should be installed. Eliminate or minimize all structures where birds may perch. Rounded and sloped surfaces that are too large in circumference for birds to grasp or too angled for birds to perch on are best.

Each WRA is unique with respect to the relationship of the facilities with potential whooping crane habitat. Thus, avoidance and minimization strategies are site-specific and require detailed knowledge of the proposed WRA and surrounding landscape as well as coordination with state and federal wildlife biologists. The preferred method of mitigation may change rapidly as more information about whooping crane behavior and habitat availability becomes available.

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1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra Energy) is currently developing plans for a wind energy facility in Burleigh County, North Dakota (Figure 1). The current layout (dated July 23, 2009) includes 66 GE xle turbines with 8 additional alternate turbine locations. No new transmission lines would be constructed as part of this Project. The facility would have a 99-megawatt (MW) operational capacity but current plans are to operate the facility at 49.5 MW. One concern when developing wind energy facilities in parts of the Great Plains is the federally endangered whooping crane (*Grus americana*). The whooping crane migrates through portions of North Dakota during spring and fall. Whooping cranes have been killed by collisions with power lines, and the whooping crane recovery plan lists construction of power lines, fences, and other structures in the migration corridor as a threat to the species (Canadian Wildlife Service [CWS] and United States Fish and Wildlife Service [USFWS] 2007). Thus, the construction of wind turbines may pose a risk to whooping cranes through direct mortality or avoidance of areas where turbines are located.

To continue their efforts to identify areas where they can minimize impacts, NextEra Energy contracted Tetra Tech EC, Inc (Tetra Tech) to conduct a landscape-scale analysis to assess the potential occurrence of whooping cranes for the Baldwin Wind Resource Area (WRA). The objective of this likelihood of occurrence analysis is to evaluate the biological and landscape features within the WRA to determine the potential for whooping cranes to occur. Despite the small population size of whooping cranes, certain landscape features may increase the likelihood of whooping crane occurrence during migration. Thus, Tetra Tech developed a likelihood index to evaluate the WRA based on its location in the migration corridor, the locations of historical observations of whooping cranes, the presence of feeding and roosting sites, and the availability of habitat within the WRA compared to the surrounding landscape. The likelihood index does not predict how many whooping cranes will occur in the WRA; rather it scores the site based on a suite of variables that are related to whooping crane occurrence. Higher scores denote higher potential likelihood of occurrence. This assessment tool is not intended to replace field surveys.

2.0 LEGAL STATUS OF THE WHOOPING CRANE IN THE UNITED STATES

The whooping crane is protected by both state and federal laws in the United States. It was considered endangered in the United States in 1970 and the endangered listing was ‘grandfathered’ into the Endangered Species Act (ESA) of 1973, which prohibits “take” (CWS and USFWS 2007). “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532(19)). Thus, mortality of a whooping crane at a wind facility would be considered take, even if the mortality was an unintended consequence of otherwise legal activities, and the wind power developer could be prosecuted by the USFWS. To Tetra Tech’s knowledge, no wind developer or utility has been prosecuted for crane collisions with transmission lines. The whooping crane is also considered a level III Species of Conservation Priority by the North Dakota Game and Fish Department (Hagen et al. 2005). Under the North Dakota comprehensive wildlife conservation strategy guide, a level three species of conservation priority is a species of moderate priority but are believed to be peripheral or non-breeding in North Dakota (Hagen et al. 2005).

The whooping crane population in North America has experienced sharp declines and disappearance from most of its historic range (CWS and USFWS 2007). The number of whooping cranes in North America prior to 1870 is estimated to have been between 500 and 1,400 individuals (Allen 1952; Banks 1978), but some biologists suggest that the population may have numbered as many as 10,000 individuals (CWS and USFWS 2007). Activities such as habitat destruction, hunting, and displacement due to anthropogenic activities likely lead to widespread population declines (CWS and USFWS 2007). One self-sustaining wild population of whooping cranes currently exists in the world. Members of this population breed primarily within the boundaries of Wood Buffalo National Park in Canada and migrate through the central United States in route to the wintering grounds at Aransas National Wildlife Refuge along the Gulf Coast of Texas. This flock is referred to as the Aransas-Wood Buffalo National Park Population. Due to intensive management, this population has increased from 15 birds in 1941 to 247 as of the start of spring migration in 2009 (USFWS 2009).

3.0 ENVIRONMENTAL SETTING AND WRA DESCRIPTION

3.1 Environmental Setting

The Baldwin WRA is located within the Northwestern Great Plains. This landscape includes the western mixed-grass prairie, short-grass prairie, and associated wetlands of the Missouri Slope and River Breaks regions. This semiarid, unglaciated region of North Dakota includes level to rolling plains topography with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Land use is predominantly dry-land farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

3.2 WRA Description

The WRA is located on privately owned lands in central North Dakota, consists of 14,460 acres, and is located approximately 17 miles north of Bismarck in Burleigh County (Figure 1). The WRA is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture and rangelands with patches of 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 WRA. Patches of trees and shrubs exist throughout the WRA, and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

4.0 WHOOPING CRANE BIOLOGY

The whooping crane is a long-lived species that may reach 28 years old in the wild (Binkley and Miller 1983). Individuals reach sexual maturity at 3 to 5 years of age and form life-long breeding pairs while on the wintering grounds or during spring migration (Stehn 1997; CWS and USFWS 2007). Whooping cranes have low annual reproductive output. Females typically lay 2 eggs, but only 10 percent of families arrive on the winter grounds with 2 chicks because the smaller chick usually dies within the first two weeks after hatching (CWS and USFWS 2007). The juveniles become independent of the parents on the wintering ground prior to spring migration. Sexually immature individuals (i.e., subadults) return to the breeding grounds where they may remain solitary or congregate in small groups on the periphery of breeding pairs (CWS and USFWS 2007).

4.1 Reasons for the Population Decline

Populations of long-lived species with low annual reproductive output such as the whooping crane are sensitive to changes in adult survival (Stahl and Oli 2006). Hunting, especially during spring migration, from 1870 to 1930 resulted in 274 documented whooping crane fatalities (Allen 1952). In addition, Hahn (1963) tallied 309 mounts and 9 skeletons in museum collections throughout the world. Because many of these specimens do not contain information regarding the date and location of collection, it is unlikely that the majority were collected by museum personnel. It is possible that mortality from shooting exceed annual production of juveniles during the early 1900s (CWS and USFWS 2007).

Degradation and loss of breeding habitat eliminated the whooping crane from much of its core breeding range in North America. Whooping cranes once bred from the southern edge of Lake Michigan north through southern Minnesota to northeastern North Dakota through Manitoba, Saskatchewan, and Alberta (Allen 1952). Conversion of prairie and pothole ecosystems to agriculture and ranching made much of the breeding habitat unsuitable (CWS and USFWS 2007). Due to their high degree of site fidelity, members of the Aransas-Wood Buffalo Population are unlikely to naturally recolonize the historic whooping crane range in North America.

4.2 Threats to Whooping Cranes

Several factors threaten the whooping crane because of its small population size and concentration of all members of the Aransas-Wood Buffalo National Park population at breeding and wintering locations. Threats to the whooping crane identified in the recovery plan that are related to wind power development include collision with power lines, fences, and other structures, and loss and degradation of stop-over and wintering habitat (CWS and USFWS 2007; USFWS 2009).

Power lines pose a major threat to whooping cranes when they are located in the vicinity of foraging or roosting habitat because individuals often fly at low altitudes (33 to 49 feet above the ground) when moving among sites (CWS and USFWS 2007; Stehn and Wassenich 2008). The majority of documented fatalities during migration are due to collision with power lines. Since 1956, 46 whooping cranes have been killed or seriously injured as a result of collisions with power lines (Stehn and Wassenich 2008). Collisions with power lines have resulted in fatalities of whooping cranes in other experimental populations that are maintained by the introduction of captive-reared young. Fourteen individuals from the Florida non-migratory population and 1 individual in the migratory Wisconsin population have died from colliding with power lines.

Although whooping crane mortality has not been attributed to wind turbines, the whooping crane recovery plan considers wind power development within the whooping crane migration corridor a threat because of the construction of power lines and associated structures (CWS and USFWS 2007). It is unknown how whooping cranes will respond to the presence of wind turbines. The USFWS (2009) holds the opinion that whooping cranes will avoid stopping at areas with operational wind turbines. Thus, behavioral avoidance of wind farms by whooping cranes may reduce the probability of collision, but may amount to loss of stop-over habitat.

5.0 WHOOPING CRANE MIGRATION

Whooping cranes undertake a 5,000-mile round-trip migration from the breeding area in Canada to the wintering area in Texas every year. Individuals depart the breeding ground in Canada and travel south through Alberta, Canada, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and reach the wintering ground on the Texas coast. The migration route is well defined and 94 percent of all observations occur within a 200-mile wide corridor during spring and fall migration (CWS and USFWS 2007, Figure 2). Whooping cranes may occasionally travel with sandhill cranes during migration, and stop-over sites used by sandhill cranes may indicate potential whooping crane stop-over areas (CWS and USFWS 2007).

During migration, whooping cranes can occur where suitable habitat is available. Some sites in the migration corridor are used consistently and have high annual use. Four traditional stop-over sites are found in Nebraska (Platte River), Kansas (Cheyenne Bottoms Wildlife Management Area, Quivira National Wildlife Refuge), and Oklahoma (Salt Plains National Wildlife Refuge). These sites are designated as critical habitat under the Endangered Species Act (CWS and USFWS 2007).

5.1 Fall Migration

Whooping cranes depart the breeding grounds at Wood Buffalo National Park in mid-September and parents with young are usually the last to depart. Birds may travel alone, in pairs, in family groups, or in small flocks (Johns 1992). Individuals travel southeast about 300 miles to the major staging area in Saskatchewan, where they may remain for 2 to 4 weeks before resuming migration. During fall migration, birds may stay at traditional stop-over sites for 7 to 10 days, but stays as long as 6 weeks have been documented at Quivira National Wildlife Refuge (CWS and USFWS 2007). The majority of whooping cranes reach the wintering grounds by mid-November. In North Dakota most sightings occur from early October to early November; peak migration occurs around October 18 (Austin and Richert 2001).

5.2 Spring Migration

Whooping cranes depart the wintering ground at Aransas National Wildlife Refuge in late March; the last birds depart in May. Breeding pairs are typically first to depart and migration is facilitated by winds from the southeast. There is no known staging area in spring as there is in fall, and migration is completed in 2 to 4 weeks. Traditional stop-over sites that are used in fall are also used in spring. However, individuals spend fewer days at stop-over sites during spring migration. Whooping cranes travel through North Dakota from early April to late April; peak migration occurs around April 19 (Austin and Richert 2001).

5.3 Migration Flight Behavior

Whooping cranes are diurnal migrants and primarily fly by using static soaring, but low-level flapping flight may be used when conditions dictate. Migration is initiated after the air has warmed and thermal updrafts are present. Individuals spiral upwards on thermals of warm air to heights of 1,000 to 6,000 feet (Kyut 1992), then enter into long, descending glides. This process is repeated throughout the day until suitable habitat is reached. Static soaring is energy efficient as birds seldom flap after they are airborne. Whooping cranes may travel up to 500 miles per day in ideal conditions; during average conditions they may travel 250 miles per day (Stehn and Wassenich 2008). During the end of the migration flight, individuals will enter long descending glides and use flapping flight at lower altitudes until they reach suitable roosting and feeding habitat. Whooping cranes do not regularly migrate during unfavorable weather conditions such as a strong headwind, rain or other precipitation, or overcast conditions. When visibility is poor, individuals use flapping flight at lower altitudes until they reach suitable roosting or feeding habitat.

5.4 Stop-over Habitat Characteristics

Whooping cranes require roosting habitat when they stop during migration. They often select sites with unobstructed visibility (Austin and Richert 2001). Palustrine wetlands (freshwater wetlands characterized by emergent vegetation) are used most often used as roosting sites, but individuals have been found roosting at lacustrine wetlands (wetlands around a lake), and riverine wetlands (wetlands along a river). Size of wetlands used during spring and fall migration ranges from 0.4 hectare (ha) to over 500 ha, and no seasonal use patterns are evident (Austin and Richert 2001); 75 percent of recorded roost wetlands were smaller than 4 ha (10 acres). Although size of the wetlands used for roosting varies, water depth ranges 18 to 20 inches and little variability is found among sites.

Whooping cranes forage in wetlands and agricultural fields during migration and may commute between roosting and feeding areas. Palustrine wetlands are used most often when whooping cranes forage in wetlands, but lacustrine and riverine have also been used as feeding sites (Austin and Richert 2001). Among agricultural crops used as feeding sites, use of winter wheat was higher than other crop types in fall and use of row-crop stubble (comprised mostly of corn) was higher in spring than other crop types (Austin and Richert 2001). Whooping cranes have also been observed feeding in sorghum, sunflower, and soybean stubble (Austin and Richert 2001). Feeding sites are often found adjacent to roosting sites. For example, 94.9 and 72.9 percent of roosting sites were within 0.62 mile of feeding sites in spring and fall, respectively (Johns et al. 1997; USFWS 2009).

6.0 ASSESSMENT OF WHOOPING CRANES LIKELIHOOD OF OCCURENCE

The primary threats of wind energy development to whooping cranes are mortality due to collision with transmission lines and associated structures and loss of habitat. Because of the high levels of concern regarding whooping cranes, the ability to evaluate the risk to whooping cranes at individual WRA areas is a critical component to understanding the environmental impacts of a proposed wind facility. Here, Tetra Tech presents a method used to evaluate the likelihood of whooping cranes to occur at a WRA located in southwest North Dakota. This evaluation method incorporates the location of the WRA in the migration corridor, the locations of historical observations of whooping cranes, the presences of feeding and roosting sites, and the availability of habitat within the WRA compared to the surrounding landscape (Table 1). Tetra Tech expects whooping cranes to be more likely to occur over the life of a WRA at WRAs with high scores. For the purposes of this report, the scores calculated for each parameter were totaled and the likelihood of occurrence for whooping cranes in the WRA was ranked accordingly: Low (0-4); Moderate (5-10); High (10+). This assessment tool is not intended to replace field surveys.

6.1 Location of a WRA in the Migration Corridor (L)

Biological Justification

The location of a potential wind facility influences the likelihood of whooping crane occurrence due to the well defined migratory pattern of the cranes. The median location of all crane observations was statistically derived and was used to describe the migration route from the breeding grounds to the wintering grounds (CWS and USFWS 2007). Buffers were then calculated based on the percentage of observations (Figure 3). For example, 75 percent of all observations occurred within the 75-percent buffer. If two sites are compared, whooping cranes are more likely to stop over at a site within the 75-percent buffer than at a site outside the 95-percent buffer.

Scoring

Tetra Tech developed scores for the location of a WRA based on the percent of observations within each buffer. If a WRA fell within the 75-percent buffer, it was scored 7.5. If a WRA fell between the 75-percent and 95-percent buffers, it was scored 2.0 because 20 percent of all observations occur between these buffers. If a WRA fell outside of the 95-percent buffer, it was scored 0.5 because 5 percent of all observations occur outside the 95-percent buffer.

Assumptions

- The likelihood of whooping crane occurrence in the future will not deviate from the patterns observed through 2008.

If a portion of the WRA fell on the boundary of a buffer or in two buffers, the WRA was assumed to be within the buffer closer to the middle of the migratory corridor.

6.2 Attractiveness on the Landscape (A)

Biological Justification

Wetlands are used by whooping cranes for feeding and roosting and the amount of wetlands within a given area compared to the surrounding landscape may influence whooping crane use of a site during migration. After whooping cranes have descended from migration flight altitudes, they may travel up to 35 miles in search of suitable roosting habitat. Therefore, Tetra Tech determined if a WRA contained a higher proportion of wetlands than was found within the 35 miles surrounding the WRA to determine if the WRA is more attractive than the surrounding area.

Scoring

Tetra Tech used GAP data for North American (Strong et al. 2005) in conjunction with National Wetlands Inventory (NWI) data (USFWS 2006) and National Land Cover Database data (USGS 2007) to determine the total acreage of wetlands within the WRA and within 35 miles of the WRA. The use of multiple data sources will help avoid the limitations of any one data source (e.g., Stahlecker 1992). Tetra Tech then calculated the proportion of the total acreage of the WRA that was comprised of wetlands and the proportion of the total acreage of a 35-mile area around the WRA that was wetlands (excluding the WRA). Tetra Tech divided the proportion of the WRA that was wetlands by the proportion of the 35-mile buffer that was wetlands to determine if the WRA contained more wetlands than the surrounding area. Tetra Tech used the ratio as the score in the likelihood index equation. If the ratio was greater than 1, the WRA contained more wetlands and is more attractive than the surrounding 35-mile buffer. If the ratio was equal to 1, the WRA contained a similar proportion of wetlands and is as attractive as the surrounding 35-mile buffer. If the ratio was less than 1, the WRA contained less wetlands and is less attractive than the surrounding 35-mile buffer.

Assumptions

- The distribution of wetlands in the Geographic Information System (GIS) data is an accurate representation of the location of wetlands in the WRA.
- Wetlands are “available” and “suitable,” regardless of type, size, or location.
- 35 miles is an appropriate scale to examine whooping crane habitat use.

6.3 Historical Whooping Cranes Observations (H)

Biological Justification

Whooping cranes are readily identified by biologists and bird watchers and tend to be conspicuous on the landscape and thus are well documented for a rare species during migration. The United States Geological Survey (USGS) has compiled a report documenting the locations and habitat of whooping cranes during migration from 1943-1999 (Austin and Richert 2001). These observations indicate that a whooping crane, or group of whooping cranes, was seen at some point between 1943 and 1999. The USFWS has produced an updated map showing the location of whooping crane observations though 2008 (Figure 3). It is important to note that while these are the best data available, they are largely non-standardized and incidental; as such these data are not suitable for assessing habitat preferences or shifts in migration patterns.

Scoring

Tetra Tech developed scores for the historical observations of whooping cranes in relation to the location of the WRA. As the occurrence of 1 whooping crane at a WRA is significant and because of the bias associated with the observations, Tetra Tech did not place weight on the number of observations, only on the general distance of the nearest observation to a given WRA. If at least 1 observation occurred on or within the WRA boundary, it was scored 3; if at least 1 observation occurred within 10 miles of the boundary, it was scored 2; if at least 1 observation occurred within 35 miles of the boundary, it was scored 1.

Assumptions

- Whooping crane locations represent the best approximate location of the observation.
- The locations in the report and the map provided by the USFWS represent the full extent of whooping crane locations known to the USGS and USFWS.
- Each observation is at least one whooping crane, although some observations may represent groups of whooping cranes.

6.4 Presence of Foraging and Roosting Sites (W)

Biological Justification

Whooping cranes often make low altitude flights between roosting and foraging habitat and are thus at risk of collision with power lines and other structures (CWS and USFWS 2007; Stehn and Wassenich 2008; USFWS 2009). Austin and Richert (2001) found that agricultural crops, especially corn, sorghum, and winter wheat were the habitat most often contiguous to roosting areas and that most cranes traveled 0.62 miles from a roosting site to a foraging site. Therefore, wetlands located within 0.62 mile of agricultural crops form a wetland-habitat matrix that is often used by whooping cranes during migration (Austin and Richert 2001). Tetra Tech determined the proportion of the WRA that was comprised of wetland-agricultural matrix. Tetra Tech included water bodies of any type (hereafter wetlands), but restricted the analysis to wetlands greater than 1 acre to eliminate inclusion of unusable wetland (e.g., borrow pits). Tetra Tech limited the analysis to crop agriculture because it is most often used for feeding habitat and restricted the analysis to agriculture greater than 1 acre because most observations of cranes occurred in agriculture greater than 1.0 acre (Austin and Richert 2001).

Scoring

To quantify the amount of roosting and foraging habitat in the WRA, geographic information system (GIS) landcover data (GAP data) was obtained for North Dakota (Strong et al. 2005). Water features and the spatial extent of waters were verified with NWI data (USGS 2007). The GIS analysis was designed to calculate the total area of wetland-agricultural matrix, which may include other habitat types between patches of wetlands and agriculture. Thus, based on the size restrictions and spatial configuration, the total acres of wetland-agricultural matrix could be greater or less than the sum of the acres of wetland and agriculture. Tetra Tech calculated the proportion of the WRA that was wetland-agricultural matrix by dividing the total acres of wetland-agricultural matrix by the total acres of the WRA. Tetra Tech used the proportion as the score in the likelihood index; therefore, scores may range from 0 to 1.

Assumptions

- The optimal distance of foraging habitat from roosting habitat is 0.62 mile.
- Wetlands and agricultural areas in the dataset are considered “available” and “suitable,” regardless of type or location.
- Habitats not classified as wetlands or agriculture are of neutral value and do not influence the availability of wetlands or agriculture on the landscape.

Field Verification

Tetra Tech verified the presence of suitable roosting locations during a site visit in October 2009 timed to coincide with the fall migratory period for whooping cranes in North Dakota. Any desktop-identified wetlands that were found to (a) either not exist or (b) exist in a form that might render them unusable by cranes were removed from the analysis. Eleven acres of wetlands and 311 acres of wetland-agricultural matrix were removed.

6.5 Likelihood Index Formula (LI)

The likelihood index of whooping cranes occurring at the WRA was calculated by evaluating the landscape features in and around the WRA. Tetra Tech used the following formula to calculate the likelihood index:

$$LI_i = (L_i \times A_i) + H_i + W_i$$

Where L_i = location of WRA in relation to the migration corridor score, A_i = attractiveness score, or the ratio of wetlands in a WRA to wetlands in a 35-mile area around a WRA, H_i = historical observation score, and W_i = wetland-agricultural matrix score. The equation places the most weight on the location in the migration corridor because of the wide range of scores. Thus, a WRA within the 75-percent corridor will tend to score higher than a WRA within the 95-percent corridor unless the attractiveness score for the WRA within the 75-percent corridor is low (e.g., <0.50) or the attractiveness score for the WRA within the 95-percent corridor is high (>4.0), when other values are equal. WRAs located outside of the 95-percent corridor will tend to score low unless the attractiveness score is high because the location score is less than 1.0.

7.0 BALDWIN ASSESSMENT AND SUMMARY

The likelihood index score was 2.9 for the WRA (Table 2) implying low likelihood of occurrence, despite the WRA's location in the central portion of the whooping crane migration corridor. Fifty-nine percent of the WRA consists of suitable wetland-agriculture matrix habitat, making the Presence of Feeding and Roosting Sites (W) value 0.61 (Figure 4). The WRA is located within the 75-percent buffer; therefore, the Location (L) parameter was 7.5. The percentage of available wetlands within the WRA is lower than the surrounding 35-mile buffer area, with a calculated Attractiveness on the Landscape (A) value of 0.047. There were no recorded observations of whooping cranes within the proposed WRA. A total of 79 observations occurred within the 35-mile buffer around the WRA (Appendix 1). The whooping crane observations should be used for general inference regarding use of an area and cannot be used for micrositing features away from whooping crane sightings because some of the observations may lack precise locations. Additionally, the absence of a sighting in a specific area should not be construed as a whooping crane having never occurred in that area.

8.0 REGULATORY CONSIDERATIONS

The whooping crane is listed as an endangered species under the ESA. Injury or death of a whooping crane from any WRA feature would be considered "take" under the ESA and subject to penalties. Under the ESA, the potential impact of wind facilities on whooping cranes will need to be addressed by the USFWS under section 7 of the ESA if the WRA has a federal nexus or under Section 10 of the ESA if there is no federal nexus and there is the potential of a take. Under a Section 7 consultation, the USFWS must have a finding of no jeopardy in order to concur with the ESA. Under a Section 10 consultation, the applicant develops mitigation and conservation plans to offset losses due to the proposed WRA by way of a habitat conservation plan (HCP), at which point the USFWS will issue an incidental take permit if they are in agreement. Currently, there are no incidental take permits or habitat conservation plans for the whooping crane. The USFWS is currently engaged in internal discussions to determine how to address the potential take of whooping cranes at wind energy facilities.

9.0 RECOMMENDATIONS

Risk to whooping cranes inside the migration corridor can be minimized by selecting sites that are not as attractive as the surrounding landscape and that do not contain a high proportion of wetland-agricultural matrix habitat, although any wetland of suitable size may be utilized by whooping cranes. Conducting a broad scale analysis of the risks associated with potential WRA sites is the first step to determining potential impacts to whooping cranes.

Determining the optimal mitigation plan for whooping cranes is challenging because the actual impacts associated with the construction and operation of a WRA are not known. The two most likely possibilities are: 1) direct mortality of whooping cranes due to collisions with transmission lines, turbines, or other facilities; or 2) whooping cranes avoidance of the area around the facility. If avoidance of a previously utilized region occurs, the area occupied by the wind facility would constitute stop-over habitat loss. Therefore, in the former case, mitigation should be directed at increases in survival or reproduction of the cranes. In the latter case, mitigation could be directed at the creation or preservation of stopover habitat. In lieu of specific data about impacts, a range of mitigation options and additional research needed are presented below. As additional species and WRA data become available, avoidance and minimization options can be refined.

Potential Avoidance and Minimization Options:

- If WRA facilities are not already engineered to prevent perching by birds, anti-perching devices should be installed. Eliminate or minimize all structures where birds may perch. Rounded and sloped surfaces that are too large in circumference for birds to grasp or too angled for birds to perch on are best.

Each WRA is unique with respect to the relationship of the facilities with potential whooping crane habitat. Thus, avoidance and minimization strategies are site-specific and require detailed knowledge of the proposed WRA and surrounding landscape as well as coordination with state and federal wildlife biologists. In the current political environment, the preferred method of avoidance and minimization may change rapidly as more information about whooping crane behavior and habitat availability becomes available.

10.0 LITERATURE CITED

Allen, R.P. 1952. The whooping crane. Natl. Audubon Soc. Resource Rep. 3. 246pp.

Austin, J.E., and A.L. Richert. 2001. A comprehensive review of the observational and site evaluation data of migrant whooping cranes in the United States, 1943-99. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, and State Museum, University of Nebraska, Lincoln, Nebraska. 157 pp.

Banks, R. 1978. The size of the early whooping crane populations. Unpubl. Rep. USFWS files. 10pp.

Binkley, C.S., and R.S. Miller. 1983. Population characteristics of the whooping crane, *Grus americana*. Can J. Zool. 61:2768-2776.

Canadian Wildlife Service and U.S. Fish and Wildlife Service [CWS and USFWS]. 2007. International recovery plan for the whooping crane. Ottawa: Recover of the Nationally Endangered Wildlife (RENEW), and U.S. Fish and Wildlife Service, Albuquerque, NM.

Strong, L.L., H.T. Sklebar, and K.E. Kermes. 2005. North Dakota GAP analysis project. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/projects/ndgap/ (Version 12JUN2006).

Hagen, S.K., P.T. Isakson, and S.R. Dyke. 2005. North Dakota Comprehensive Wildlife Conservation Strategy. North Dakota Game and Fish Department. Bismarck, ND. 454 pp. http://www.gf.nd.gov/conservation/cwcs.html

Hahn, P. 1963. Where is that vanished bird? Royal Ontario Museum, Univ. Toronto, Canada.

Johns, B.W. 1992. Preliminary identification of whooping crane staging areas in prairie Canada. Pages 61-66 in D.A. Wood, ed. Proc. 1988 N. Am Crane Workshop. Florida Game and Fresh Water Fish Commission, Tallahassee.

Johns, B.W., E.J. Woodsworth, and E.A. Driver. 1997. Proc. North Am. Crane Workshop 7:123-131

Kyut, E. 1992. Aerial radio-tracking of whooping cranes migrating between Wood Buffalo National Park and Aransas National Wildlife Refuge, 1981-84. Occ. Pap. 74, Canadian Wildl. Service, 53 pp.

Stahl, J.T. and M.K. Oli. 2006. Relative importance of avian life-history variables to population growth rate. Ecological Modeling 198:23-39.

Stahlecker, D.A. 1992. Using National wetlands inventory maps to quantify whooping crane stopover habitat in Oklahoma. Proc. N. Am. Crane Workshop 6:62-68.

Stehn, T.V. 1997. Pair formation by color-marked whooping cranes on the wintering grounds. Proc. N. Am. Crane Workshop 7:24-28.

Stehn, T.V., and T. Wassenich. 2008. Whooping crane collisions with power lines: an issue paper. 2006 Proc. N. Am. Crane Workshop. In press.

U.S. Fish and Wildlife Service (USFWS). 2009. Whooping cranes and wind development – An issues paper. USFWS Regions 2 and 6. Available at: http://www.fws.gov/southwest/es/library/

U.S. Fish and Wildlife Service (UWFWS). 2006. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31. Available at: http://www.fws.gov/nwi.

U.S. Geological Survey (USGS). 2007. National Land Cover Database 2001. Available at http://www.mrlc.gov/multizone_download.php?zone=6.

TABLES

Table 1. Parameters used in the likelihood index calculation.

Parameter	Score	Justification
Location in the Migration Corridor (L)		
Within the 75-percent buffer	7.5	75% of all whooping crane observations occur within the 75-percent buffer
Between the 75-percent and 95-percent buffers	2.0	20% of all observations occur between 75-percent and 95-percent buffers
Outside the 95-percent buffer	0.5	5% of observations occurred outside the 95-percent buffer
Attractiveness on the Landscape (A)		
Ratio of wetlands per total acreage for WRA / wetland per total acreage for 35-mile area not including WRA	Actual ratio	Indicates if the WRA is similar (=), less (<), or more (>) attractive than the surrounding landscape to migrating cranes searching for roosting habitat
Historical Whooping Crane Observations (H)		
Within WRA	3	Whooping cranes were historically observed within the WRA
Within 10 miles of WRA	2	Whooping cranes historically in the vicinity
Within 25 miles from WRA	1	Whooping cranes historically in the area
Presence of Foraging and Roosting Habitat (W)		
Proportion of WRA that is a wetland-agricultural matrix	Actual proportion	Indicates the proportion of the WRA that is favored by cranes for foraging and roosting habitat

Table 2. Likelihood index scores for the Baldwin WRA.

Location in the Migration Corridor (*L*)	Attractiveness on the Landscape (*A*)	Historical Whooping Crane Observations (*H*)	Presence of Foraging and Roosting Habitat (*W*)	Likelihood Index Score (*LI*)
7.5	0.047	2	0.59	2.9

FIGURES

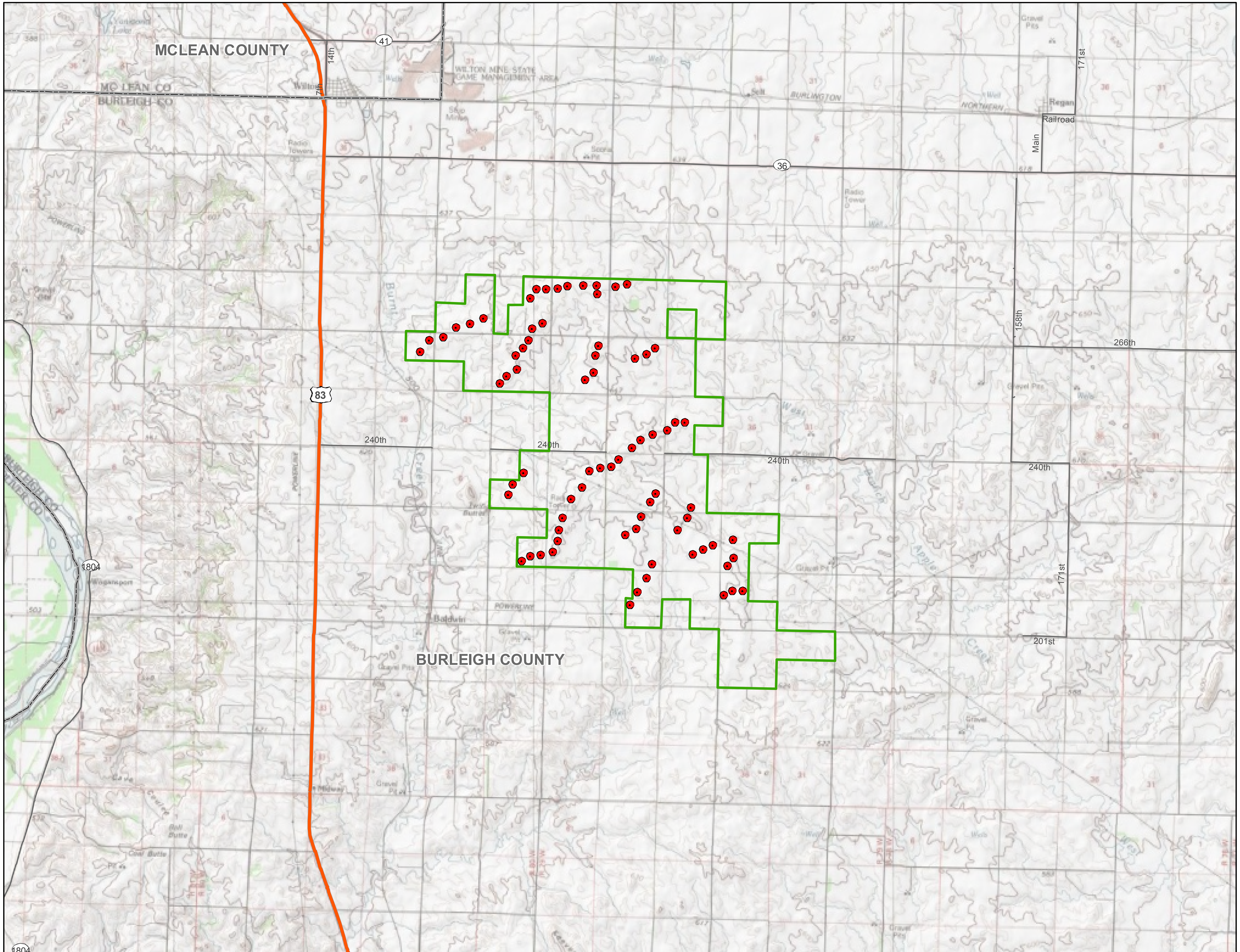

Figure 1.
Baldwin Wind Resource Area Vicinity Map

Burleigh County,
North Dakota

November 2009

L E G E N D

- Baldwin Turine Array (9/9/09)
- Baldwin Wind Resource Area (9/9/09)
- County Boundary
- State Boundary
- Highway
- Major Road
- Local Road

Data Sources:
National Geographic Topo Maps
ESRI Streetmap 9.3

0 0.2 0.4 0.8 1.2 1.6
Miles

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

L O C A T I O N M A P

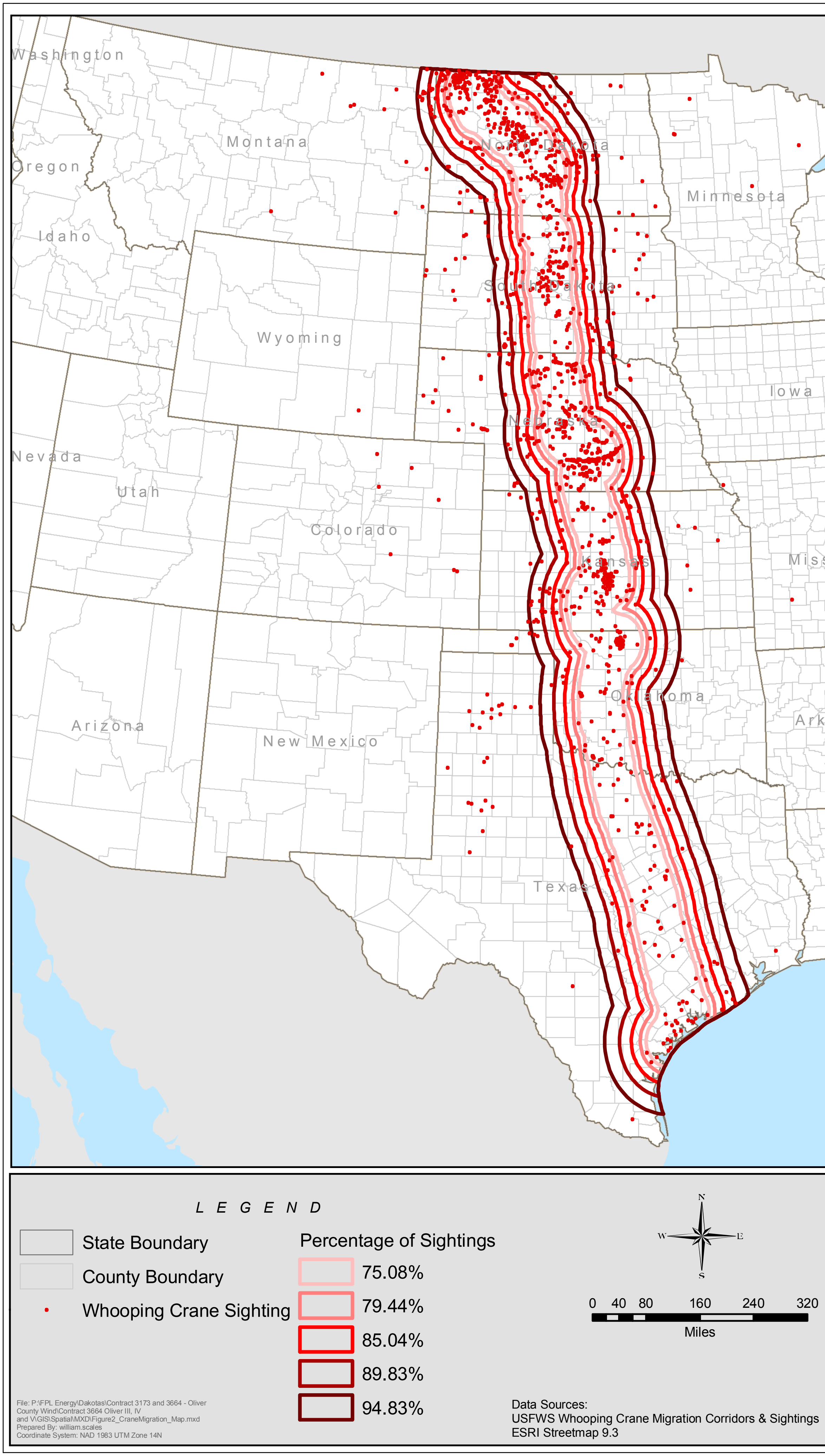
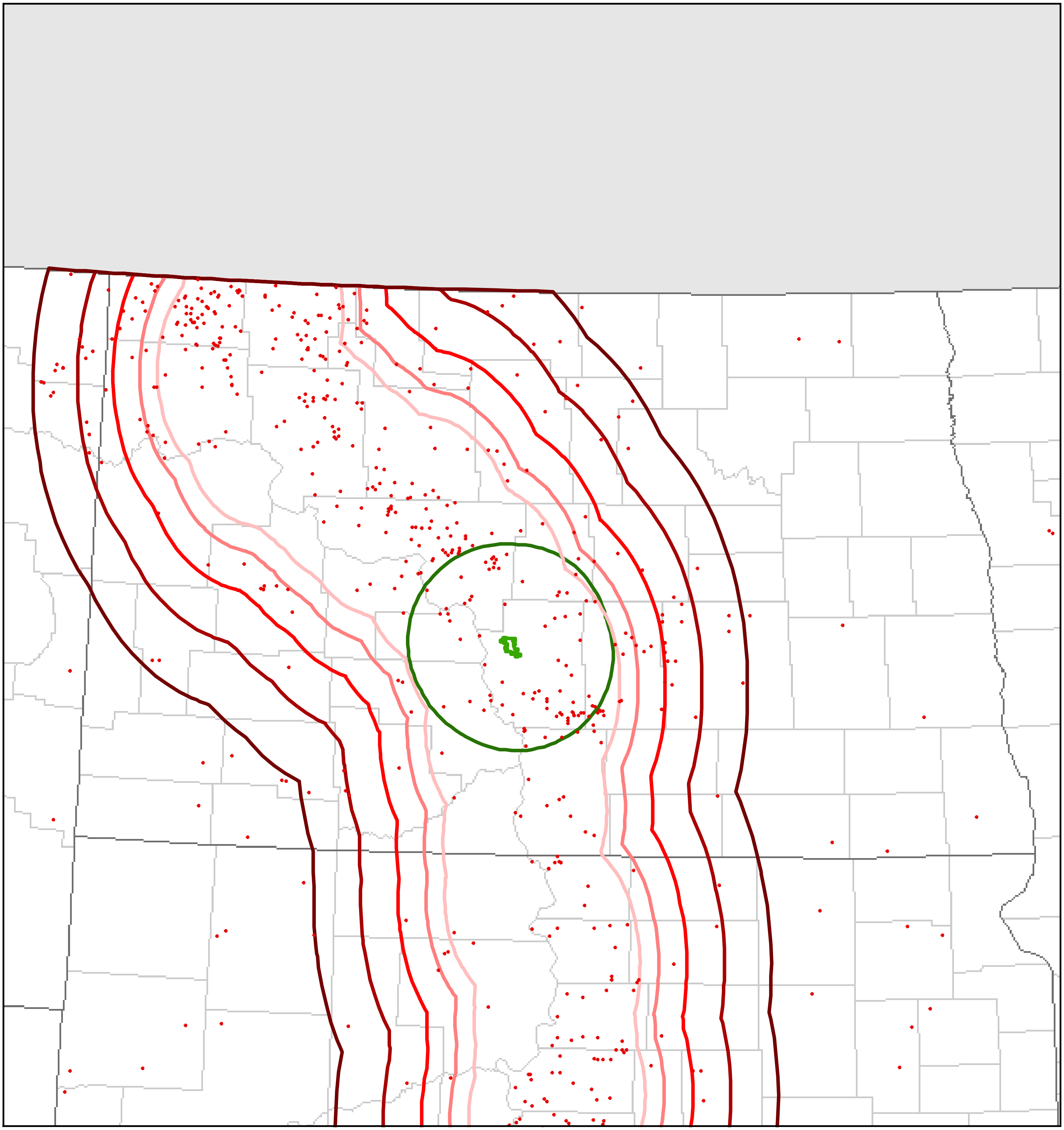


Figure 2.
Whooping Crane Migration Route in the United States



LEGEND

- Whooping Crane Sighting
- Percentage of Sightings
  - 75.08%
  - 79.44%
  - 85.04%
  - 89.83%
  - 94.83%
- Baldwin Wind Resource Area (9/9/09)
- 35-Mile Buffer
- State Boundary
- County Boundary

N
W E
S

0 10 20 40 60 80
Miles

Data Sources:
USFWS Whooping Crane Data
ESRI Streetmap 9.3

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

Figure 3.
Baldwin Wind Resource Area
Whooping Crane Migration
Map: North Dakota

November 2009

NEXTera ENERGY RESOURCES

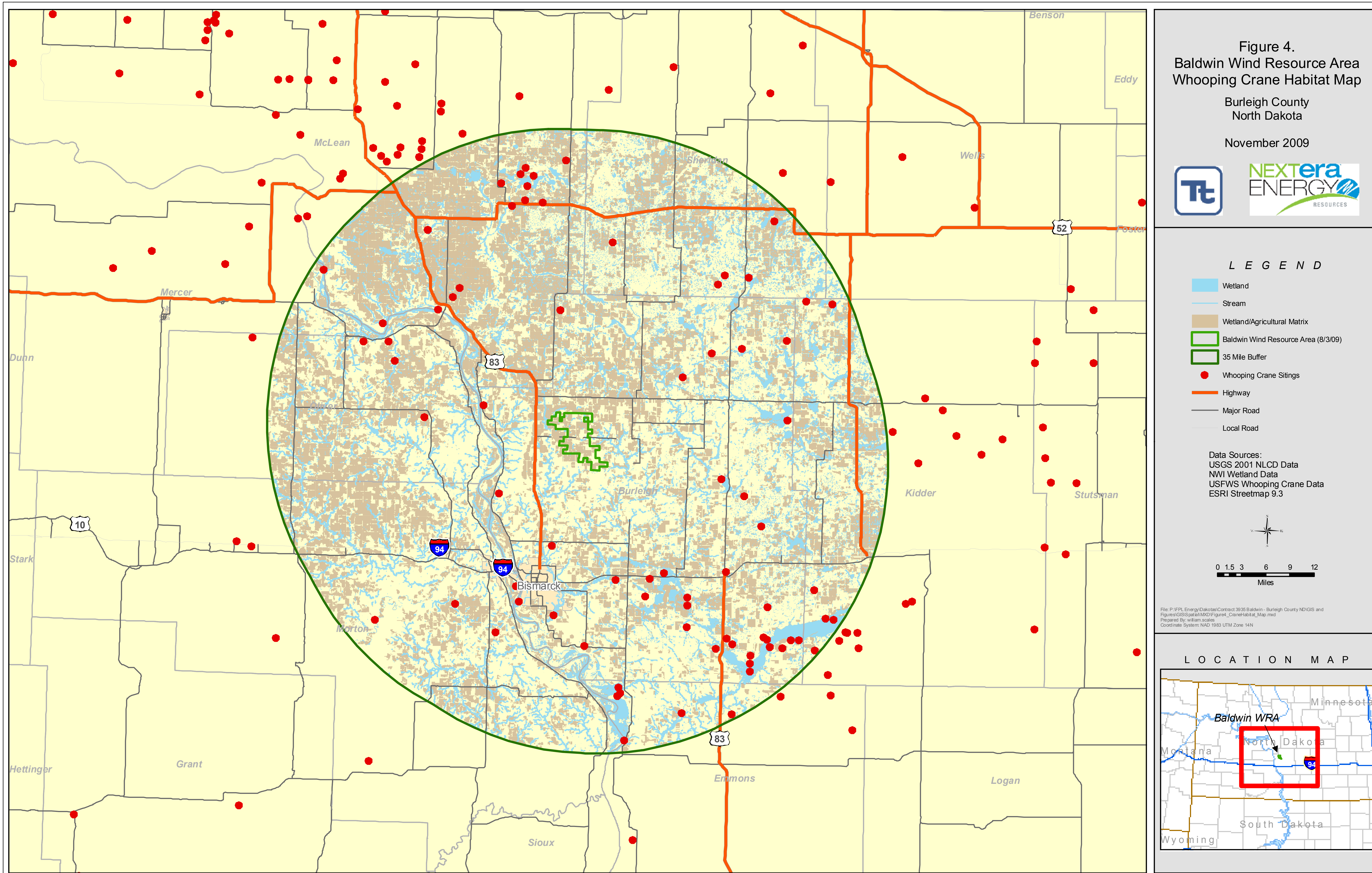
Figure 4.
Baldwin Wind Resource Area
Whooping Crane Habitat Map
Burleigh County
North Dakota
November 2009
NEXTera ENERGY RESOURCES
L E G E N D
Wetland
Stream
Wetland/Agricultural Matrix
Baldwin Wind Resource Area (8/3/09)
35 Mile Buffer
Whooping Crane Sitings
Highway
Major Road
Local Road
Data Sources:
USGS 2001 NLCD Data
NWI Wetland Data
USFWS Whooping Crane Data
ESRI Streetmap 9.3
0 1.5 3 6 9 12
Miles
File: P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Figure4_CraneHabitat_Map.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 14N
L O C A T I O N M A P
Baldwin WRA
Minnesota
North Dakota
Montana
South Dakota
Wyoming
94
Benson
Eddy
McLean
Sheridan
Wells
Foster
Mercer
Dunn
Oliver
Burleigh
Kidder
Stutsman
Stark
Morton
Bismarck
Hettinger
Grant
Emmons
Logan
Sioux
83
52
10
94

APPENDIX

Appendix 1. Whooping Crane sightings within 35 miles of the Baldwin WRA						
Adults	**Juveniles**	**Total**	**Date**	**Year**	**County**	**Location Specifics**
1	0	1	09/24/61	1961	OLIVER	FT. CLARK
2	1	3	10/25/64	1964	BURLEIGH	10N MANDAN
2	0	2	04/13/67	1967	BURLEIGH	LONG LAKE NWR
2	0	2	04/27/67	1967	BURLEIGH	LONG LAKE NWR
2	1	3	04/16/68	1968	KIDDER	12N,8E WING
3	0	3	04/21/68	1968	MORTON	6.5S,4E JUDSON
2	0	2	05/03/70	1970	BURLEIGH	3SW BISMARCK, MISSOURI RIVER
1	0	1	09/23/71	1971	MCLEAN	1NE BLUE LAKE
1	0	1	10/16/71	1971	MCLEAN	1E,2S TURTLE LAKE
1	0	1	04/24/72	1972	BURLEIGH	MIDDLE RICE LAKE
1	0	1	09/27/72	1972	BURLEIGH	LONG LAKE NWR
7	0	7	04/19/77	1977	BURLEIGH	10NE WING
1	0	1	10/21/77	1977	BURLEIGH	3S,1.5E MENOKEN
1	0	1	10/28/77	1977	BURLEIGH	22SW BISMARCK
3	1	4	10/31/77	1977	BURLEIGH	LONG LAKE NWR
1	0	1	10/29/78	1978	MCLEAN	LAKE WILLIAMS
2	0	2	09/24/79	1979	MCLEAN	2NE TURTLE LAKE
1	0	1	09/29/81	1981	MCLEAN	NEAR LAKE WILLIAMS
4	1	5	11/07/83	1983	BURLEIGH	LONG LAKE NWR
1	0	1	10/13/83	1983	MCLEAN	5W MERCER
2	0	2	09/29/84	1984	BURLEIGH	NEAR MCKENZIE SLOUGH
1	0	1	09/26/85	1985	BURLEIGH	LONG LAKE NWR,5.5E,2N MOFFIT
1	0	1	09/26/86	1986	BURLEIGH	6N,1E WING
1	0	1	09/21/86	1986	BURLEIGH	NEAR LONG LAKE NWR
4	0	4	04/17/87	1987	BURLEIGH	BISMARCK,MISSOURI RIVER
4	1	5	04/15/88	1988	MCLEAN	3SE UNDERWOOD
0	1	1	04/15/88	1988	MCLEAN	3SE UNDERWOOD
1	0	1	05/04/89	1989	KIDDER	LONG LAKE NWR
6	1	7	11/01/89	1989	EMMONS	19SE BISMARCK, MISSOURI RIVER
1	0	1	05/07/90	1990	BURLEIGH	2S,2E ARENA,LAKE ARENA WPA
1	0	1	10/04/90	1990	KIDDER	3S,6W STEELE
6	0	6	10/21/91	1991	MERCER/McLEAN	MISSOURI RIVER,3N,1E STANTON
1	0	1	09/29/93	1993	MCLEAN	2S,4.5E,.25N TURTLE LAKE
1	0	1	10/13/93	1993	MCLEAN	2N,3E TURTLE LAKE
1	0	1	10/25/94	1994	MCLEAN	1/2W TURTLE LAKE
1	0	1	10/13/96	1996	BURLEIGH	3W,8N WING
3	0	3	10/29/96	1996	SHERIDAN	5N FLORENCE LAKE NWR
4	0	4	10/01/96	1996	BURLEIGH	3N STERLING
1	0	1	10/03/96	1996	BURLEIGH	5S,1E MCKENZIE
1	0	1	10/03/97	1997	BURLEIGH	9N,2.25E STERLING I-94 EXIT
1	0	1	04/20/98	1998	BURLEIGH	4E MOFFIT, LONG LAKE NWR
2	0	2	10/16/98	1998	EMMONS	5W BRADDOCK
3	0	3	04/14/99	1999	BURLEIGH	2N,0.5E MOFFIT
2	1	3	10/27/99	1999	MCLEAN	9W WASHBURY, NEAR MISSOURI R.
1	0	1	10/03/99	1999	SHERIDAN	6E,8S MCCLUSKY

Appendix 1. Whooping Crane sightings within 35 miles of the Baldwin WRA						
Adults	**Juveniles**	**Total**	**Date**	**Year**	**County**	**Location Specifics**
2	0	2	04/16/00	2000	EMMONS	8SW MOFFIT
3	1	4	04/10/00	2000	BURLEIGH	8SE BISMARCK
2	0	2	10/28/00	2000	BURLEIGH	2N,2E MOFFIT
8	1	9	11/03/00	2000	OLIVER	10E CENTER
4	0	4	10/22/01	2001	BURLEIGH	15N,2E WING
2	0	2	10/22/01	2001	EMMONS	5S,12W MOFFIT
2	1	3	10/23/01	2001	EMMONS	5S,12W MOFFIT
7	0	7	04/17/02	2002	BURLEIGH	0.25W MCKENZIE,MCKENZIE SLOUGH
5	0	5	10/25/02	2002	BURLEIGH	BISMARCK, SERTOMA PARK
2	0	2	10/25/02	2002	EMMONS	5S,12W MOFFIT
2	0	2	10/25/02	2002	BURLEIGH	BISMARCK AIRPORT
3	0	3	10/16/02	2002	MCLEAN	2N WASHBURN
6	0	6	10/16/02	2002	MCLEAN	4.5NE WASHBURN
3	0	3	04/13/03	2003	OLIVER	9SW WASHBURN
3	0	3	04/13/03	2003	BURLEIGH	5N,3W DRISCOLL
2	0	2	04/06/03/	2003	BURLEIGH	2W MENOKEN
2	0	2	10/04/03	2003	KIDDER	7S,4W STEELE
2	0	2	10/16/03	2003	BURLEIGH	LONG LAKE NWR,3E MOFFIT
1	0	1	10/09/04	2004	BURLEIGH	5NE MOFFIT
1	0	1	10/10/04	2004	KIDDER	12S STEELE
2	0	2	04/30/05	2005	MORTON	5SW MANDAN
1	0	1	09/30/05	2005	BURLEIGH	LONG LAKE NWR, 3SE MOFFIT
12	0	12	10/16/05	2005	SHERIDAN	3S, 1.5W PICKARDVILLE
2	1	3	11/03/05	2005	BURLEIGH	4.5S, 1W DRISCOLL
3	0	3	11/13/05	2005	BURLEIGH	7W, 2S WILTON, MO RIVER BOTTOMS
3	0	3	04/22/06	2006	MCLEAN	MISSOURI RIVER, 2W WASHBURN
2	0	2	05/04/06	2006	BURLEIGH	9N, 2E WILTON
1	0	1	05/05/06	2006	KIDDER	12N TUTTLE
2	0	2	09/25/06	2006	SHERIDAN	2W, 2S GOODRICH
1	0	1	4/15/2007	2007	BURLEIGH	2E MENOKEN, ALONG HWY 10
20	0	20	4/15/2007	2007	BURLEIGH	SW BISMARCK
3	0	3	5/22/2007	2007	MERCER	4S, 7W WASHBURN
2	0	2	10/22/2007	2007	BURLEIGH	4S, 1.5E MCKENZIE
4	1	5	11/03/2007	2007	BURLEIGH	W-NW OF WING

MAC
Metcalf Archaeological Consultants, Inc.

November 18, 2009

Ms. Anne-Marie Griger
Tetra Tech EC
78100 Shoal Creek Boulevard
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Austin, Texas 78757

RE: Nextera's Baldwin Wind Energy Center - Preliminary Report on Findings

Metcalf Archaeological Consultants, Inc. (MAC) conducted a Class III Cultural Resource Inventory of 76 blocks along with associated access roads, collector line, and transmission corridors for Nextera's wind energy center in Burleigh County, North Dakota. As planned, 66 of the blocks will be utilized for wind turbine construction. Most of the inventoried blocks are 500 by 500 feet (5.7 acres) although 20 if the blocks, at the ends of turbine strings, are 600 by 700 feet (9.6 acres). All corridor widths are 200 feet and run between the turbine blocks or along existing road ways and section lines. Changes to routes and turbine locations are possible. These locations will be inventoried as plans are finalized and a visual impact study is also anticipated.

The inventory was conducted between October 7 and 28, 2009 by Ed Stine, Principal Investigator, Crew Chiefs Aaron Barth and Andrea Kulevsky, and crew members Bill Christensen, Nichole Reisdorf, Jonathon Schwartz, and Derek Sondeland.

Prior to field work a search of the State Historical Society of North Dakota's site and manuscript files, covering a one mile radius of the project area, was conducted. The search revealed that 11 investigations have occurred in the area including three, conducted by MAC, related to the Wilton wind farm immediately to the north of the project. Three additional inventories were also conducted by MAC. Other investigations include two bridge surveys and a historic coal mine district study. The search also revealed nine historic sites leads (including six coal mines) 13 prehistoric chipped stone isolated finds, four historic/architectural sites (2 churches, 1 bridge, 1 railroad) and three prehistoric sites within a mile of the project. None of the sites are within the project boundaries.

The majority of the inventoried blocks and corridors lie in cultivated farm land with only a small percentage in native prairie. Six prehistoric stone feature sites were documented, all in native prairie, and three prehistoric chipped stone isolated finds were documented in cultivated fields. In addition two architectural sites were documented. The sites are plotted on the attached maps.

Five of the prehistoric sites, MAC-BWF-01, MAC-BWF-06, MAC-BWF-07, MAC-BWF-08, and MAC-BWF-09, consist of single rock cairns. Cairns are known to have served a variety of functions including marking caches, marking trails and important locations, serving as burial

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caps, and other domestic and ceremonial purposes. Although the sites have not been evaluated for the National Register they may be a property "... of traditional religious and cultural importance to an Indian tribe ... and that meet(s) the National Register criteria" (36 CFR 800.16[I] [1]).

Prehistoric site MAC-BWF-10 is a single stone circle. Stone circles are viewed by archaeologists as having a number of possible functions. They are most commonly viewed as having been used in the construction of tipis, but other less familiar, though significant, functions involve a variety of social/ceremonial activities. Some circles may be the remains of stone effigies and often still hold significance for contemporary Native American tribes. Although the site has not been evaluated for the National Register it may be a property "... of traditional religious and cultural importance to an Indian tribe ... and that meet(s) the National Register criteria" (36 CFR 800.16[I] [1]).

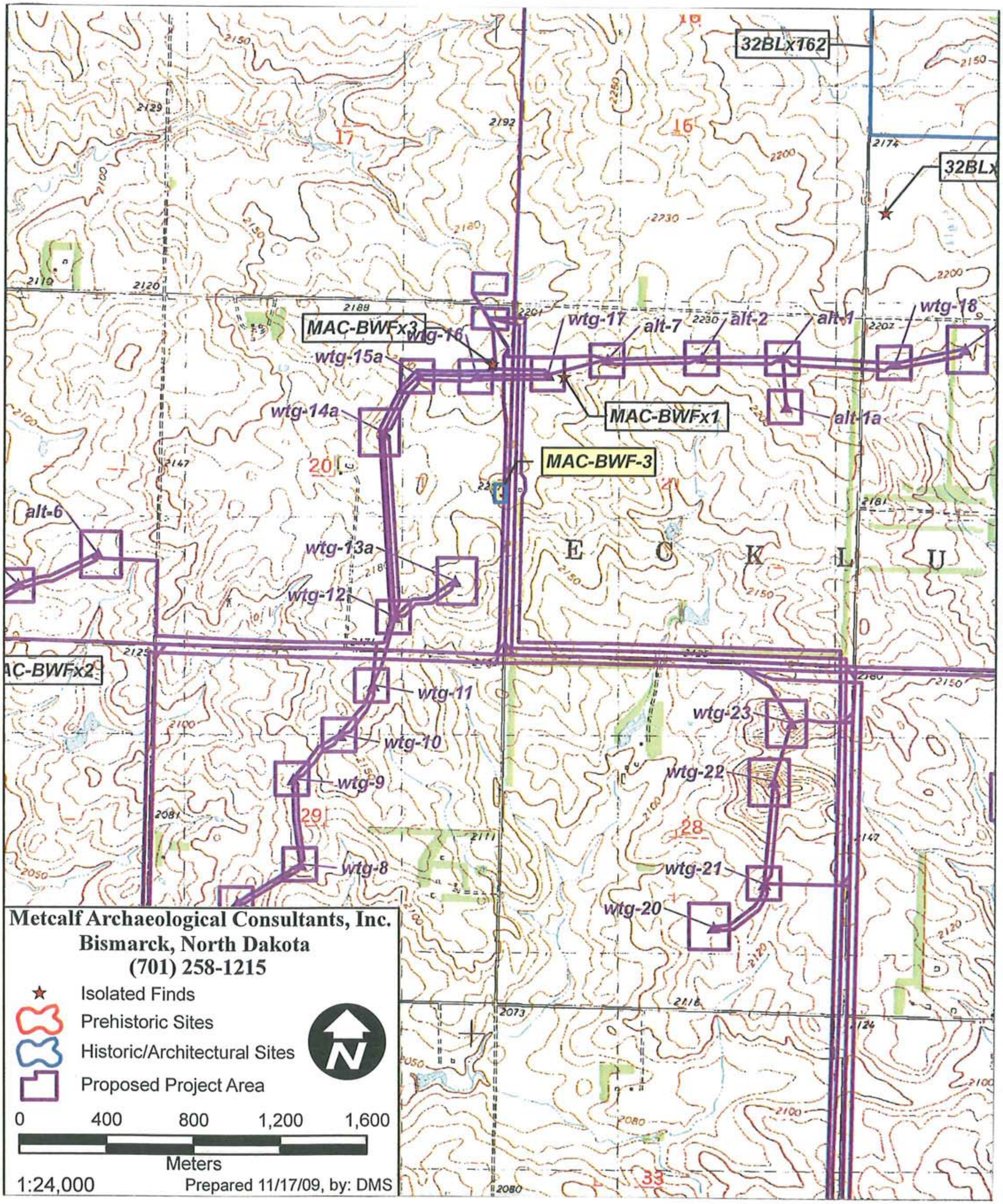
The two architectural sites consist of a farmstead with three structures and a school house. Neither appear to be eligible for the National Register. Regardless, the proposed project would not impact these sites beyond having a temporary visual impact during construction.

The stone feature sites have not been evaluated for National Register of Historic Places eligibility and in lieu of evaluative testing avoidance is recommended. Avoidance can be accomplished by fencing during construction. The sites are far enough from proposed turbines/corridor centerlines that no turbine moves and only minor shifts within the 200 foot wide corridors would be needed to avoid the fenced site areas. The isolated finds are recommended as not eligible for the National Register and no avoidance or further investigation is recommended at their locations.

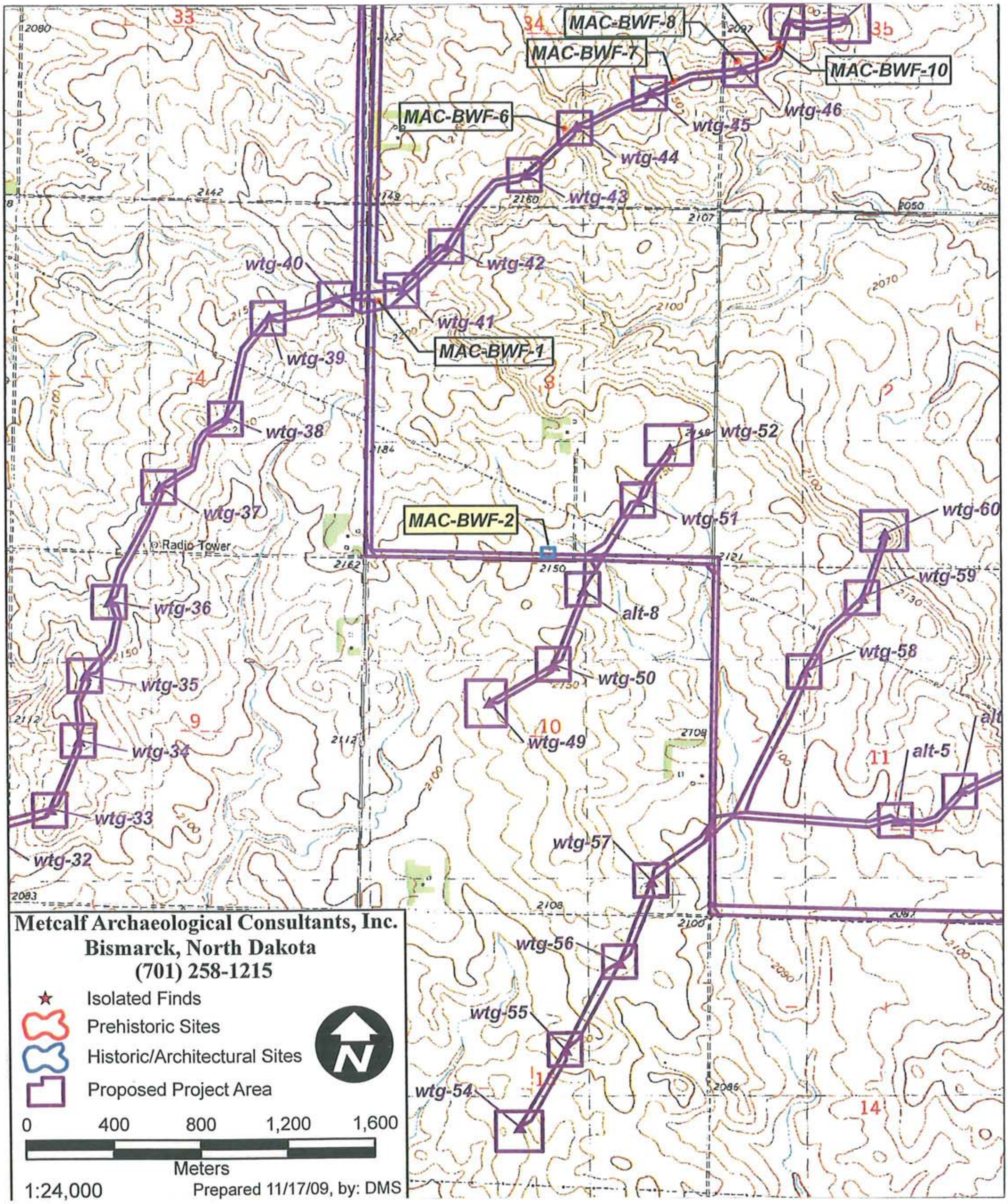
Provided that the prehistoric sites are fenced and avoided a finding of *No Historic Properties Affected* is recommended for the proposed undertaking.

Submitted by:

Ed Stine, Principal Investigator



Map 3: Farmstead location.



Map 4: School location.

Analysis of Potential Media Interference for the Proposed NDBaldwin WindFarm

June 29, 2009

Previous literature has examined the impact of wind turbine generators on various media communications (AM/FM radio and Off-Air Television) and has demonstrated the potential for interference [1]. The extent of the interference created by wind turbines has been gradually diminished over the past decade due to advances in turbine manufacturing and transmitter/receiver antenna design. This has significantly reduced the impact on AM and FM radio systems to the point where only small degradation of signal is noticed a few meters from a turbine location [1]. With the switch to Digital Television (DTV) on June 12th, 2009 in the United States, the concern of ghost images and flickering caused by wind turbine interference with analogue signals are no longer an issue. Wind turbines have no impact on digital picture quality, but may impact signal strength to receivers within 5 km of a turbine [2]. To determine the potential effect of a wind farm the signal strength and coverage area of each television station is analyzed below. It is important to note that it is difficult to accurately pinpoint the impact of large wind farms for each individual household, as there are several factors that need to be considered.

- Coverage of AM and FM radio services are not expected to be impacted by the wind farm because there are no transmitter towers located within the project boundary and turbines will be constructed a sufficient distance from each dwelling (427m).

- According to the Federal Communications Commission (FCC), over the air television coverage is strong to moderate within the project area, with many stations transmitting from Bismarck, ND. Table 1 shows the signal strength of off-air stations near the project area as calculated by a terrain-sensitive propagation model.

- Coverage maps of each off-air station near the project boundary are available below. With the exception to station KNDX (FOX), full power coverage of the off-air stations fully encompass the project area providing strong to moderate signal strength. Coverage for KNDX extends to the northern edge of the project area and may be impacted.

- From the above analysis, it is expected that homes with the greatest potential of signal interference from wind turbines will be within the northern portion of the project area, where the signal is weakened. Station KNDX is expected to be impacted the most.

[1] Sengupta, D.L. and Senior, T. B. A., "Electromagnetic Interference from Wind Turbines", *Wind Turbine Technology*, Chapter 9, ASME Press, 1994.

[2] ITU-R BT.805, Assessment of impairment caused to television reception by a wind turbine, 1992.

CALLSIGN	LICENSEE	STATION / Network	LAT	LON	Distance to Project (km)
KBME	Prairie Public Broadcasting, INC.	3-1	46.5897222	-100.8005556	44.54
KFYR	Hoak Media of Dakota License, LLC	5-1	46.6055556	-100.8061111	42.91
KXMB	Reiten Television, INC.	12-1	46.5897222	-100.8005556	44.54
KNDX	Prime Cities Broadcasting, Inc.	26-1	46.5897222	-100.7941667	44.54

Table 1 Digital television signal strength as indicated by the FCC terrain-sensitive propagation model for Regan, ND. A strong signal is indicated by the green highlight, a moderate signal by the yellow highlight, and a weak signal by the red highlight. These signal strength calculations are approximate and assume limited impacts of buildings, weather, and antenna design.

Digital Television Station Coverage Maps

for the

Baldwin, ND Wind Farm Project

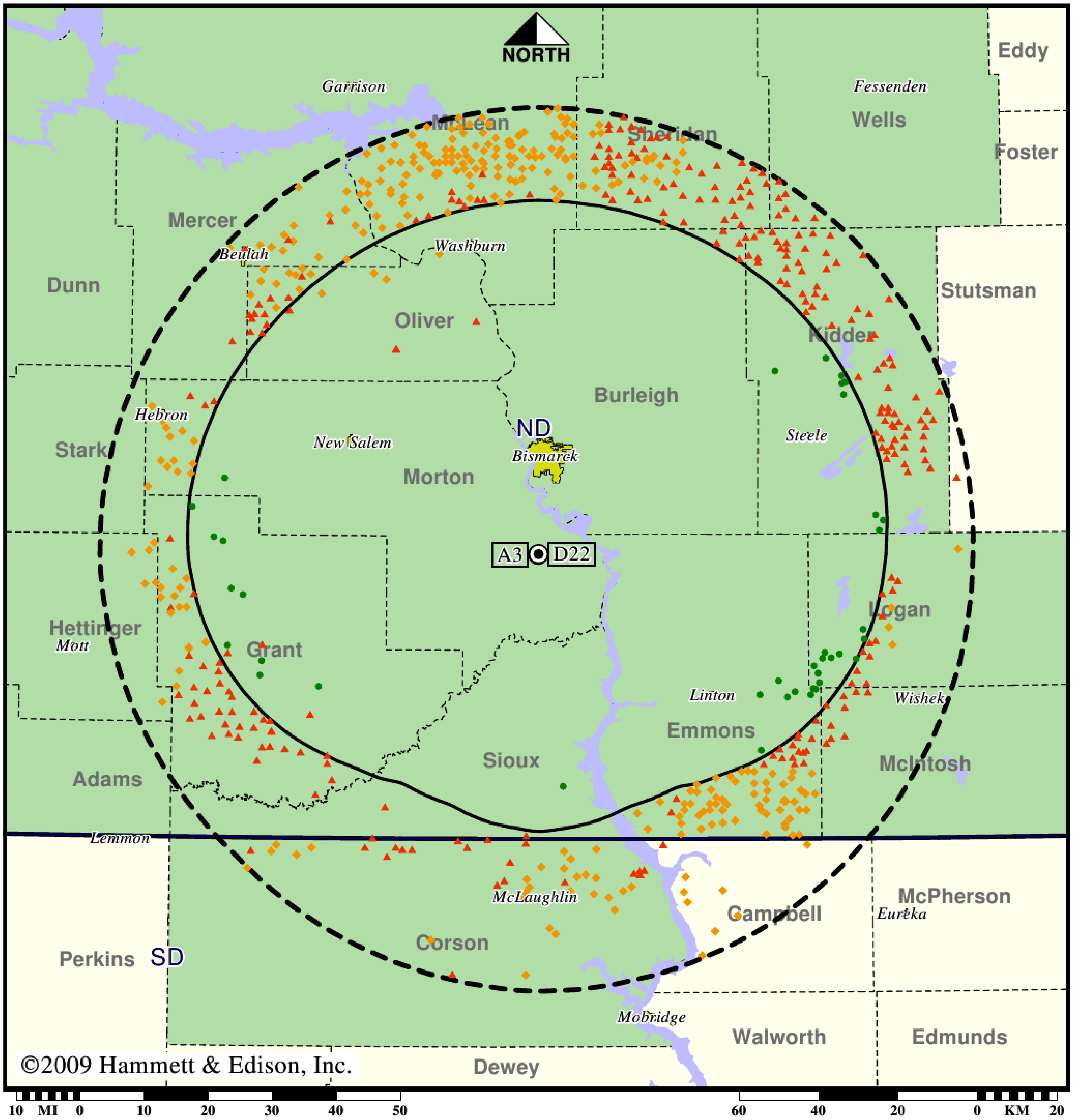
Maps courtesy of the FCC
Expected digital coverage areas
Current as of June 29, 2009

Station KBME-TV • Analog Channel 3, DTV Channel 22 • Bismarck, ND

Expected Operation on June 13: Licensed

Digital License (solid): 97.3 kW ERP at 392 m HAAT, Network: PBS
vs. Analog (dashed): 79.4 kW ERP at 425 m HAAT, Network: PBS

Market: Minot-Bismarck-Dickinson, ND



- ● Coverage gained after DTV transition
- No symbol = no change in coverage
- ◆ Coverage lost but still served by same network
- ▲ Coverage lost and no other service by same network

Analog service	121,020 persons
Digital service	110,625
Analog loss	10,941
Digital gain	546
Net gain	-10,395

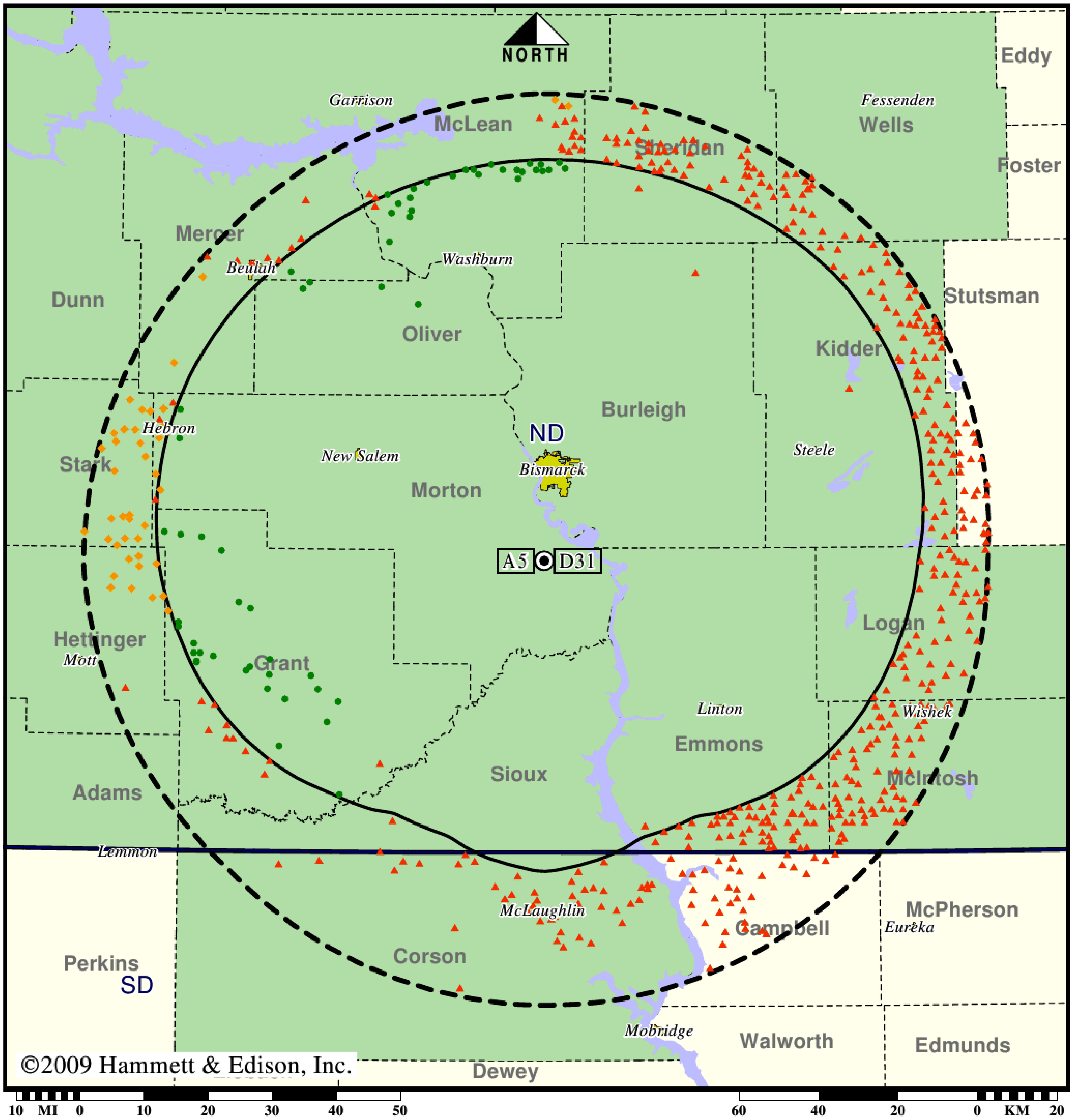
BLEDT-20020122AAD
KBME-TV Digital License

Station KFYR-TV • Analog Channel 5, DTV Channel 31 • Bismarck, ND

Expected Operation on June 13: Licensed

Digital License (solid): 500 kW ERP at 389 m HAAT, Network: NBC
vs. Analog (dashed): 100 kW ERP at 427 m HAAT, Network: NBC

Market: Minot-Bismarck-Dickinson, ND



- Coverage gained after DTV transition
- No symbol = no change in coverage
- Coverage lost but still served by same network
- Coverage lost and no other service by same network

Analog service	125,413 persons
Digital service	118,436
Analog loss	8,387
Digital gain	1,410
Net gain	-6,977

BLCDT-20071108ADF
KFYR-TV Digital License

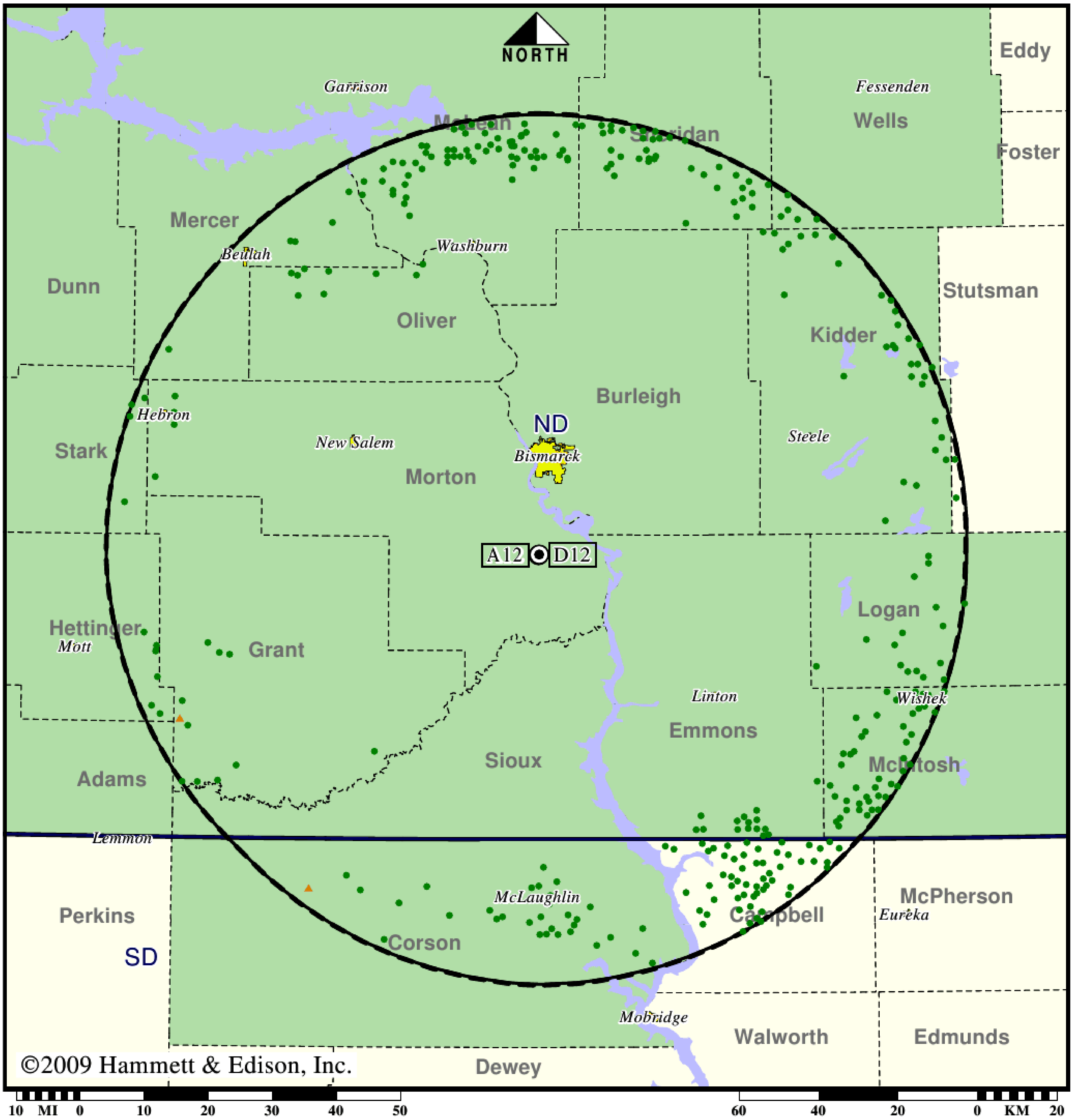
Map set 1

Station KXMB-TV • Analog Channel 12, DTV Channel 12 • Bismarck, ND

Expected Operation on June 13: Granted Construction Permit

Digital CP (solid): 19.1 kW ERP at 444 m HAAT, Network: CBS
vs. Analog (dashed): 316 kW ERP at 466 m HAAT, Network: CBS

Market: Minot-Bismarck-Dickinson, ND



Coverage gained after DTV transition

No symbol = no change in coverage

Coverage lost after DTV transition

Analog service	119,433 persons
Digital service	126,503
Analog loss	4
Digital gain	7,074
Net gain	7,070

BPCDT-20080320ABC
KXMB-TV Digital CP

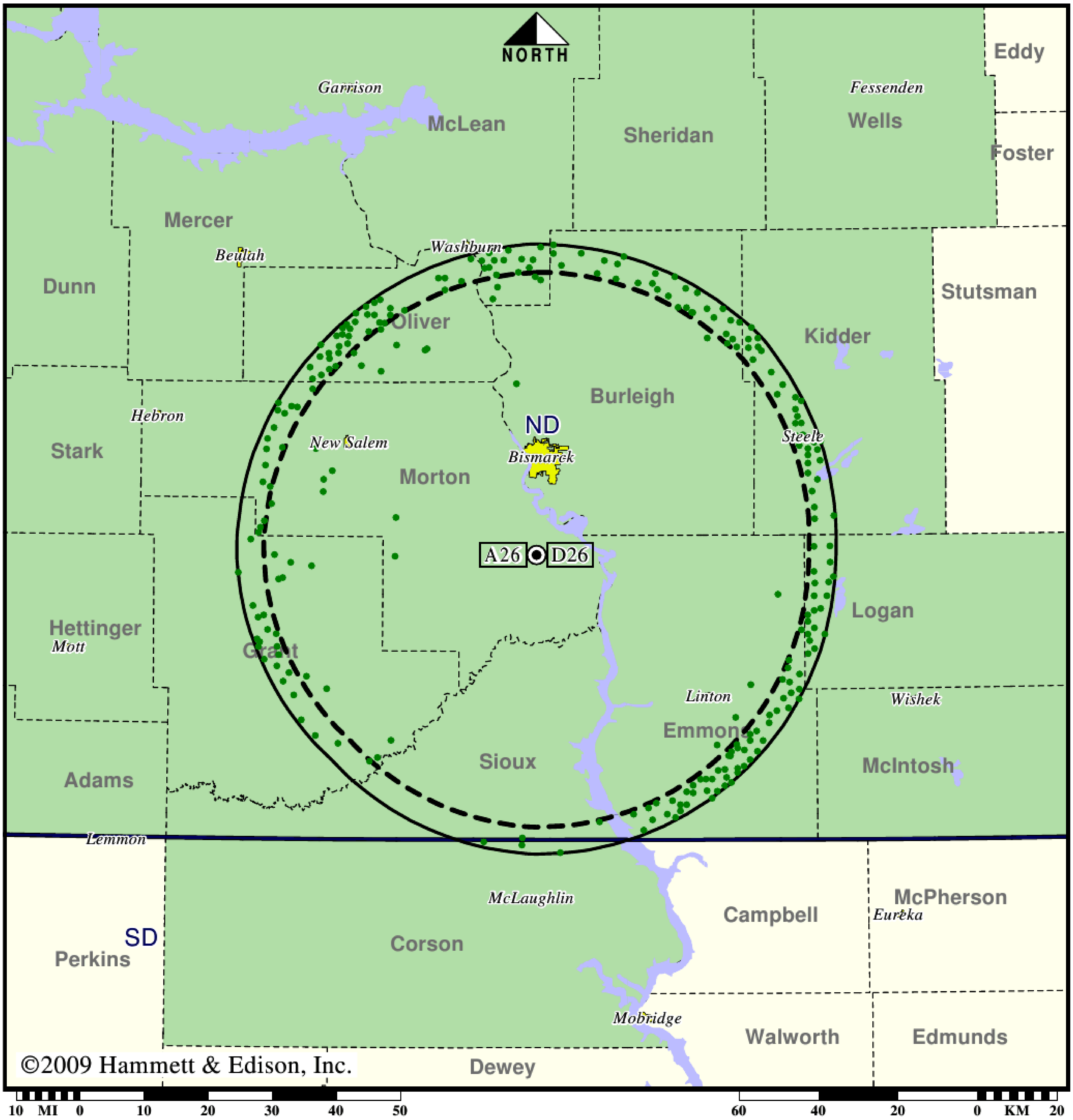
Map set 1

TV Station KNDX • Analog Channel 26, DTV Channel 26 • Bismarck, ND

Expected Operation on June 13: Granted Construction Permit

Digital CP (solid): 50.0 kW ERP at 300 m HAAT, Network: Fox
vs. Analog (dashed): 741 kW ERP at 300 m HAAT, Network: Fox

Market: Minot-Bismarck-Dickinson, ND



● Coverage gained after DTV transition
No symbol = no change in coverage

Analog service	100,820 persons
Digital service	104,571
Analog loss	0
Digital gain	3,751
Net gain	3,751

Baldwin Wind Project Non-Federal Beam Path June 29, 2009

Baldwin Wind Energy Center
Acoustic Assessment
Burleigh County, North Dakota

October 8, 2009

Prepared for

NEXTera ENERGY RESOURCES

Prepared by

TETRA TECH EC, INC.
133 Federal Street
Boston, MA 02110
617-457-8200

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AGL	above ground level
Applicant	NextEra Energy Resources, LLC
BIL	basic impulse level
BLM	Bureau of Land Management
CadnaA	Computer-Aided Noise Abatement Program
dB	decibel
dBA	A-weighted decibel
dBL	unweighted decibel
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
GE	General Electric
Hz	Hertz
HPD	hearing protection devices
IEC	International Electrotechnical Commission
ISO	Organization for International Standardization
kHz	kilohertz
kV	kilovolt
L_{dn}	day-night averaged sound level
L_{eq}	equivalent sound level
LFN	low frequency noise
L_{max}	maximum sound level
L_p	sound pressure level
L_w	sound power level
m/s	meters per second
mph	miles per hour
MVA	megavolt amperes
MW	megawatt
NEMA	National Electrical Manufacturers Association
NSA	noise sensitive area
OSHA	Occupational Safety and Health Administration
PEIS	Programmatic Environmental Impact Statement
PEL	permissible exposure limit
Project	Baldwin Wind Energy Center
pW	picowatt
Tetra Tech	Tetra Tech EC, Inc.
µPa	microPascal
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
W	watt
WTG	wind turbine generator

EXECUTIVE SUMMARY

Tetra Tech EC, Inc. (Tetra Tech) has completed the acoustic assessment for the proposed 66-turbine wind energy project, the Baldwin Wind Energy Center (Project) located in Burleigh County, North Dakota. An engineering analysis was developed to address sound levels resulting from wind turbine operations, as well as the consideration of sound from the electrical substation and sound generated during Project construction and maintenance activities. The overall objectives of this study were to: (1) quantify Project sound sources and site-specific sound propagation characteristics; (2) computer simulate wind turbine generator (WTG) sound levels over the full range of future Project operational and meteorological conditions; and (3) determine the feasibility of the Project to operate in compliance with applicable noise standards and guidelines.

Wind turbine sound source data was obtained from General Electric (GE), the manufacturer of the GE xle 1.5 megawatt (MW) wind turbine model. Sound propagation modeling was conducted using the Computer-Aided Noise Abatement (CadnaA) software program (version 3.7.123), a comprehensive 3-dimensional acoustic modeling computer simulation software specifically developed for the power generation industry with calculations made in accordance with the Organization for International Standardization (ISO) 9613-2 “Attenuation of Sound During Propagation Outdoors.”. The industry standard CadnaA acoustic modeling software is widely used by sound engineers due to its adaptability to describe complex acoustic scenarios. CadnaA, programmed with the ISO 9613-2 standard, has been shown to be a highly effective and accurate acoustic modeling assessment tool, assisting in the siting of wind energy projects in Europe, Canada, and the United States. The results of the acoustic modeling results were compared to U.S. Environmental Protection Agency (EPA) environmental noise guidelines and Occupational Safety and Health Administration (OSHA) regulatory limits for worker exposure and public safety.

The overall conclusions of the acoustic assessment are as follows:

1. Acoustic modeling results show that the Project has been designed, inclusive of a number of conservative model input assumptions, to operate in compliance with EPA noise guidelines and OSHA safety standards at all existing inhabited structures considered to be noise sensitive areas (NSAs).
2. The proposed turbine model will not produce an audible steady state pure tone or apparent tonal conditions at any existing NSAs, as defined per International Electrotechnical Commission (IEC) standards for WTG operation.
3. Operation of the Project may result in periodically audible sound at NSAs under certain operational and meteorological conditions. Specifically, the Project will be audible at the closest NSAs relative to the Project, when background sound levels are low, and wind speeds high enough for WTG operation. Residents outside their houses and with a direct line of sight to an operating WTG may hear a gentle swooshing sound characteristic of wind energy projects. At more distant receptor locations during meteorological conditions favorable to sound propagation and very quiet background ambient sound conditions, WTGs may be periodically audible but will be well within the recommended guideline limits to avoid the potential for adverse noise impacts on public health and safety.

1.0 INTRODUCTION

NextEra Energy Resources, LLC (the Applicant) proposes to construct the 99 megawatt (MW) wind energy facility in Burleigh County, North Dakota, referred to as the Baldwin Wind Energy Center (the Project). The Project consists of a total of 66 1.5 MW GE xle wind turbine generators (WTGs) with a rotor diameter of 270 feet (82.5 meters) and an effective hub height of 262.5 feet (80 meters) above grade. The Project will also include an electrical substation, which transforms the power generated from on-site WTGs to a higher voltage suitable for the local distribution system.

In support of environmental permitting efforts, Tetra Tech EC, Inc. (Tetra Tech) was retained to perform the acoustic assessment of several iterative Project layouts. The acoustic assessment analyzed the total potential Project power production output of 99 MW; however, it is expected that the Project will primarily be operated at half of its potential capacity (i.e., 49.5 MW). The final project layout, dated September 10, 2009, includes six alternate WTG sites. This document presents the findings of the assessment, including calculated future sound levels resulting from project operation using the finalized layout and the electrical substation and an evaluation of the feasibility of the Project to operate in compliance with applicable noise regulations and guidelines. In addition, noise associated with Project construction and maintenance activities has been assessed in a semi-qualitative manner. While construction is required to erect the Project WTGs and supporting electrical substation, no transmission line construction is anticipated in support of this Project.

1.1 Project Acoustic Study Area

The Baldwin Wind Energy Center is located within the Northwestern Great Plains. The landscape includes the western mixed-grass prairie, short-grass prairie, and associated wetlands of the Missouri Slope and River Breaks regions. This semiarid, unglaciated region of North Dakota includes level to rolling plains topography with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Land use is predominantly dry-land farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

The Project is located on privately owned lands in central North Dakota, consists of 14,300 acres, approximately 17 miles north of Bismarck in Burleigh County (Figure 1). The Project area is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture and rangelands with patches of native prairie. The area contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Residences and abandoned farmsteads are widely scattered throughout the Project area. Patches of trees and shrubs exist throughout the Project area and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

A total of 46 potential Noise Sensitive Areas (NSAs) were identified within the designated acoustic study area using the Project Farmstead Location Report dated August 18, 2009. Figure 1 presents the Burleigh County acoustic study area, the locations of the proposed WTGs and NSAs. While all identified NSAs were included in the acoustic modeling analysis, as indicated in Figure 1, several NSAs were found to be abandoned or not currently used for residential purposes during the farmstead survey completed Swenson, Hagen & Co. P.C of Bismarck, North Dakota.

1.2 Existing Acoustic Environment

Burleigh County would generally be characterized as a rural agricultural land use area, and existing ambient sound levels are expected to be relatively low, although sound levels may be sporadically elevated in localized areas due to roadway noise or periods of human activity. Background sound levels will vary both spatially and temporally depending on proximity to area sound sources, roadways and natural sounds. Principal contributors to the existing acoustic environment likely include motor vehicle traffic, mobile farming equipment, farming activities such as plowing and irrigation, all-terrain vehicles, local roadways, rail movements, periodic aircraft flyovers, and natural sounds such as birds, insects, and leaf or vegetation rustle during elevated wind conditions in areas with established tree stands or established crops. Diurnal effects result in sound levels that are typically quieter during the night than during the daytime, except during periods when evening and nighttime insect noise dominate in warmer seasons.

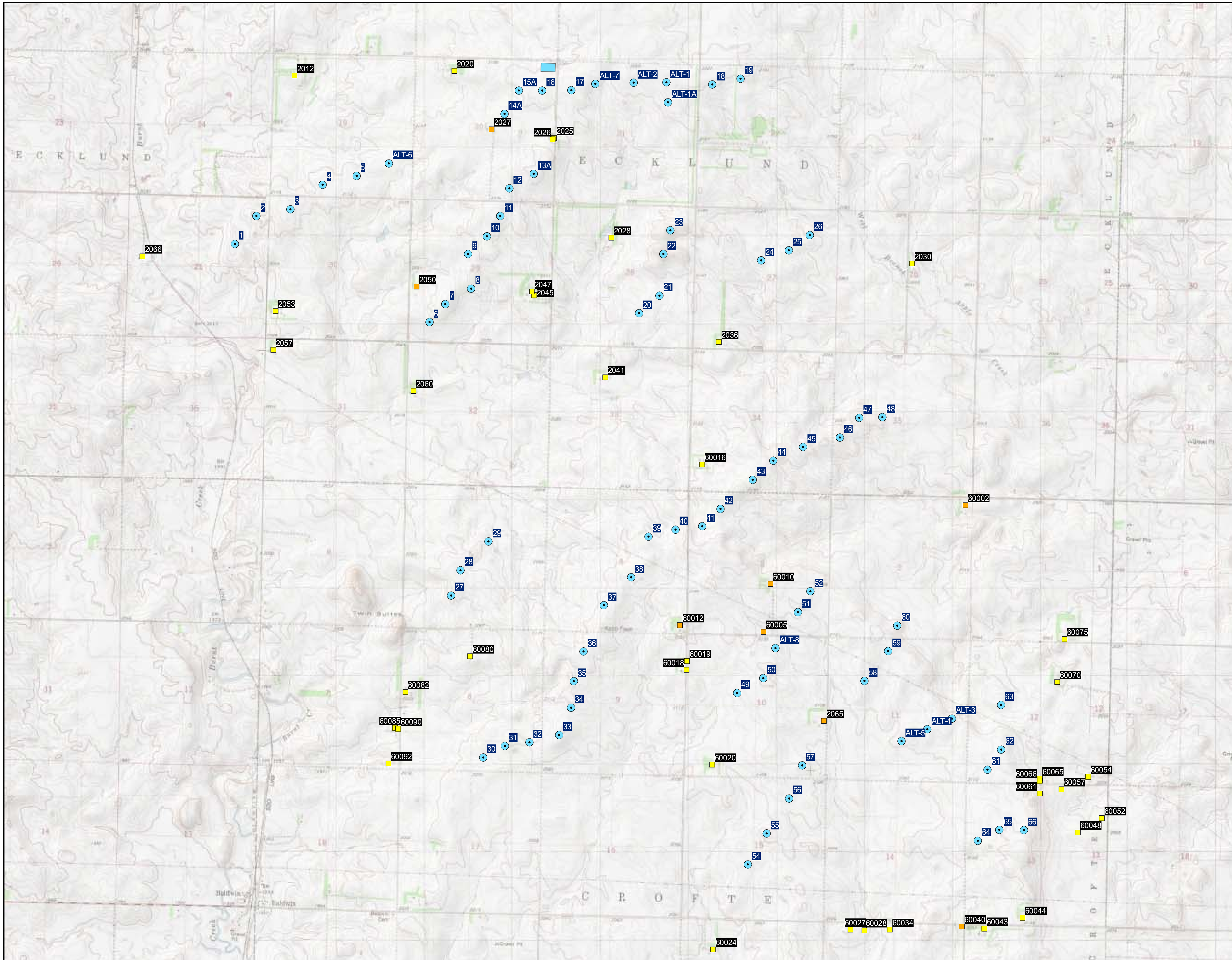
In areas with elevated background sound levels, sound may be obscured through a mechanism referred to as acoustic masking. Seasonal effects such as cricket chirping, certain farming activities, as well as wind-generated ambient noise as airflow interacts with foliage and cropland, contribute to this masking effect. The latter is most prevalent in rural and suburban areas with established tree stands. Wintertime defoliate conditions typically have lower background sound levels due to lower wind masking effects and reduced outdoor activities in colder climates. During colder seasons, people typically exhibit lower sensitivities to outdoor sound levels, particularly in this geographical region of the United States, as windows are closed, further enhancing outdoor to indoor transmission losses, and limited time is spent outdoors as compared to more temperate climates.

NEXTERA ENERGY RESOURCES, LLC
BALDWIN WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 1
PROJECT LAYOUT

OCTOBER 2009

TETRA TECH EC, INC.



Legend

Turbine Location (9-9-2009)

Substation

Receptor

Occupied

Unoccupied

N W E S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Noise\Fig1_ProjectLayout.mxd 10/7/2009

1.3 Acoustic Terminology

All sounds originate with a source whether it is a human voice, motor vehicles on a roadway, or a wind turbine generator. Sound energy propagates through a medium where it is sensed and then interpreted by a receiver. A sound source is defined by a sound power level (L_w), which is independent of any external factors. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts (W). Sound energy travels in the form of a wave, a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure. A sound pressure level (L_P) is a measure of this fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. Sound power, however, cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source.

Sound levels are described on a logarithmic scale to account for the large range of pressure that the human ear can perceive, and is expressed in units of decibels (dB). A decibel is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals (μPa). Conversely, sound power is referenced to 1 picowatt (pW). Since the human ear does not perceive every frequency with equal loudness, complex sounds are often adjusted with a weighting filter. Sound exposure in acoustic assessments is commonly reported in A-weighted decibels. The A-weighted filter is applied to compensate for the frequency response of the human auditory system and sound levels are reported in units of dBA.

An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling of 100 dBA. The human ear does not sense changes in the sound pressure level as equal changes in perceived loudness. Scientific research demonstrates that the following general relationships hold between sound level and human perception for two broadband sound levels with the same or similar frequency characteristics:

- 1 dBA is the practically achievable limit of the accuracy of sound measurement systems and corresponds to an approximate 10 percent variation in sound pressure. A 1 dBA increase or decrease is a non-perceptible change in sound.
- 3 dBA increase or decrease is a doubling (or halving) of acoustic energy and it corresponds to the threshold of perceptibility of change in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors.
- 5 dBA increase or decrease is described as a perceptible change in sound level and is a discernable change in an outdoor environment.
- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic energy but is perceived as a doubling or halving in sound (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

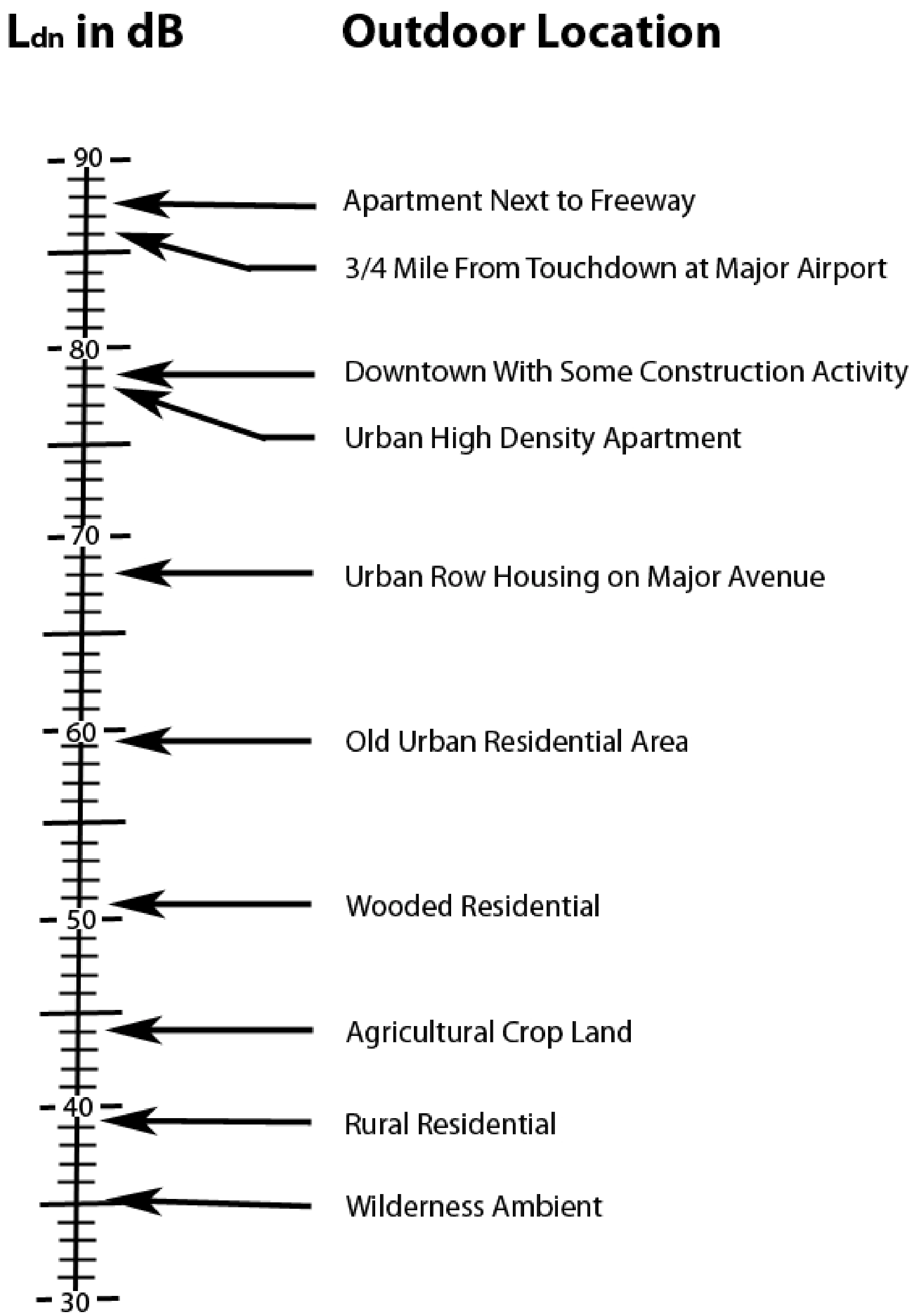
While the concept of sound is defined by the laws of physics, the term ‘noise’ has further qualities of being excessive or loud. The perception of sound as noise is influenced by technical factors as intensity, sound quality, tonality, duration, and the existing background levels. The effects of noise on people can be classified into three general categories: (1) subjective responses such as annoyance, nuisance, and dissatisfaction; (2) activity interference, e.g., speech, sleep, and learning; and (3) physiological effects such as anxiety or hearing loss. Environmental sound levels associated with wind energy development projects have been found to generally produce effects only in the first two categories.

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The equivalent sound level has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments of wind energy projects. Community sound levels are also often described in terms of the day-night averaged sound level (L_{dn}), which accounts for the increased potential for annoyance that comes with elevated sound levels at night. In addition, the maximum sound level (L_{max}) can be used to quantify the maximum instantaneous sound pressure level generated by a source and is often used in establishing regulatory noise limits.

Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, data may also include the analysis of the various frequency components of the sound spectrum to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves, and typically the frequency analysis examines 11 octave (or 1/3 octave) bands from 16 Hz (low) to 16,000 Hz (high).

The EPA estimates of various outdoor sound pressure levels and acoustic environments are presented in the day-night averaged sound level (L_{dn}) in Table 1. Table 2 presents additional reference information on terminology used in the acoustic assessment.

Table 1. Various Outdoor Sound Pressure (L_P) Levels



Notes:

μPa - Micropascals describe sound pressure levels (force/area).
dBA - A-weighted decibels describe sound pressure on a logarithmic scale referenced to 20 μPa.
Reference: USEPA, Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November 1978.

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Unwanted sound based on level, character, frequency or pitch, time of day, and sensitivity and perception of the listener.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. It is the amplitude of the oscillating sound pressure and is measured in Pascals (Pa), Newtons per square meter, which is a metric equivalent of pounds per square inch. Sound pressure is reported on the decibel scale referenced to 20 micronewtons per square meter, the approximate threshold of human hearing to sound pressure level at a frequency of 1000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to 10^{-12} watts. The wind turbine noise source levels are reported by the manufacturer in these terms since sound power is independent of environment.
A-Weighted Decibels (dBA)	Environmental sound is typically composed of acoustic energy across a wide spectrum of frequencies. Noise exposure in a community is commonly expressed in terms of the A-weighted sound level and is referred to as dBA in this report. A-weighting approximates the frequency response of the human ear.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear, or dBL. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise.
Propagation/Attenuation	The decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Other factors that can effect attenuation include air absorption, terrain effects, ground absorption, diffraction around objects and topographical features, trees, and meteorological conditions including wind velocity, temperature, humidity, and non-homogenous atmospheric conditions.
Aerodynamic noise	Aerodynamic noise is produced by the movement of an object through the air. For wind turbines, it is the noise caused by the rotor blades passing through the air. In general, the higher the rotational speed, the louder the sound. Recent improvements in the mechanical design of large WTGs have resulted in significantly reduced mechanical noise. As a result, aerodynamic noise is the dominant source from modern WTGs.
Acoustic Modulation	Technical term describing the variation of sound pressure levels (blade swish) caused by aerodynamic noise as the WTG blade passes through the air and the interaction with the WTG tower structure, i.e., shielding effect or blade/tower aerodynamic interaction.
Broadband	Containing sound energy at all frequencies across the entire audible spectra.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hertz and is typically divided into center frequencies (Hz) ranging from 31 to 8,000 Hz.
Low Frequency Noise (LFN)	The frequency range of 10 Hz to 200 Hz is typically defined as low frequency noise. At sufficiently high levels, LFN can cause vibrations in structures and physiological effects in humans. LFN is generally associated with older wind turbines with downwind rotors. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.
Directivity	Directivity accounts for the variation in sound intensity with orientation relative to the noise source. The Directivity correction is given as DI.
Wavelength	The distance between peaks of a propagating wave with a well defined frequency. It is related to the frequency through the following equation $\lambda=c/f$ where c is the sound speed and f is the frequency in Hz. It has the dimension of length.

Note: Compiled by Tetra Tech from multiple technical and engineering resources.

2.0 NOISE REGULATIONS AND GUIDELINES

This section presents information on the criteria used to evaluate the effects of noise from the Project. With the exception of the EPA environmental noise guidelines and the United States Occupational Health and Safety Administration's (OSHA) regulations that describe health and safety limits for noise exposure, there are no overarching state, county, or federal noise requirements specific to this Project or wind energy facilities in the state of North Dakota. Burleigh County does not have an ordinance with numerical decibel limits.

2.1 Environmental Protection Agency Environmental Noise Guidelines

While the EPA has no regulation governing environmental noise, the agency has conducted several extensive studies to identify the effects of sound level on public health and welfare. In 1974, the EPA published a landmark document entitled "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety." This publication remains the authoritative study based on a large sampling of community reaction to noise. The EPA sound level guidelines do not provide an absolute measure of noise impact, but rather a consensus on potential activity interference and annoyance. For outdoor residential areas, the recommended EPA guideline is an L_{dn} of 55 dBA (equivalent to an L_{eq} (1-hour) of 48.6 dBA assuming continuous 24-hour operation). The EPA sound level guidelines also suggest an L_{eq} of 70 dBA (24-hour) limit to avoid adverse effects on health and safety at publicly accessible property lines or work areas. Since these protective levels were derived without concern for technical or economic feasibility, and contain a margin of safety to ensure their protective value, they must not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there is no reason to suspect that the general population will be at risk from any of the identified effects of noise. The EPA criteria limits are summarized in Table 3.

Table 3. Summary of EPA Cause and Effect Noise Levels

Location	Level	Effect
All public accessible areas with prolonged exposure	70 dBA $L_{eq(24)}$	Safety / hearing loss concerns
Outdoor at residential structure and other NSAs where a large amount of time is spent	55 dBA L_{dn}	Protection against annoyance and activity interference
Outdoor areas where limited amounts of time are spent, e.g., park areas, school yards, golf courses, etc.	55 dBA $L_{eq(24)}$	
Indoor residential	45 dBA L_{dn}	
Indoor non-residential	55 dBA $L_{eq(24)}$	

The EPA sound level guidelines state that the levels identified are low enough to be protective with an adequate margin of safety. The EPA sound level guidelines do not impose arbitrary federal decisions about the appropriateness of noise environments upon any level of government, nor are they a source of instructions for solving local noise problems, but best viewed as a technical aid for local decision makers who seek to balance scientific information about effects of noise on people, and to reconcile local economic and political realities with scientific information such as cost and technical feasibility. It should also be noted that in any environment, a portion of the general population may be annoyed (and complain) due to the presence of any level of recurring audible sound regardless of the actual or perceived loudness.

2.2 Bureau of Land Management Guidance

In June 2005, the United States Department of the Interior Bureau of Land Management (BLM) published the Final Programmatic Environmental Impact Statement (PEIS) to address the potential impacts of wind energy projects on BLM Lands in the Western United States. One of the issues identified was the siting of wind energy projects in areas that do not have applicable noise standards. Section 4.5.4 of that document states, "The EPA guideline recommends an L_{dn} of 55 dBA to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas. The EPA limit is not a regulatory limit but "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety". The BLM PEIS findings are not directly applicable to the Baldwin Wind Energy Center as it will be entirely sited on private land; however, the BLM restatement of the EPA guideline provides insight on how one governmental agency is addressing the potential for noise impacts produced by wind energy projects in areas with no state or local noise regulation.

2.3 Occupational Safety and Health Administration Noise Safety Standards

The federal government has long recognized the potential hazards caused by noise on industrial and construction projects. OSHA's current noise standard for the construction industry stems from the occupational noise standard originally published in 1969 by the Bureau of Labor Standards under the authority of the Construction Safety Act (40 U.S.C. 333). OSHA adopted the construction noise standard in 1971 (36 FR 7340, 4/27/ 71) and later recodified it as 29 CFR 1926.52. Another section of the construction standard (29 CFR 1926.101) contains a provision requiring employers to provide hearing protection devices when needed. Both sections 1926.52 and 1926.101 apply to employers engaged in construction where high noise levels are possible.

Paragraph (a) of section 1926.52 requires protection against the effects of noise exposure when 8-hour time-weighted average sound levels exceed a permissible exposure limit (PEL) of 90 dBA, measured on the A-scale of a sound level meter set at slow response. The exposure level is raised 5 dB for every halving of exposure duration as shown in Table 4. Furthermore, exposure to impulsive or impact noise should not exceed a 140 dB peak sound pressure level.

Table 4. OSHA Permissible Daily Noise Exposure Limits

Duration of Exposure Per Day (Hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

Paragraph 29 CFR 1926.52(b) states that when employees are subjected to noise doses exceeding those shown in Table 4, feasible administrative or engineering controls will be identified and implemented to lower employee noise exposure. If controls fail to reduce sound to the PEL, personal protective equipment must be provided and used to reduce noise exposure. In compliance with OSHA, Project contractors will be required to readily provide construction workers with OSHA-approved hearing protection devices (HPD) and to identify high noise areas and activities where hearing protection will be required. Operational sound generated from the Project will not approach OSHA noise exposure limits even in very close proximity to individual WTG locations.

2.4 Summary of Acoustic Criteria

A summary of the pertinent acoustic criteria used to assess sound levels at existing NSAs during project operation is provided below:

- EPA 70 dBA $L_{eq\ (24)}$ at publicly accessible project property lines or extents of work areas where extended public exposure is possible;
- EPA 55 dBA $L_{eq\ (24)}$ in outdoor areas where limited time is spent;
- 55 dBA $L_{dn\ (24)}$ outdoors at all residential receptor locations where extended periods of time are spent outdoors, residential structures and areas in close proximity to the residential structure, e.g., yards. Wind turbines operate intermittently depending on wind conditions at hub height. Assuming the wind turbine is operating as a continuous steady state sound source and is the dominant contributor of environmental sound level at the receiver location, the L_{dn} is approximately 6.4 dB above the measured L_{eq}. Consequently, an L_{dn} of 55 dBA corresponds to a maximum instantaneous L_{eq} of 48.6 dBA; and
- OSHA regulatory limits for worker exposure and public safety.

The application of the EPA noise guidelines is a common compliance approach used to ensure adequate protection of human health and welfare. While the EPA criteria limits cannot be used to infer audibility thresholds, compliance with EPA guidelines would likely result in the reduced probability of dissatisfaction. Inaudibility under all operating conditions is an unrealistic expectation, and one that is not required under any other industrial, commercial, or agricultural activity in the state of North Dakota. OSHA noise safety standards are mandatory requirements at all times. Guideline limits identified are absolute and independent of the existing acoustic environment; therefore, no baseline sound survey is required to assess conformity.

3.0 ACOUSTIC MODELING METHODOLOGY

This section discusses the sound source characteristics, modeling procedures, and input parameters used in the acoustic assessment. Tetra Tech's procedures have been developed based on review of relevant databases and technical reports, Geographic Information System (GIS) data, manufacturers' sound emission data specifications, and extensive experience in the modeling and compliance measurements of operational wind energy facilities. Regulatory and GIS data sets were compiled through in-house libraries and verifiable federal, state, and local agency sources.

3.1 Wind Turbine Sound Characteristics

There are two principal sound sources from an operating WTG: mechanical and aerodynamic sound. Mechanical sound is generated at the gearbox, generator, and cooling fan, and is radiated from the surfaces of the nacelle and machinery enclosure and by openings in the nacelle casing. Mechanical noise does not generally contribute significantly to the overall sound emissions from modern wind turbines. This is due to the improved design of mechanical components and the use of improved noise damping materials within the nacelle to contain and absorb acoustical energy. Aside from upset conditions that may result in abnormal mechanical sound emissions, the dominant sound generating components of utility scale WTGs is aerodynamic.

Aerodynamic sound is related to air flow and the interaction with the tower structure and rotor blades when in motion. Air flow entering the rotor swept area is not completely smooth, consisting of turbulent eddies of air that result in sound due to inflow turbulence. Air flow occurring across the blade produces turbulence at the surface boundary layer, resulting in trailing edge boundary sound. Trailing edge sound is considered the principal aerodynamic noise source component from WTGs. In addition, tip sound is created by vortex shedding as the blade tips pass through the air. Vortices that are shed from the tips of the WTG blades are blown back behind the rotating blades by the wind. When these eddies cut across the wind support structure, this results in the characteristic amplitude modulated (time-varying) swooshing sound at the rate at which the blade passes the tower. Acoustic modulation is most perceptible in close proximity to the base of the WTG tower.

Wind turbine manufacturers have instituted sound reduction measures to both decrease aerodynamic sound and increase power generation efficiency by reducing trailing edge and tip sound generation. Efforts to reduce aerodynamic sounds have included the use of lower tip speed ratios, lower blade angles of attack, upwind rotor designs, variable speed operation, and the use of specially modified blade trailing edges to reduce turbulence. Early WTG designs had the blades located downwind of the support structure. As the blades passed through the vortex shed behind the support tower, the blade would become excited when it was momentarily deflected, resulting in a pressure pulse. This becomes the mechanism for the generation of excessive acoustic modulation and low frequency sound. The downwind rotor design is rarely used in modern utility-scale WTGs that employ the now-standard upwind rotor design with blades upstream of the tower structure. This change in rotor location has eliminated the issues associated with the downwind design and resulted in a decrease of 10 dB or greater, which corresponds to a perceived decrease in loudness by a factor of two.

A somewhat unique acoustic characteristic of wind energy projects is that the sound generated by each individual wind turbine will increase as the wind speed across the site increases, up to a certain maximum sound level under elevated wind conditions (i.e., greater than approximately 8 meters per second [m/s]). The GE 1.5 MW xle is a variable speed-type wind turbine with sound predominantly determined by the aerodynamic broadband sound of the rotor blades, which is directly related to the circumferential or blade tip speed. WTG sound is negligible when the rotor is at rest, increases as the rotor tip speed increases, and is generally constant once rated power output and full rotational speed is reached. As an offset, as wind speeds increase, the background ambient sound levels likely will continue to increase, resulting in acoustic masking effects.

3.2 Acoustic Modeling Software and Calculation Methods

The operational acoustic assessment was performed using the Project design layout as of September 10, 2009 and employing the most recent version of DataKustic GmbH's CadnaA, the computer-aided noise abatement program (v 3.7.123). CadnaA is a comprehensive 3-dimensional acoustic software model that conforms to the Organization for International Standardization (ISO) standard ISO 9613-2 "Attenuation of Sound During Propagation Outdoors." The engineering methods specified in this standard consist of 1/1 octave band algorithms that incorporate the following:

- Geometric spreading wave divergence
- Reflection from surfaces
- Atmospheric absorption
- Screening by topography and obstacles
- Terrain complexity and ground effects
- Source directivity factors
- Height of both sources and receptors
- Seasonal foliage effects
- Meteorological conditions including the effects of wind and atmospheric inversions

The CadnaA acoustic modeling software has been shown to be a highly accurate and effective acoustic modeling tool for wind energy projects when appropriate WTG acoustic modeling techniques and site-specific terrain and topographical features are considered. Calculation correction factors have been applied to address inherent limitations in the ISO 9613-2 standard to account for specialized application of a large dimension-elevated sound source such as a WTG.

The ISO 9613-2 standard calculates received sound pressure levels for meteorological conditions favorable to propagation, i.e., downwind sound propagation or what might occur typically during a moderate atmospheric ground level inversion. Though a physical impracticality, the ISO 9613-2 standard simulates omnidirectional downwind propagation and worst-case WTG source directivity factors. For receptors located between discrete WTG locations or WTG groupings, the acoustic model will result in over-predicted received sound level results. In addition, the acoustic modeling algorithms essentially assume laminar atmospheric conditions, in which neighboring layers of air do not mix but flow at different velocities. This conservative assumption does not take into consideration turbulent eddies that form when winds change speed or direction, which can interfere with the sound wave propagation path and increase attenuation effects. Conversely, there may be anomalous meteorological conditions from time to time that will aid in the long range propagation of sound, potentially causing Project sound levels to increase, specifically at points of reception located further away from Project WTGs.

Topographical information was imported into the acoustic model using the official United States Geological Survey (USGS) digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of 0 for acoustically hard, reflective surfaces and 1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, or for sound traveling over bodies of water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation. In contrast, ground covered in snow (common in this particular area during the winter season), vegetation, including suburban lawns, livestock and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation, i.e., G=1.0. For the acoustic modeling analysis, a conservative ground absorption rate was selected, accounting for a semi-reflective ground surface. This ground absorption coefficient was further reduced for receiver locations in close proximity to WTGs to account for decreased ground attenuation effects associated with an elevated sound source relative to receiver height. Additional sound attenuation through foliage and diffraction around and over existing anthropogenic structures were disregarded for all modeling scenarios. The results are therefore representative of a worst-case defoliate winter time conditions.

For this model, each WTG was modeled as an elevated point source at the position of the hub, an approach which is valid when the distance from the source to receiver is large compared to the dimensions of the source. The equivalent continuous downwind octave band sound pressure level at a receiver location is calculated for each individual WTG source and its image sources on both a broadband and frequency dependent basis from 31 Hz to 8 kHz. Geometrical divergence accounts for spherical spreading in the free field from a point sound source according to the equation below:

$$L_P = L_W + DI_\theta - 10\log\left(\frac{1}{2}\pi R^2\right) - A \text{ in dBA or dBL}$$

Where:

L_P	=	calculated sound pressure level at receiver location
L_W	=	reference sound power level by octave band center frequency
DI_θ	=	directivity index correction to account for the variation in sound intensity with orientation relative to the noise source
R	=	linear (slant) distance of L_p from source in meters (or feet multiplied by 3.28) to calculate geometrical divergence with distance
A	=	extraneous attenuation factors that may occur during propagation from the point sound source to the receiver

For idealized point sources, sound levels will attenuate with increased distance from the source in accordance with the “inverse square law” due to geometric divergence that occurs as the sound energy is spread across a sphere of greater dimensions. The classical theory of spherical wave propagation may not be valid at large distances from a sound source when the influences of wind or temperature gradients are present i.e., anomalous meteorological conditions. The presence of anomalous meteorological conditions can cause sound waves to curve downward towards the ground and then reflect upwards towards the gradient, which is then repeated leading to a trapped sound wave. The wave refraction effects due to wind and temperature gradients during downwind conditions result into the convergence of modified cylindrical wave spreading, which has a reduced rate of sound attenuation. Though somewhat infrequent, Project operational sound levels resulting from anomalous meteorological conditions were also considered in the modeling analysis approach to ensure a complete and conservative acoustic assessment.

In addition to geometrical divergence, attenuation factors (A) include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. Meteorological factors that can influence sound propagation include (in approximate order of increasing importance) humidity, precipitation, temperature, atmospheric stability, turbulence, wind speed and direction.

The acoustic model assumes that all WTGs are operating continuously and concurrently at the maximum manufacturer-rated sound level at the given operational condition and sound energy is summed using the following equation in accordance with ISO 9613-2:

$$\mathrm{L}_{\mathrm{P}A}\,(\mathrm{DW}) = 10\log\left\{\sum_{\mathrm{i}=1}^{n}\left[\sum_{\mathrm{j}=1}^{9}10^{0,1\left[\mathrm{L}_{\mathrm{fT}}(ij)+f(A-wtd)(j)\right]}\right]\right\}$$

Where:

n	=	the number of contributions i (sources and paths)
j	=	an index indicating the nine standard octave band center frequencies spanning from 31 Hz to 8 kHz

The above equation determines the equivalent continuous A-weighted downwind sound pressure level at a point of reception (i.e., NSA), taking into account the contributing sound pressure levels produced by all Project WTGs. Calculations were completed using an 82-foot (25 meters) by 82-foot grid with a receiver height of 5 feet (1.5 meters) above grade (the approximate height of ears of a standing person). Calculations were also completed at discrete receptor locations at all NSAs.

3.3 Acoustic Modeling Input Parameters

In order to assist project developers and acoustical engineers, wind turbine manufacturers report WTG sound power data at integer wind speeds referenced to a height of 32.8 feet (10 meters) above grade, ranging from cut-in to full rated power. This internationally accepted International Electrotechnical Commission (IEC) standard was developed to ensure consistent and comparable sound emission data of utility-scale wind turbines between manufacturers. These data are inclusive of both mechanical and aerodynamic source components. Wind turbines can be somewhat directional, radiating more sound in some directions than others. The IEC test measurement protocol requires that sound measurements are made for the maximum downwind directional location when reporting apparent sound power levels. Thus, worst-case WTG directivity and sound generating efficiencies are reported in the sound source data and used in the acoustic model calibration.

A summary of sound power data for the selected GE 1.5 MW xle WTG correlated by wind speed at a height of 32.8 feet (10 meters) above grade are presented in Table 5. Source data were modeled at the rotor hub height of 262.4 feet (80 meters). The GE 1.5 xle specification reports a confidence interval of K=2 dB to account for the manufacturer’s warranty clause, which was incorporated into the acoustic model to ensure a conservative acoustic modeling assessment.

Table 5. Broadband Sound Power Levels (dBA) Correlated with Wind Speed

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed						
10-meter AGL Wind Speed	9 mph (4 m/s)	11.2 mph (5 m/s)	13.4 mph (6 m/s)	15.9 mph (7 m/s)	17.9 mph (8 m/s)	20.1 mph (9 m/s)	22.4 mph (10 m/s)
GE 1.5 MW xle	<96	<96	98.8	102.3	<104.0	<104.0	<104.0

A summary of sound power data for the GE 1.5 xle by octave band center frequency is presented in Table 6.

Table 6. GE 1.5 xle Sound Power Level by Octave Band Center Frequency

Frequency (Hz)	Octave Band Sound Power Level (dBA)								Broadband (dBA)
	63	125	250	500	1000	2000	4000	8000	
GE 1.5 MW xle	83.4	92.2	97.8	99.4	97.7	93.4	86.6	84.8	104.0

4.0 MODELING RESULTS AND COMPLIANCE DETERMINATION

Operational broadband (dBA) sound pressure levels were calculated throughout the Project area. Acoustic modeling results and the overall analysis conclusions are given in the following sections.

4.1 Acoustic Modeling Results

Acoustic modeling for the final Project layout was completed for WTG cut-in and full rotational operating conditions, thereby describing sound pressure levels over the entire range of future Project operational conditions. The acoustic modeling analysis consisted of calculating received sound levels at receptors in Burleigh County. A list of receptors, unique number identifier, Universal Transverse Mercator (UTM) coordinates, and received sound levels are provided in Table 7.

Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 2 through 4. Figure 2 shows broadband (dBA) operational sound levels under low-level wind speeds sufficient for WTGs to operate at initial cut-in rotational speeds. Figures 3 and 4 show broadband (dBA) operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds for moderate downwind propagation and under worst-case anomalous meteorological conditions, respectively. The acoustic modeling was completed for all WTGs operating concurrently. The resultant sound contour plots are independent of the existing acoustic environment, i.e., the plots represent Project-generated sound levels only.

Table 7. Summary of WTG Acoustic Model Output at Receptors (dBA)

Residence ID	UTM Coordinates (m)		Cut-In	Maximum Rotation	Anomalous Meteorological Conditions	Anomalous Meteorological Conditions Plus Substation
	Easting	Northing				
2012	367496	5219030	27.8	35.8	38.5	38.5
2020	369311	5219083	32.6	40.6	42.0	42.3
2025	370442	5218318	37.8	45.8	46.3	46.8
2026	370430	5218306	37.8	45.8	46.3	46.8
2027*	369737	5218420	42.4	50.4	50.6	50.7
2028	371097	5217187	34.6	42.6	43.8	43.9
2030	374515	5216892	27.6	35.6	38.5	38.5
2047	370195	5216577	34.3	42.3	43.6	43.6
2045	370219	5216534	34.0	42.0	43.4	43.4
2050	368883	5216631	38.2	46.2	46.6	46.6
2057	367253	5215913	27.1	35.1	38.0	38.0
2065	373513	5211697	35.6	43.6	44.6	44.6
2066	365766	5216977	26.4	34.4	36.8	36.8
60002	375122	5214148	28.3	36.3	39.4	39.4
60005*	372824	5212708	42.6	50.6	50.8	50.8
60010	372903	5213255	37.3	45.3	46.1	46.1
60012	371876	5212785	34.0	42.0	43.6	43.6
60016	372129	5214610	36.0	44.0	44.9	44.9
60018	371953	5212277	34.0	42.0	43.6	43.6
60019	371956	5212378	33.9	41.9	43.5	43.5
60020	372243	5211201	32.6	40.6	42.5	42.5
60024	372252	5209103	26.7	34.7	37.4	37.4

Residence ID	UTM Coordinates (m)		Cut-In	Maximum Rotation	Anomalous Meteorological Conditions	Anomalous Meteorological Conditions Plus Substation
	Easting	Northing				
60027	373812	5209326	27.0	35.0	37.9	37.9
60028	373971	5209320	26.9	34.9	37.9	37.9
60034	374260	5209324	27.3	35.3	38.3	38.3
60040*	375079	5209360	28.4	36.4	38.6	38.6
60043	375335	5209337	28.7	36.7	38.9	38.9
60044	375770	5209460	29.4	37.4	39.2	39.2
60048	376397	5210430	32.0	40.0	40.9	40.9
60052	376671	5210591	29.3	37.3	39.1	39.1
60054	376515	5211062	30.3	38.3	39.9	39.9
60057	376211	5210921	33.3	41.3	41.9	41.9
60061	375965	5210874	36.1	44.1	44.4	44.4
60065	375966	5211041	35.4	43.4	43.8	43.8
60066	375965	5211018	35.4	43.4	43.7	43.7
60070	376164	5212140	31.2	39.2	40.6	40.6
60075	376245	5212627	28.3	36.3	38.8	38.8
60080	369491	5212432	32.4	40.4	41.8	41.8
60082	368755	5212024	28.9	36.9	39.2	39.2
60085	368637	5211618	28.3	36.3	38.8	38.8
60090	368671	5211608	28.5	36.5	38.9	38.9
60092	368562	5211213	27.5	35.5	38.0	38.0
2036	372317	5216001	32.5	40.5	42.5	42.5
2041	371025	5215602	31.1	39.1	41.4	41.5
2053	367280	5216355	29.7	37.7	39.6	39.6
2060	368847	5215446	30.5	38.5	40.6	40.6
Number of Potential Exceedances of EPA Noise Guideline at NSAs			**None**	**2**	**2**	**2**

*** Residence listed as 'Abandoned' in Farmstead Location Report dated 8-18-2009.**

The manufacturers' guaranteed maximum sound power level of 106 dBA and worst-case directivity effects were incorporated into the modeling analysis to ensure conservative results. Reported sound pressure levels are representative of receptors located downwind of the WTGs; lower sound levels are expected in other directions dependent on wind velocities, speed, direction, and gustiness. The acoustic modeling results were compared to the broadband (dBA) guideline criteria as described in Section 2.0 of this report, specifically the EPA broadband guideline of 55 dBA L_{dn} (equivalent to a $L_{eq\ (1\text{-hour})}$ of 48.6 dBA assuming continuous 24-hour operation), which was used as an internal Project design goal.

The EPA guideline limits presented in Section 2.1 are based on the yearly L_{dn}. To calculate the yearly L_{dn}, knowledge of future atmospheric conditions across the entire site over an extended time period are required to determine the long term sound exposure. The conservative approach employed in the Baldwin Wind Energy Center acoustic assessment assumed a sustained wind speed in excess of 8 m/s (17.9 mph) at WTG hub height over a continuous one year period. Actual wind speeds and directions over the course of a year will vary.

The yearly L_{dn} is calculated using the following equation per the EPA guidance document:

$$Yearly\ L_{dn}(exterior) = 10 \cdot \log_{10}\left[\frac{\left(15 \cdot 10^{\left(Leq(1-hour)/10\right)} + 9 \cdot 10^{\left((Leq(1-hour)+10)/10\right)}\right)}{24}\right] dBA$$

In the equation to calculate yearly L_{dn}, the $L_{eq\ (1\text{-hour})}$ was assigned the value of the Project-generated instantaneous maximum sound level (L_{max}) for the operating condition under analysis (either cut-in or at full rotational speed). Under real world meteorological conditions wind speed and direction will be variable. Over the course of a one year, the actual received sound pressure levels as a result of Project operations will fluctuate from periods of calm or low level wind speeds, to wind speeds ranging from cut-in up to maximum rotational. During periods of calm and low level wind speeds below the rated cut-in wind speeds when WTGs will not operate, the Project will generate negligible sound. For time-varying sources, including wind energy projects, assessing compliance under this continuous worst-case operational condition (L_{max}) will ensure compliance during all other possible future operational conditions. Though this worst case continuous operating scenario is not realistic, the intention of employing this calculation methodology is to ensure a high level of conservatism in the compliance assessment approach..

4.2 Compliance Determination

Project operational sound has been calculated and compared to relevant environmental noise criteria as established by the EPA and OSHA. Table 8 summarizes sound modeling results for Project cut-in and maximum rotational speeds as may occur during moderate wind velocities and under certain anomalous meteorological conditions.

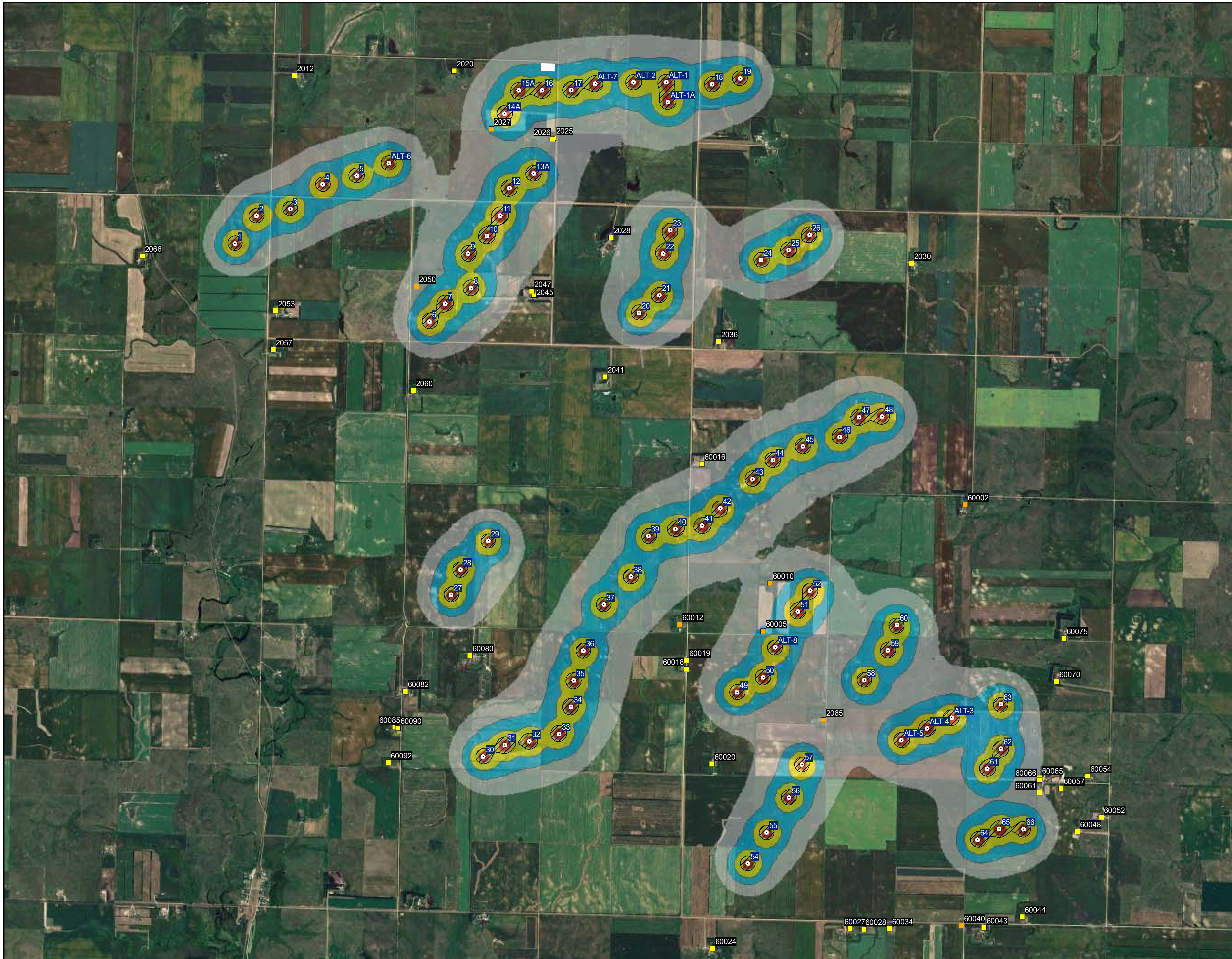
Table 8. Summary of Modeling Results and Comparison to EPA Guidelines

Operating Scenario	Receptor IDs of Potential Exceedances of EPA Guideline (NSAs)
Cut-in Operation	None
Maximum Rotational – Moderate Downwind Meteorological Conditions	2
Maximum Rotational – Anomalous Downwind Meteorological Conditions	2

As shown in Table 8 and the acoustic model contour isopleths, results showed potential exceedances of the 55 dBA L_{dn} EPA noise guideline at two NSAs. These exceedance conditions occur at Residence IDs 2027 and 60005, which have been categorized in the Farmstead Report as abandoned or not currently used for residential purposes; therefore, these exceedances can be considered insignificant. Results demonstrate that the Project has been designed to operate in full compliance with EPA noise guidelines at all remaining NSAs.

The EPA guideline limits identified are not legally enforceable requirements, but serve as useful guidelines to determine the likelihood of adverse community noise impacts. The EPA guidelines do not require inaudibility of a sound source. In fact, even if received sound levels are below ambient conditions, the spectral and temporal characteristics of a sound may result in perceptible sound. The results of the acoustic modeling analysis indicate that operation of the Project may result in periodically audible sound within the adjacent areas under certain operational and meteorological conditions. Individual response to low-level WTG sound is largely subjective and therefore not easily predictable and may depend on several technical and non-technical factors, including predetermined perceptions of the Project, individual and community economic incentives, existing background sound levels, the proximity of the listener to a single or grouping of WTGs, among several others. Project participants have been found to be less likely to be annoyed by low-level WTG sound than non-participants. Non-participants that consider the development of renewable energy sources, and wind farms specifically, as beneficial will also be more likely to deem the low-level environmental noise as generally acceptable. Nonetheless, complaints about noise from wind energy projects may still occur, even when fixed-level noise criteria or standards are met.

In conclusion, the Project has been designed to operate in compliance with guideline limits under all future WTG operational conditions. Acoustic modeling results inclusive of a number of conservative assumptions demonstrate compliance with the EPA guideline limits. Sound from the Project when audible will likely not be deemed excessive or unusually loud at the proposed setback distance and will be consistent with sound generated at similar wind energy projects successfully sited throughout the state of North Dakota employing similar noise criteria limits.



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BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 2
RECEIVED SOUND LEVELS
WTGS AT CUT-IN

OCTOBER 2009

TETRA TECH EC, INC.

Legend

- Turbine Location (9-9-2009)
- Substation

Receptor

- Occupied
- Unoccupied

Isopleth Ranges (dBA)

- 35 - 40
- 40 - 45
- 45 - 50
- >50
- Isopleth Range Exceeding EPA Guideline (>48.6 dBA)

N
W E
S

0 0.5 1 Miles

REFERENCE MAP

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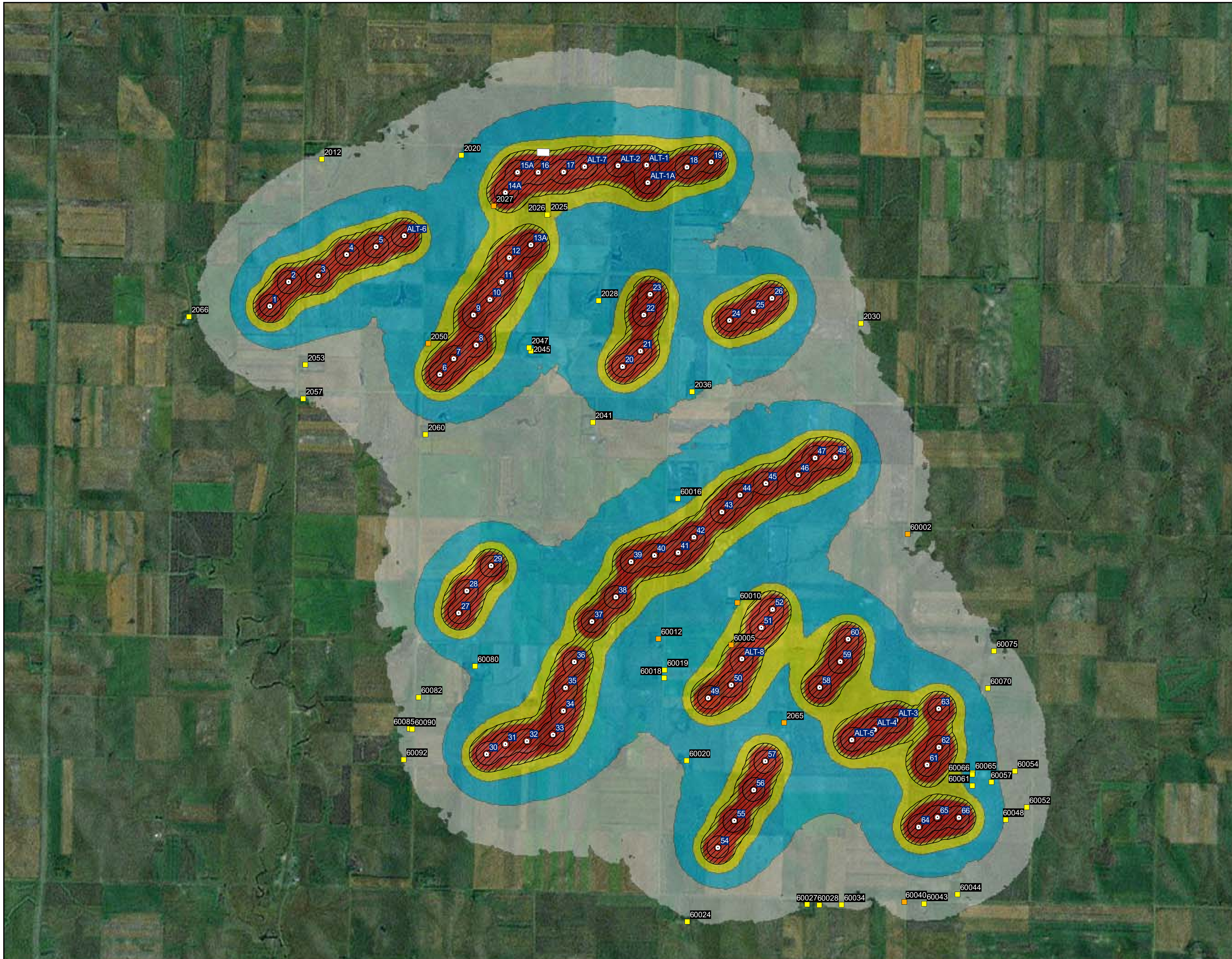
FIGURE 3
RECEIVED SOUND LEVELS
WTGS AT MAXIMUM ROTATION

OCTOBER 2009

TETRA TECH EC, INC.



Legend

- Turbine Location (9-9-2009)
- Substation

Receptor

- Occupied
- Unoccupied

Isopleth Ranges (dBA)

- 35 - 40
- 40 - 45
- 45 - 50
- >50
- Isopleth Range Exceeding EPA Guideline (>48.6 dBA)

N
W E
S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Noise\Fig3_WTG_MaxRot.mxd 10/7/2009

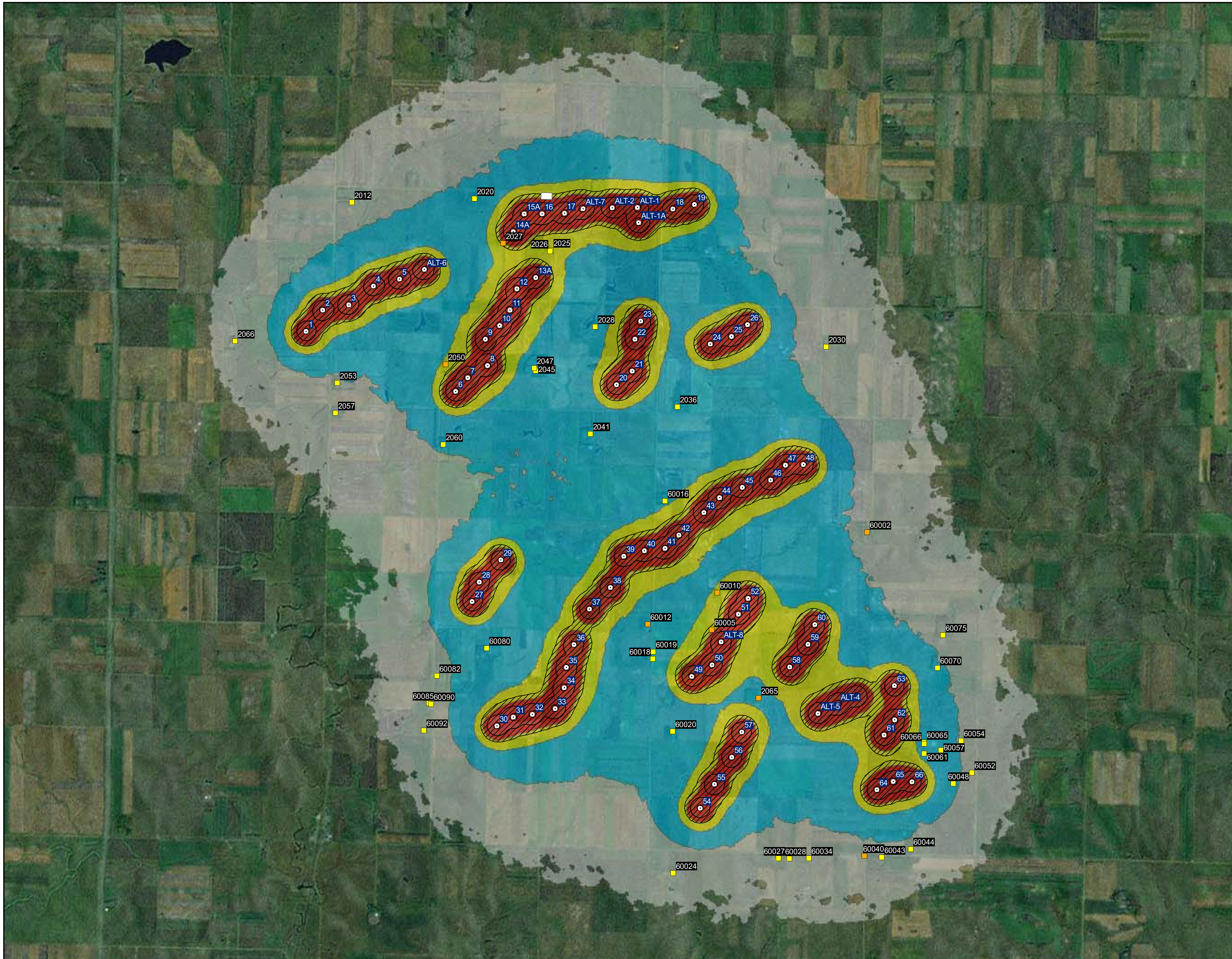


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FIGURE 4
RECEIVED SOUND LEVELS
WTGS AT MAXIMUM ROTATION
ANOMALOUS METEOROLOGICAL CONDITIONS

OCTOBER 2009

TETRA TECH EC, INC.

Legend

Turbine Location (9-9-2009)

Substation

Receptor

Occupied

Unoccupied

Isopleth Ranges (dBA)

35 - 40

40 - 45

45 - 50

>50

Isopleth Range Exceeding EPA Guideline (>48.6 dBA)

N
W
E
S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Noise\Fig4_WTG_MaxRotMet.mxd 10/7/2009

5.0 OTHER CONSIDERATIONS

5.1 Electrical Substation

As a part of a thorough acoustic assessment completed for the Baldwin Wind Energy Center, not only was sound generated by Project WTGs reviewed, but also from the on-site electrical substation. The substation is an integral part of the Project as it collects and increases the voltage produced by the WTGs to the higher voltage needed for transmission by the local grid system.

Substations have switching, protection and control equipment and one or more transformers, which generate the sound generally described as a low humming. There are three main sound sources associated with a transformer: core noise, load noise and noise generated by the operation of the cooling equipment. The core is the principal noise source, dominating in the intermediate frequency range between 100 and 600 Hz. The relative magnitudes of the noise at these different frequency components is dependent on the design of the transformer (i.e., core material, core geometry) and does not vary significantly with the load on the transformer, meaning that the noise generated is largely independent of the transformer load. The load noise is primarily caused by the load current in the transformer's conducting coils (or windings) and consequently the main frequency of this sound is twice the supply frequency; 100 Hz for 50 Hz transformers and 120 Hz for 60 Hz transformers. The cooling equipment (fans and pumps) noise typically dominates the very low and very high frequency ends of the sound spectrum; however, cooling equipment sound is comparatively lower and considered secondary to the sound produced by the core and load.

Transformers are designed and catalogued by kilovolt ampere (kVA) ratings. Just as horsepower ratings designate the power capacity of an electric motor, a transformer's kVA rating indicates its maximum power output capacity. The transformer industry uses the National Electrical Manufacturers Association (NEMA) sound level rating to designate the sound emitted from a transformer. This rating system requires the determination of the average A-weighted sound level at a distance of 0.3 meters (1 foot) from the wall surfaces of the transformer and is specified by the equipment manufacturer. The sound power radiated is a function of the NEMA rating and the total surface area of the four side walls.

Few complaints from nearby residents are expected regarding substations with transformers less than 10 MVA capacities, except in urban areas with little or no buffer distance attenuation between source and receiver locations. Complaints are more likely at substations with transformer sizes of 10 to 150 MVA with separation distances of 500 to 600 feet or less. In very quiet rural areas where the nighttime ambient acoustic environment can reach levels of 20 to 25 dBA under calm wind conditions, the sound generated from transformers of this size may be periodically audible at distances of half a mile or greater.

The Baldwin electrical substation will be located in the northern section of the Project area, approximately 800 meters (2,625 feet) north of the closest receptors (IDs 2025 and 2026 as shown in Figure 1). To assess potential impacts of electrical substation operation on nearby residential receptors, a screening level acoustic analysis was conducted using the CadnaA model incorporating site-specific topographic and terrain data and modeled cumulatively with WTG operational scenarios. Transformer sound source levels were estimated for a NEMA sound rating of 82 dBA and are presented in Table 9. The octave band center frequencies were calculated linearly from standard engineering technical guidelines.

Table 9. Transformer Sound Power Level (NEMA 82 dBA)

	Unweighted Octave Band Sound Power Data (dBL)								
	31.5	63	125	250	500	1000	2000	4000	8000
NEMA Rating 82 dBA	100	106	108	103	103	97	92	87	80

Sound contour plots displaying operational broadband (dBA) sound levels in color-coded isopleths are provided in Figure 5 for maximum electrical output. Cumulative received sound levels resulting from the electrical substation concurrent with worst case WTG operation at all NSAs can be found in Table 7. These results demonstrate feasibility of the Project electrical substation to operate in compliance with the EPA guidelines at the proposed siting location.

5.2 Construction Noise

The development of the Baldwin Wind Energy Center will involve construction to establish access roads, excavate and form WTG foundations, works associated with preparing the site for crane-lifting, and actual WTG assembly and commissioning. Work on large-scale wind projects such as Burleigh County is generally divided into four phases consisting of the following:

1. *Site Clearing*: The initial site mobilization phase includes the establishment of temporary site offices, workshops, stores, and other on-site facilities. Installation of erosion and sedimentation control measures will be completed as well as the preparation of initial haulage routes.

2. *Excavation*: This phase would begin with the excavation and formation of access roads and preparation of laydown areas. Excavation for the concrete turbine foundations would also be completed.

3. *Foundation Work*: Construction of the reinforced concrete turbine foundations would take place in addition to installation of the internal transmission network.

4. *Wind Turbine Installation*: Delivery of the turbine components would occur followed by their installation and commissioning.

Work on these construction activities is expected to overlap. It is likely that the wind turbines will be erected in small groupings. Each grouping may undergo testing and commissioning prior to commencement of full commercial operation. Other construction activities include those for the supporting infrastructure such as the substation, maintenance building, and the overhead transmission lines, though no transmission line construction is anticipated for Project.

The construction of the Project may cause short-term but unavoidable noise impacts. The sound levels resulting from construction activities vary significantly depending on several factors such as the type and age of equipment, the specific equipment manufacturer and model, the operations being performed, and the overall condition of the equipment and exhaust system mufflers. The list of construction equipment that may be used on the Project and estimates of near and far sound source levels are presented in Table 10.

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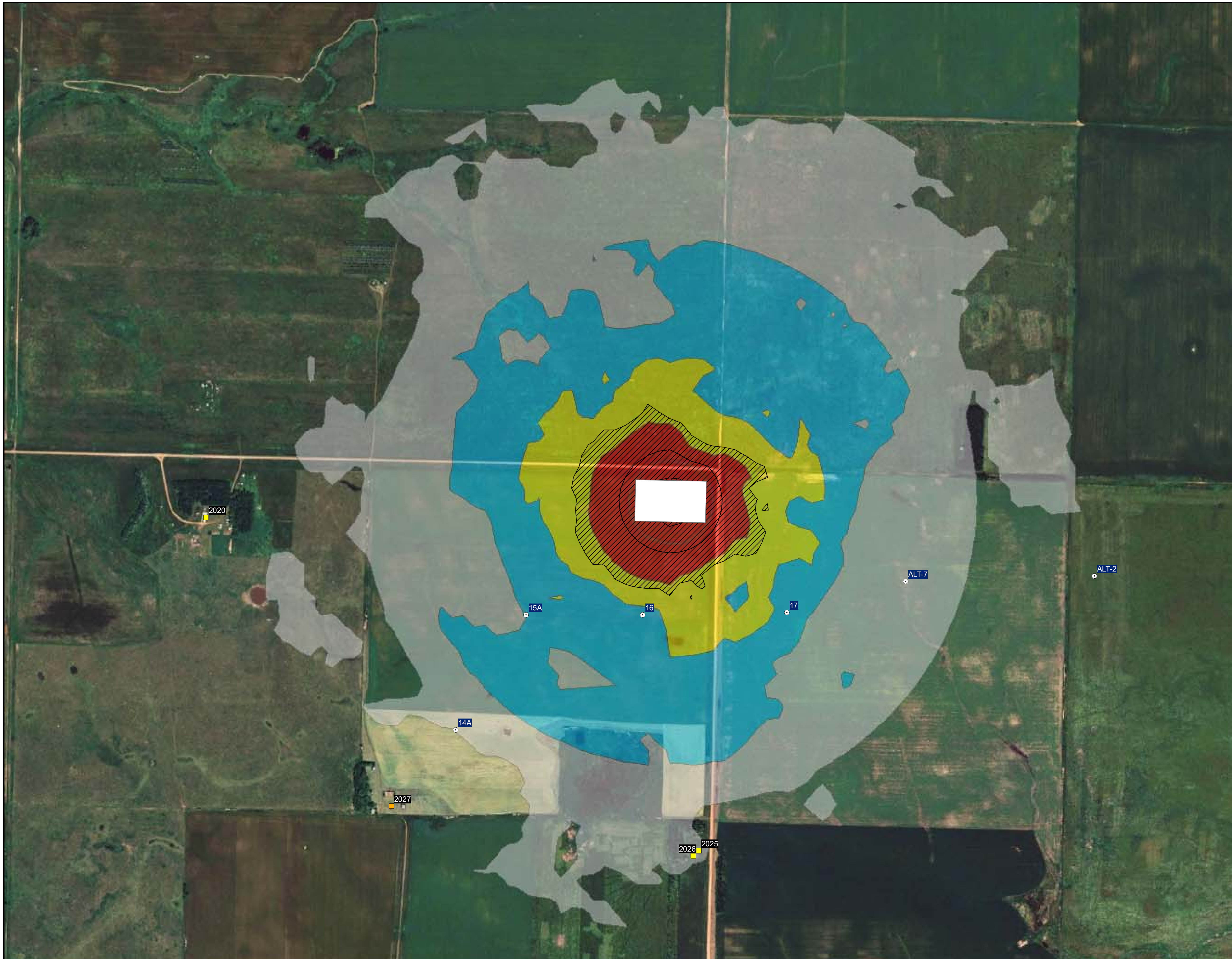
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 5
RECEIVED SOUND LEVELS
ELECTRICAL SUBSTATION
ANOMALOUS METEOROLOGICAL CONDITIONS

OCTOBER 2009

TETRA TECH EC, INC.



Legend

Turbine Location (9-9-2009)

Substation

Receptor

Occupied

Unoccupied

Isopleth Ranges (dBA)

35 - 40

40 - 45

45 - 50

>50

Isopleth Range Exceeding EPA Guideline (>48.6 dBA)

N W E S

0 0.125 0.25 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Noise\Fig5_Substation.mxd 10/7/2009

Sounds generated by construction activities are typically exempt from state and local noise oversight provided that they occur within weekday, daytime periods as may be specified under local zoning or legal codes. All reasonable efforts will be made to minimize the impact of noise resulting from construction activities. As the design of the Project progresses and construction scheduling is finalized, the construction engineer should notify the community via public notice or alternative method of expected Project construction commencement and duration to help minimize the effects of construction noise. In addition, the location of stationary equipment and the siting of construction laydown areas should be carefully selected to be as far removed from existing NSAs as is practical. Candidate construction noise mitigation measures include scheduling louder construction activities during daytime hours and treating internal combustion engines with appropriate sized muffler systems to minimize noise excessive emissions. If blasting for foundation or other noisy activities are required during the construction period, nearby residents shall be notified in advance.

Table 10. Estimated L_{max} Sound Pressure Levels from Construction Equipment

Equipment*	Estimated Sound Pressure Level at 50 feet (dBA)	Estimated Sound Pressure Level at 2000 feet (dBA)
Crane	85	53
Forklift	80	48
Backhoe	80	48
Grader	85	53
Man basket	85	53
Dozer	83 - 88	51 - 56
Loader	83 - 88	51 - 56
Scissor Lift	85	53
Truck	84	52
Welder	73	41
Compressor	80	48
Concrete Pump	77	45

Data compiled in part from the following sources:

Federal Highway Administration, "Roadway Construction Noise Model User's Guide," Report FHWA-HEP-05-054 / DOT-VNTSC-FHWA-05-01, January 2006.

Power Plant Construction Noise Guide, Bolt Beranek and Newman, Inc. 1977.

Federal Highway Administration, "Procedures for Abatement of Highway Traffic Noise and Construction Noise." Code of Federal Regulations, Title 23, Part 772, 1992.

Construction activity will generate traffic having potential noise effects, such as trucks travelling to and from the site on public roads. At the early stage of the construction phase, equipment and materials will be delivered to the site, such as hydraulic excavators and associated spreading and compacting equipment needed to form access roads and foundation platforms for each turbine. Once the access roads are constructed, equipment for lifting the towers and turbine components will arrive. Traffic noise is categorized into two categories: (1) the noise that will occur during the initial temporary traffic movements related to turbine delivery, haulage of components and remaining construction; and (2) maintenance and ongoing traffic from staff and contractors, which is expected to be minor.

Federal laws prohibit state and local governments from regulating off-site sound levels generated by trucks and automobiles operating on a private site or public roadways. This federal regulatory preemption is specified in the Federal Noise Control Act of 1972 and in the Surface Transportation Assistance Act of 1982, both of which prohibit states and local authorities from regulating the noise emitted by trucks engaged in interstate commerce, i.e., truck deliveries. A federal OSHA preemption also prohibits local and state governments from regulating safety signals on trucks and construction equipment.

6.0 TECHNICAL REFERENCES

ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers). 1989. ASHRAE Handbook—Fundamentals, Atlanta, Georgia.

Bolt, Beranek and Newman, Inc., Power Plant Construction Noise Guide, prepared for the Empire State Electric Energy Research Corporation, Report No. 3321, 1977.

David Bies, Collin Hansen. “Engineering Noise Control: Theory and Practice”, Pages 554-555, Published by Taylor & Francis, 2003.

DataKustik GmbH. 2007. Computer-Aided Noise Abatement Model CadnaA, Version 3.57 Munich, Germany.

Department of the Interior, Bureau of Land Management, “Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States, “FES 05-11, June 2005.

Elliott, T. et al. Standard handbook of powerplant engineering. McGraw-Hill: 1998, New York.

Federal Highway Administration, FHWA Roadway Construction Noise Model User’s Guide, FHWA-HEP-05-054, January 2006.

Federal Highway Administration, “Procedures for Abatement of Highway Traffic Noise and Construction Noise”. Code of Federal Regulations, Title 23, Part 772, 1992.

IEC (International Electromechanical Commission). 61400-11:2002(E) Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques, Second Edition 2002-12.

ISO (International Organization for Standardization). 1989. Standard ISO 9613-2 Acoustics – Attenuation of Sound During Propagation Outdoors. Part 2 General Method of Calculation. Geneva, Switzerland.

NWCC, 2002, Permitting of Wind Energy Facilities: A Handbook, Siting Subcommittee, c/o RESOLVE, Washington, D.C., March.

Rogers, Anthony, James Manwell, Sally Wright. 2006. “Wind Turbine Noise – A White Paper,” Renewable Energy Research Laboratory, University of Massachusetts at Amherst, June 2002, Amended January 2006.

Wilton Phase III Wind Farm, Farmstead Location Report, Swenson, Hagen & Co P.C, August 18, 2009

Technical Documentation: Wind Turbine Generator Systems GE 1.5 xle – 50Hz and 60Hz, Noise emission characteristics Normal operation according to IEC, GE Wind Energy GmbH, 2005.

USEPA (U.S. Environmental Protection Agency). 1974. Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety, Publication EPA-550/9-74-004, March.

USEPA. 1978. Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November.

Wagner, S., Bareib, R. and Guidati, G. 1996. Wind Turbine Noise, Springer, Berlin.

FINAL REPORT AND ANY INFORMATION
REMOVED SHOULD BE CONSIDERED AS:

<u>NON-INTERNET PUBLIC INFORMATION</u>

Shadow Flicker Impact Analysis for the Baldwin Wind Energy Center

Prepared for

NextEra Energy Resources, LLC

Prepared by

TETRA TECH EC, INC.

133 Federal Street
Boston, MA 02110

October 2009

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1.0 OVERVIEW

A wind turbine's moving blades can cast a moving shadow on locations within a certain distance of a turbine. These moving shadows are called shadow flicker, and can be a temporary phenomena experienced by people at nearby residences or public gathering places. The impact area depends on the time of year and day (which determines the sun's azimuth and altitude angles) and the wind turbine's physical characteristics (height, rotor diameter, blade width, and orientation of the rotor blades). Shadow flicker generally occurs during low angle sunlight conditions, typical during sunrise and sunset times of the day. However, when the sun angle gets very low (less than 3 degrees), the light has to pass through more atmosphere and becomes too diffuse to form a coherent shadow. Shadow flicker will not occur when the sun is obscured by clouds or fog, at night, or when the source turbine(s) are not operating.

Shadow flicker intensity is defined as the difference in brightness at a given location in the presence and absence of a shadow. Shadow flicker intensity diminishes with greater receptor-to-turbine separation distance. Shadow flicker intensity for receptor-to-turbine distances beyond 1,500 meters is very low and generally considered imperceptible. Shadow flicker intensity for receptor-to-turbine distances between 1,000 and 1,500 meters (between 3,281 and 4,921 feet) is also low and considered barely noticeable. At this distance shadow flicker intensity would only tend to be noticed under conditions that would enhance the intensity difference, such as observing from a dark room with a single window directly facing the turbine casting the shadow. At distances less than 1,000 meters (3,281 feet), shadow flicker may be more noticeable. In general, the largest number of shadow flicker hours, along with greatest shadow flicker intensity, occurs nearest the wind turbines.

NextEra Energy Resources, LLC is proposing to install 66 wind turbines as part of the Baldwin Wind Energy Center (Project) in Burleigh County, North Dakota. Since the Project is using a minimum turbine siting setback requirement of 1,500 feet (from occupied residences), sensitive receptors (occupied residences) are generally not located in the worst case potential shadow flicker impact zones, which ensures that shadow flicker impacts are minimized.

The wind turbine being considered for the Project, and evaluated for potential shadow flicker impacts, has the following characteristics:

- **GE Wind Energy GE 1.5xle** – 3-blade 82.5-meter-diameter rotor, with a hub height of 80 meters. The GE 1.5xle has a nominal rotor speed of 18 rpm which translates to a blade pass frequency of 0.9 Hz (less than 1 alternation per second).

Shadow flicker frequency is related to the wind turbine's rotor blade speed and the number of blades on the rotor. From a health standpoint, such low frequencies are harmless. For comparison, strobe lights used in discotheques have frequencies which range from about 3 Hertz (Hz) to 10 Hz (1 Hz = 1 flash per second). As a result, public concerns that flickering light from wind turbines can have negative health effects, such as triggering seizures in people with epilepsy, are unfounded. Epilepsy Action (working name for the British Epilepsy Foundation), states that there is no evidence that wind turbines can cause seizures. However, they recommend that wind turbine flicker frequency be limited to 3 Hz (http://www.epilepsy.org.uk/info/photo_other.html). Since the proposed Project's wind turbine blade pass frequency is approximately 0.9 Hz (less than 1 alternation per second), no negative health effects to individuals with photosensitive epilepsy are anticipated.

2.0 WINDPRO SHADOW FLICKER ANALYSIS

An analysis of potential shadow flicker impacts from the Project was conducted using the WindPro software package. The turbine array dated September 9, 2009, which includes 66 turbines and 8 alternate locations, was included in the analysis. The WindPro analysis was conducted to determine shadow flicker impacts under realistic impact conditions (actual expected shadow). This analysis calculated the total amount of time (hours and minutes per year) that shadow flicker could occur at receptors out to 1,500 meters (4,921.3 feet). The realistic impact condition scenario is based on the following assumptions:

- The elevation and position geometries of the wind turbines and surrounding receptors (houses). Elevations were determined using USGS digital elevation model (DEM) data. Positions geometries were determined using GIS and referenced to UTM Zone 14 (NAD83).
- The position of the sun and the incident sunlight relative to the wind turbine and receptors on a minute by minute basis over the course of a year.
- Historical sunshine hours availability (percent of total available). Historical sunshine rates for the area (as listed by the National Weather Service for nearby Bismarck, ND) used in this analysis are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53%	53%	58%	58%	61%	74%	73%	72%	65%	58%	43%	47%

- Estimated wind turbine operations and orientation (based on approximately 16.5 years of wind data from 1/1/93 to 6/21/09 (wind speed / wind direction frequency distribution) measured at meteorological tower approximately 57 miles east of the proposed project site). The WindPro calculated wind direction frequency distribution for operating hour winds is as follows:

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
7.1%	4.9%	5.4%	7.0%	9.1%	10.1%	8.3%	5.6%	6.3%	10.0%	13.8%	12.4%

- Receptor viewpoints (i.e., house windows) are assumed to always be directly facing turbine to sun line of sight ("greenhouse mode").

WindPro incorporates terrain elevation contour information and the analysis accounts for terrain elevation differences. The sun's path with respect to each turbine location is calculated by the software to determine the cast shadow paths every minute over a full year. Sun angles less than 3 degrees above the horizon were excluded, for the reasons identified earlier in this section.

A total of 46 sensitive receptor locations were identified in the vicinity of the Project Area. These receptors are based on the September 9, 2009 Farmstead Report, and supplementary input from the client based on local knowledge. These locations correspond to houses or other structures in the Project Area. A receptor in the model is defined as a 1 m^2 area (approximate size of a typical window), 1 meter (3.28 feet) aboveground level. Approximate eye level is set at 1.5 meters (4.94 feet). Figure 1 shows the sensitive receptor locations considered.

3.0 WINDPRO SHADOW FLICKER ANALYSIS RESULTS

WindPro predicts that shadow flicker impacts will primarily occur near the wind turbines. Figure 2 illustrates the WindPro predicted expected shadow flicker impact areas. A detailed WindPro shadow flicker analysis results summary, for each of the modeling receptor locations, is provided in Attachment A. Table 1 presents the WindPro predicted expected shadow flicker impacts for the top ten worst case impact receptors. Only 3 of the 46 receptors modeled had expected shadow flicker impacts predicted for more than 30 hours per year, and the two highest impact receptors are unoccupied houses.

Table 1. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Impacts

Receptor ID	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
19	Unoccupied House	60:08
20	Unoccupied House	37:43
37	Occupied House	34:54
3	Occupied House	24:20
12	Unoccupied House	23:48
4	Occupied House	23:07
6	Occupied House	20:10
11	Occupied House	19:31
5	Unoccupied House	19:22
36	Occupied House	19:15

The maximum predicted shadow flicker impact at any receptor, for the range of potential wind turbine options, is 60 hours, 8 minutes per year, which is only approximately 1.4 percent of the potential available daylight hours.

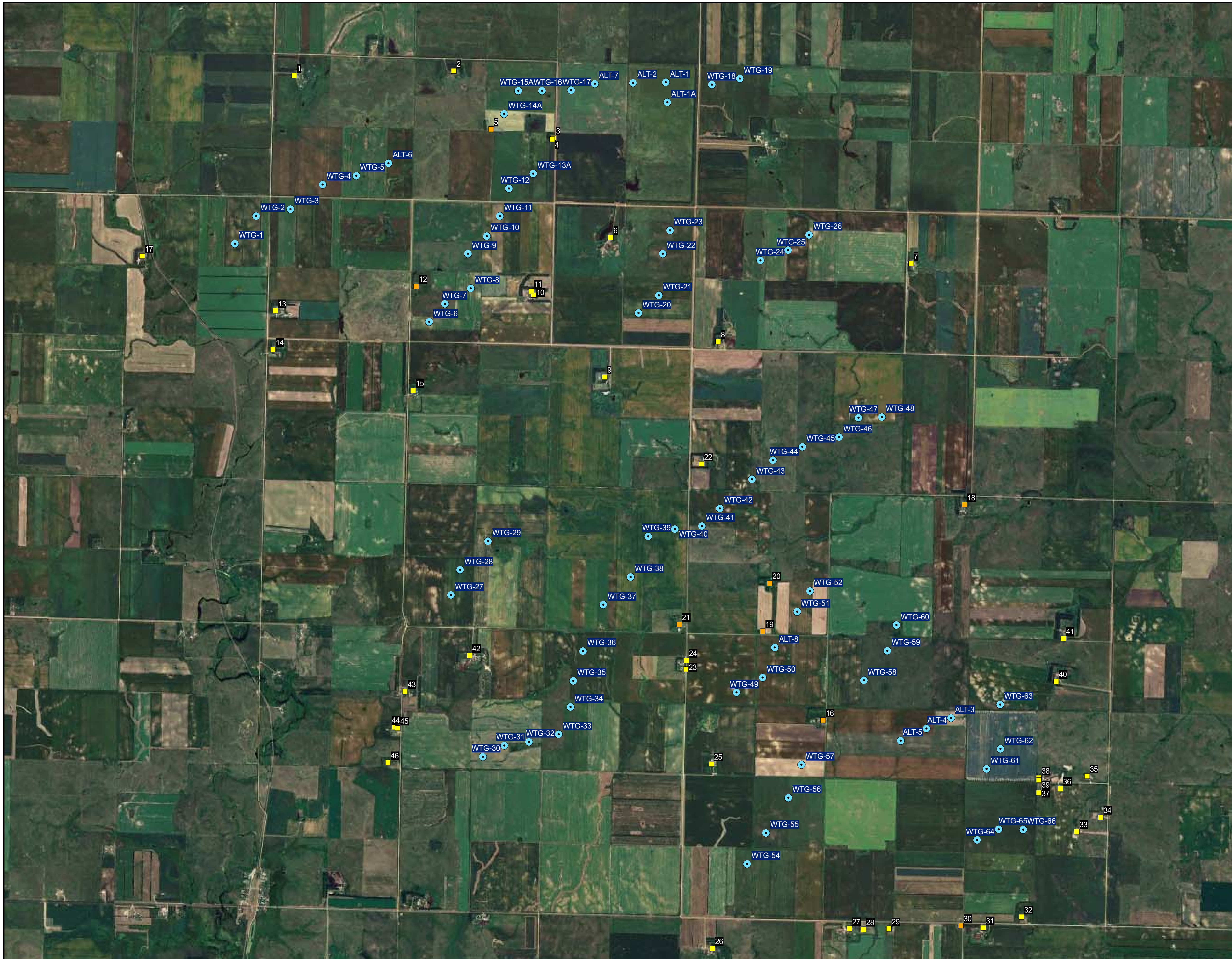
The overwhelming majority of the receptor locations evaluated have less than 25 hours per year of predicted shadow flicker impact. The shadow flicker impact prediction statistics are as summarized in Table 2.

Table 2. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Sensitive Receptor Locations

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	46
= 0 Hours	12
> 0 Hours < 10 hours	15
≥ 10 Hours < 20 hours	12
≥ 20 Hours < 30 hours	4
≥ 30 Hours < 40 hours	2
≥ 40 hours	1

4.0 CONCLUSION

The analysis of potential shadow flicker impacts from the Project on nearby houses (receptors) shows that shadow flicker impacts within the area of study are expected to be minor. The analysis assumes that the houses all have a direct in line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions which may block sunlight. In reality, the windows of many houses will not face the sun directly for the key shadow flicker impact times. In addition, potential shadow flicker impacts for wind turbines up to 1,500 meters (4,921 feet) away were determined. In reality, the shadow flicker impacts for turbines beyond 1,000 meters (3,281 feet) will be very low intensity. For these reasons, shadow flicker impacts are expected to be less than estimated with the conservative analysis, and shadow flicker is not expected to be a significant environmental impact.



NEXTERA ENERGY RESOURCES, LLC
BALDWIN WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 1
SENSITIVE RECEPTORS MODELED
WITH WINDPRO TO PREDICT
EXPECTED SHADOW FLICKER IMPACTS

SEPTEMBER 2009

TETRA TECH EC, INC.

Legend

Turbine Location (based on 9-9-09 layout)

Receptor

Occupied

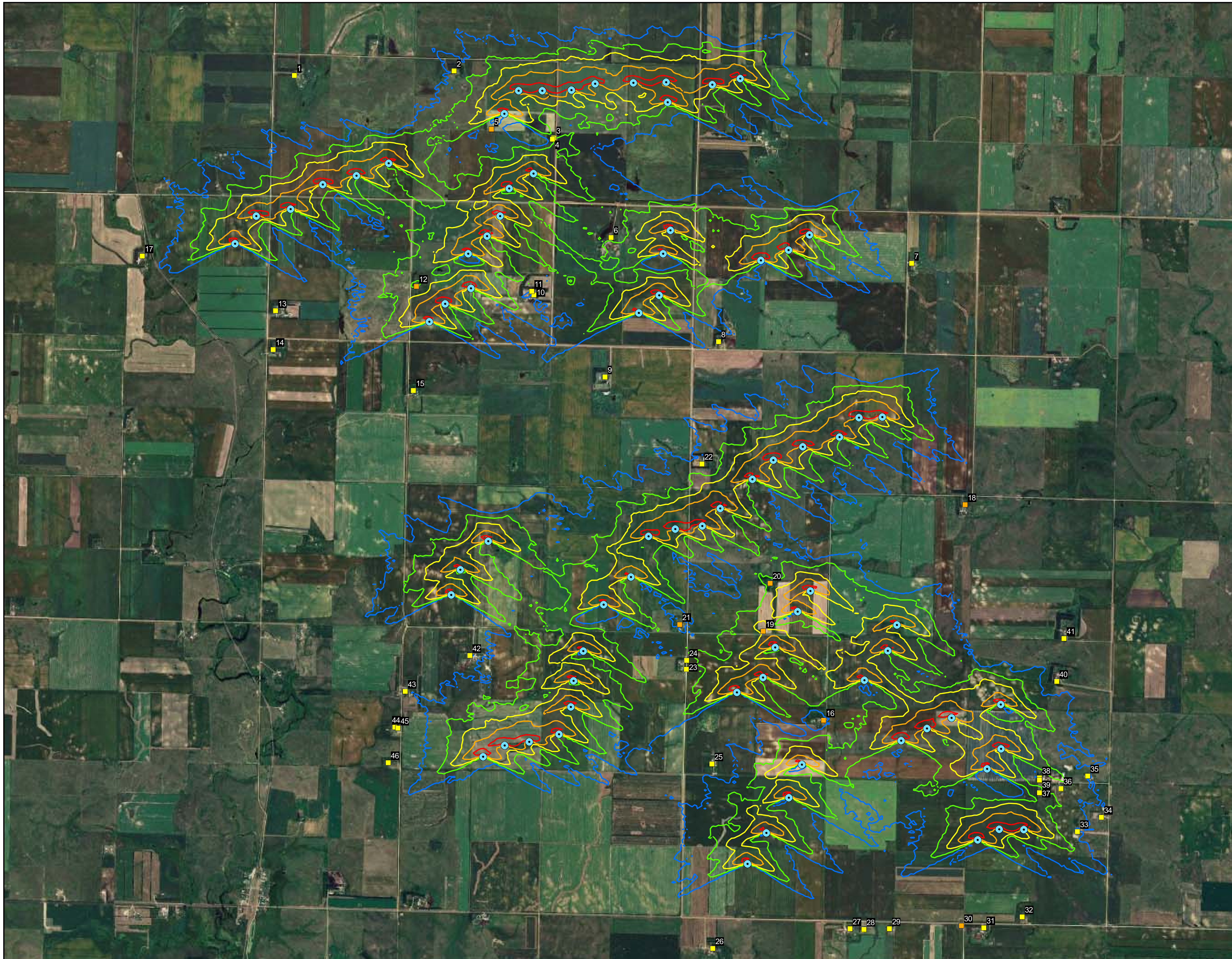
Unoccupied

N W E S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Shadow_Flicker_Fig1_Receptors.mxd 9/25/2009



NEXTERA ENERGY RESOURCES, LLC
BALDWIN WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 2
WINDPRO PREDICTED EXPECTED
SHADOW FLICKER IMPACT AREAS

SEPTEMBER 2009

TETRA TECH EC, INC.

Legend

Turbine Location (based on 9-9-09 layout)

Receptor

Occupied

Unoccupied

Shadow Flicker Iso Line

10 hrs/yr

25 hrs/yr

50 hrs/yr

100 hrs/yr

200 hrs/yr

N S W E

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3935 Baldwin - Burleigh County ND\GIS and Figures\GIS\Spatial\MXD\Shadow_Flicker_Fig2_Isolines.mxd 9/25/2009

ATTACHMENT A

Detailed Summary of WindPro Shadow Flicker Analysis Results

Baldwin Wind Energy Center
WindPro Shadow Flicker Analysis Results Summary

WindPro Receptor ID	NextEra Baldwin Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)	Receptor Status
1	2012	367,496	5,219,030	2:00:00	Occupied
2	2020	369,311	5,219,083	15:04:00	Occupied
3	2025	370,442	5,218,318	24:20:00	Occupied
4	2026	370,430	5,218,306	23:07:00	Occupied
5	2027	369,737	5,218,420	19:22:00	Unoccupied
6	2028	371,097	5,217,187	20:10:00	Occupied
7	2030	374,515	5,216,892	3:29:00	Occupied
8	2036	372,317	5,216,001	3:48:00	Occupied
9	2041	371,025	5,215,602	0:00:00	Occupied
10	2045	370,219	5,216,534	15:51:00	Occupied
11	2047	370,195	5,216,577	19:31:00	Occupied
12	2050	368,883	5,216,631	23:48:00	Unoccupied
13	2053	367,280	5,216,355	0:00:00	Occupied
14	2057	367,253	5,215,913	0:00:00	Occupied
15	2060	368,847	5,215,446	0:00:00	Occupied
16	2065	373,513	5,211,697	8:05:00	Unoccupied
17	2066	365,766	5,216,977	4:22:00	Occupied
18	60002	375,122	5,214,148	0:00:00	Unoccupied
19	60005	372,824	5,212,708	60:08:00	Unoccupied
20	60010	372,903	5,213,255	37:43:00	Unoccupied
21	60012	371,876	5,212,785	9:58:00	Unoccupied
22	60016	372,129	5,214,610	12:49:00	Occupied
23	60018	371,953	5,212,277	19:01:00	Occupied
24	60019	371,956	5,212,378	17:58:00	Occupied
25	60020	372,243	5,211,201	5:07:00	Occupied
26	60024	372,252	5,209,103	0:00:00	Occupied
27	60027	373,812	5,209,326	2:20:00	Occupied
28	60028	373,971	5,209,320	0:00:00	Occupied
29	60034	374,260	5,209,324	0:00:00	Occupied
30	60040	375,079	5,209,360	0:00:00	Unoccupied
31	60043	375,335	5,209,337	0:00:00	Occupied
32	60044	375,770	5,209,460	0:00:00	Occupied
33	60048	376,397	5,210,430	10:39:00	Occupied
34	60052	376,671	5,210,591	6:53:00	Occupied
35	60054	376,515	5,211,062	13:00:00	Occupied
36	60057	376,211	5,210,921	19:15:00	Occupied
37	60061	375,965	5,210,874	34:54:00	Occupied
38	60065	375,966	5,211,041	12:06:00	Occupied
39	60066	375,965	5,211,018	14:51:00	Occupied
40	60070	376,164	5,212,140	5:47:00	Occupied
41	60075	376,245	5,212,627	0:00:00	Occupied
42	60080	369,491	5,212,432	8:21:00	Occupied
43	60082	368,755	5,212,024	5:33:00	Occupied
44	60085	368,637	5,211,618	3:53:00	Occupied
45	60090	368,671	5,211,608	4:07:00	Occupied
46	60092	368,562	5,211,213	3:51:00	Occupied