Appendix C
Studies and Assessments

Spring Avian Survey

Oliver Expansion Wind Resource Area
Phases III, IV, and V
Oliver and Morton Counties, North Dakota

Prepared for
FPL Energy, LLC

August 2008

TETRA TECH EC, INC.

EXECUTIVE SUMMARY

Tetra Tech, EC, Inc. (Tetra Tech) was contracted by FPL Energy, LLC. (FPL Energy) to undertake spring avian use surveys for the proposed Oliver Expansion (Phases III, IV, and V) Wind Resource Area (WRA) in Oliver and Morton Counties, North Dakota. The studies were conducted to identify potential avian impacts associated with building and operating the wind conversion facility. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines and displacement due to the presence of the associated structures. Weekly spring surveys were performed at the Oliver Expansion WRA from March 28 to June 11, 2008. Fixed point count surveys (800-meter radius) were conducted at 36 points distributed throughout the Oliver Expansion WRA. The results of these surveys are relevant to the spring season only, and the conclusions drawn from these data may not be applicable to other times of year.

A total of 68 identified species and 1 unidentified species group, consisting of 4,581 birds were observed within the Oliver Expansion WRA. Overall mean bird use within the Oliver Expansion WRA was 10.60 birds/20 minutes, ranging from 0 to 505 birds per 20-minute point count. Comparing bird use rates to publicly available studies conducted in the spring for existing wind energy facilities throughout the country, the Oliver Expansion WRA ranked thirty-second out of 34 for raptor use, and ninth out of 23 for non-raptor use.

Songbirds had the highest mean use out of all species groups observed (7.40 birds/20 minutes). The most commonly observed species, the western meadowlark (1.78 birds/20 minutes), red-winged blackbird (1.31 birds/20 minutes), ring-necked pheasant (1.24 birds/20 minutes), and horned lark (0.99 birds/ 20 minutes) are all widespread species and have relatively stable populations (Sauer et al. 2007). Thus, local mortality is not expected to have population-level consequences for the most commonly observed species.

Red-tailed hawks and northern harriers were the most commonly observed raptors in the Oliver Expansion WRA (0.07 birds/20 minutes); however, these species were not regularly encountered and were observed only in 5.8 percent and 6.3 percent, of all surveys, respectively. Red-tailed hawks have a propensity to fly within the rotor swept area (RSA) and, as a result, are at risk of being killed by turbines. However, red-tailed hawks are widespread throughout North America, and populations appear to be relatively stable and mortalities are not anticipated to have population-level impacts. Northern harriers have a propensity to fly low to the ground and below the RSA. Northern harriers are also widespread and relatively stable, therefore, this species is not expected to experience population-level impacts.

Listed and Sensitive Species

There were no federally listed species observed during the Spring 2008 point count surveys in the Oliver Expansion WRA. North Dakota does not have a state list of threatened and endangered species; however, it lists 100 Species of Conservation Priority. These species are ranked in three priority levels based on such factors as known status, funding availability, and

presence of breeding habitat within North Dakota. There were thirteen of these species observed during the point count surveys. The chestnut-collared longspur (Level I), grasshopper sparrow (Level I), lark bunting (Level I), Sprague's pipit (Level I), Swainson's hawk (Level I), upland sandpiper (Level I), marbled godwit (Level I), bobolink (Level II), loggerhead shrike (Level II), northern harrier (Level II), northern pintail (Level II), sharp-tailed grouse (Level II), and peregrine falcon (Level III) were all observed during surveys.

Recommendations

Table ES-1 summarizes the overall potential impacts of developing the Oliver Expansion WRA. The greatest potential impact on avian species is direct mortality or injury from collisions with turbines and associated overhead transmission lines and loss of habitat. Tetra Tech suggests the following recommendations and standard best management practices:

- Grouse leks occur throughout the WRA. Tetra Tech recommends continued consultation with state and federal agencies to determine the best course of action.
- Minimize the use of power lines; if necessary, outfit the power poles with bird perch guards and the above-ground lines with bird diverters.
- Minimize the use of lights on turbines in accordance with state, local, and federal requirements.
- Map and flag any raptor nests and place turbines as far from nests as practicable and out of the direct line of sight. Avoid tree removal. Construction and operation of turbines may need to be scheduled during seasonal windows to minimize impact to active nests.
- Minimize impacts to native vegetation and reseed areas that are disturbed. Where practicable, replace invasive species with native ones.
- Develop a management plan to prevent spread of noxious weeds.

Additionally, we recommend continuing avian surveys throughout the fall to understand and minimize potential impacts to avian species. We also recommend conducting post-construction mortality monitoring.

Table ES-1. Potential Project Impact Summary

	Ranking*	Details
Raptors		
Mean use	Low	
Mean use without turkey vultures	Low	
Mean use within the rotor swept area (RSA)	Low	
Number of species with high encounter rates (>1.0 birds/20 min)	None	
Eagles observed in WRA	No	
Eagles observed nesting in WRA	No	
Federally listed[1] species observed within WRA	No	
Federally listed species observed nesting	No	
Federally listed species within RSA	No	
State-listed species[2] within WRA	Yes	Swainson's hawk, northern harrier, and peregrine falcon
State-listed species observed nesting within WRA	Yes	Swainson's hawk
State-listed species within RSA	Yes	Swainson's hawk and northern harrier
Non-raptors		
Mean use	Moderate	
Mean use within RSA	Low	
Number of species with high encounter rates (>1.0 birds/20 min)	None	
Federally listed species observed within the WRA	No	
Federally listed species within RSA	No	
State-listed species within WRA	Yes	Chestnut-collared longspur, grasshopper sparrow, lark bunting, Sprague's pipit, upland sandpiper, marbled godwit, bobolink, loggerhead shrike, northern pintail, and sharp-tailed grouse
State-listed species observed nesting within the WRA	No	
Grouse leks observed within WRA	Yes	sharp-tailed grouse
Habitat		
Native habitat likely to be affected by development	Yes	native prairie
Lakes (waterfowl attractant)	Yes	multiple
Wetlands (attractant for cranes, waterfowl, and other water-based species)	Yes	prairie pothole wetlands
Cliffs (raptor nesting and traveling)	No	
River (permanent water source, migration corridor)	No	
Known refuges or habitat features that may funnel migrants	No	

[1] Federally listed species include threatened, endangered, or candidate species designations

[2] State-listed species include threatened, endangered, candidate, species of concern, and species of conservation concern designations. State species listed are those in addition to federally listed species.

[*] Ranking column also contains information on whether some specific observations were made.

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1.0 INTRODUCTION

FPL Energy, LLC (FPL Energy) is planning to develop a wind energy conversion facility in central North Dakota in Oliver and Morton Counties. The Oliver Expansion (Phases III, IV, and V) Wind Resource Area (WRA) is located on private and state-owned land (**Figure 1**). FPL Energy is committed to environmental due diligence and has contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct a spring avian migration survey at the Oliver Expansion WRA to quantify local avian use in the area and to identify potential avian impacts associated with building and operating the proposed facility.

Based on spatial data dated July 2008, the Oliver Expansion WRA is approximately 107,159 acres and is located in the Northwestern Great Plains ecoregion. Landscape components within this ecoregion include western mixed-grass/short-grass prairie, planted or tame grassland, upland deciduous forest, and associated wetlands. Land use within the rural WRA consists primarily of farming, livestock grazing, and related agricultural operations. Residences and abandoned farmsteads are scattered throughout the WRA. The area is located in the mixed and short-grass prairie region, which contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Patches of trees and shrubs exist throughout the WRA, located primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

Wind energy provides a clean, renewable energy source that is in high demand. As wind power has become more common, the need to address potential environmental impacts has increased. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines and displacement due to the presence of the associated structures (Erickson et al. 2005, Drewitt and Langston 2006, Arnett et al. 2007). Specifically, raptors and migrant passerines (e.g., songbirds) were found more often in post-construction mortality monitoring compared to other groups of birds (Erickson et al. 2001, 2005, Drewitt and Langston 2006, Johnson et al. 2007, Strickland and Morrison 2008).

North Dakota has 354 documented bird species and is situated within the Central Flyway, one of the main bird migratory routes (USFWS 2008). The Central Flyway runs through the central portion of the United States and, consequently, the Oliver Expansion WRA. Most birds that move along the Central Flyway travel from Canada through the central states, eventually reaching the tropics of South America via the Gulf of Mexico (USFWS 2008).

Figure 1.
FPL Energy - Oliver Wind Resource Area Location Map

Oliver and Morton Counties, North Dakota
July 18, 2008

Oliver Expansion
- Phases III, IV, and V
- County Boundary
- Stream
- Intermittent Stream
- Water Body

Transportation
- Limited Access
- Highway
- Major Road

FPL Energy

1:500,000
NAD 83 UTM 14

Miles
0 2.5 5 10

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2.0 METHODS

To evaluate avian risk at wind energy facilities, standardized protocols for pre-construction point counts have been established and were used for this survey. Data collected from these counts can then be used to identify species or species groups of concern and may provide additional information for micro-siting to minimize impacts to birds. To facilitate identifying species at risk, results in this report are presented in terms of species groupings, and highlight federally listed species, state-listed species, and species of concern.

2.1 Diurnal Fixed-point and Incidental Avian Use Surveys

Fixed-point Surveys

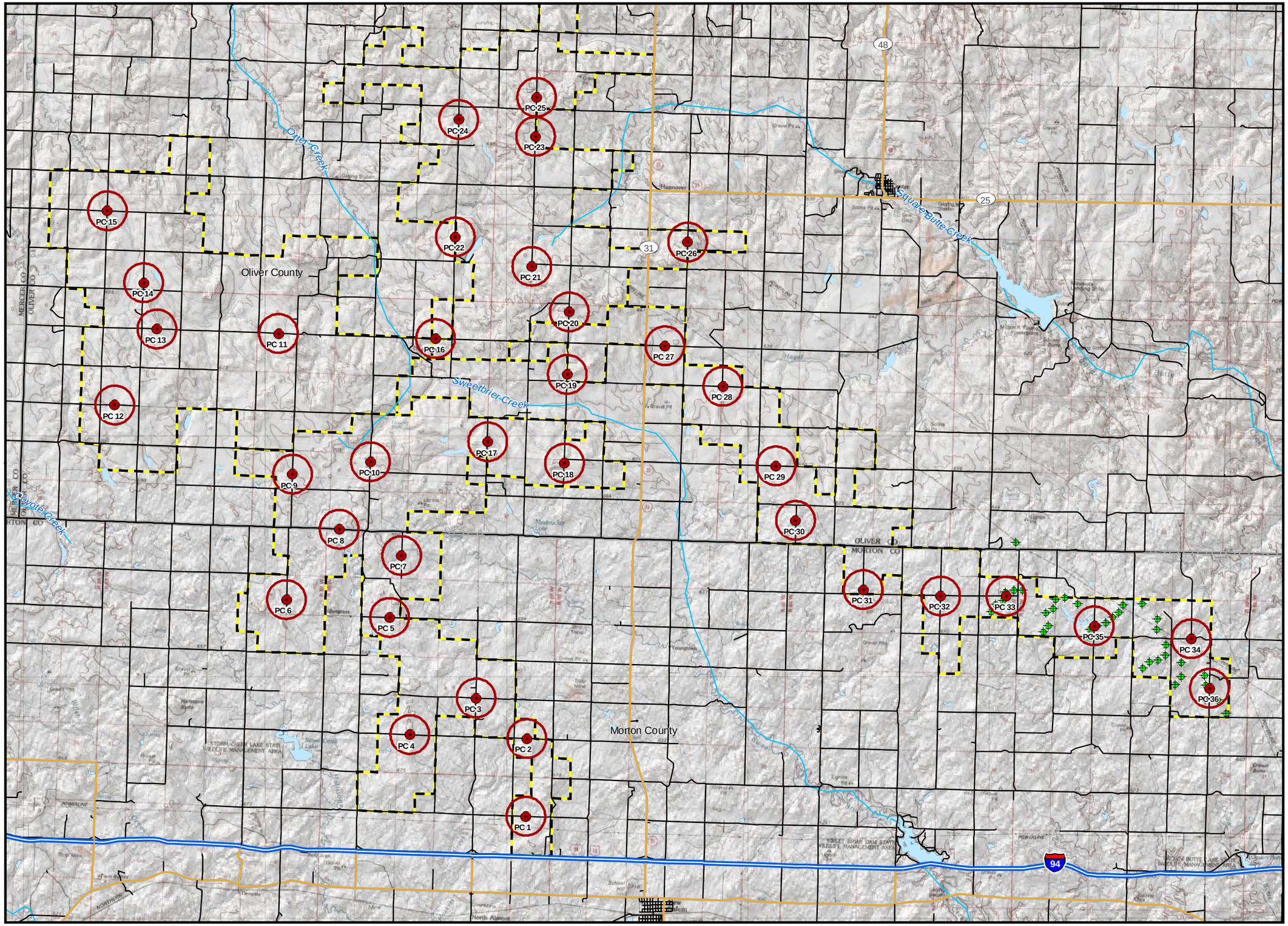
Experienced field biologists conducted 20-minute point count surveys at 36 locations within the Oliver Expansion WRA to evaluate avian use, behavior, and species composition during spring migration (**Figure 2**). Tetra Tech selected survey dates to encompass the spring migration period. Biologists conducted weekly surveys from March 28 to June 11 (**Table 1**). The range of dates included observations of winter residents and summer breeding birds in addition to migrants. Because turbine locations were not known at the time of the survey, Tetra Tech distributed the survey locations throughout the WRA and chose locations that maximized the 360-degree sight distance for the observer and covered a diversity of habitats.

Experienced field ornithologists collected data on all birds observed within an 800-meter radius circle centered on the point count location. The biologists also recorded incidental observations, such as birds detected outside the 800-meter radius or while moving between point count locations. Surveys at each point lasted for 20 minutes, during which time biologists continuously scanned for birds and recorded any visual or auditory observations. Biologists scheduled point counts to cover all daylight hours and to ensure that each point was visited during different times of day to ensure species coverage. Biologists collected the following data: species, number of individuals, time, height above ground, behavior, and flight direction. Flight direction data are included in **Appendix 1**. The biologists also estimated flight heights and distances using existing meteorological towers, local transmission lines, and topographic maps for reference.

The survey protocol used in this study is designed to collect data on all bird species and to provide results that are comparable with other studies of avian use at wind farms rather than to target specific taxa. The benefit of using this method is that it estimates avian use throughout the day and captures activity by a variety of bird species. During the breeding season, songbirds are most active in the morning and can be difficult to detect during the afternoon. In contrast, raptors become active as the sunlight heats the air and creates thermals, which individuals use for soaring (Ballam 1984). Thus, raptors are more readily detected several hours after sunrise. Therefore, the survey method used in this study is appropriate for the bird community using the WRA.

Figure 2.
FPL Energy - Oliver Point Count Location Map

Oliver and Morton Counties, North Dakota
July 18, 2008



Avian Survey Point
Survey Point - 800m buffer
Proposed Turbine *

Oliver Expansion

- Phases III, IV, and V
- County Boundary

- Stream
- Intermittent Stream
- Water Body

Transportation

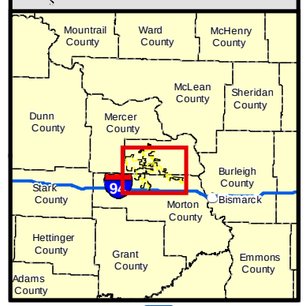
- Limited Access
- Highway
- Major Road
- Other Road

* only a portion of turbines shown

FPL Energy

1:150,000
NAD 83 UTM 14

Miles
0 0.5 1 2



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Tetra Tech chose 20-minute survey periods because they provide adequate time to detect both raptors and non-raptors. However, time periods of 20 minutes may lead to double-counting of songbirds (i.e., counting the same individual more than once) because individuals may appear and disappear from view. For example, if a horned lark is detected perched on a fence then disappears from view and, 6 minutes later, a horned lark is seen flying, these birds are recorded as separate observations because it is not possible to distinguish individuals. Double-counting of birds is not problematic for this type of survey because the objective is to document use in terms of number of birds noted per 20-minute survey, not number of distinct individual birds.

Detectability varies among species and potentially not all individuals within the 800-meter survey were counted. This variation in detectability results in an overestimate of mean use in conspicuous species and an underestimate of mean use in reclusive species (Thompson 2002). Birds not easily identifiable, such as those seen under low light conditions or small birds seen at a distance, were identified to the lowest taxonomic level possible. Hence, unidentified birds are presented in the results.

Incidental Observations

Incidental observations included observations that occurred 1) during travel between points, 2) before or after the official 20-minute survey period, and 3) outside the 800-meter radius circular plot. Biologists recorded these observations on separate data sheets and these data were not used in the formal analysis; however, a summary of incidental birds is presented to provide additional information about species found in the local area.

Data Quality Assurance/Quality Control

Tetra Tech implemented quality assurance and quality control (QA/QC) measures during all stages of data collection, analysis, and report preparation. To ensure legibility and completeness of data sheets, each biologist reviewed, and clarified if needed, all data sheets before data entry into a Filemaker™ relational database for data storage and analysis. Prior to analysis, an independent reviewer conducted a 100-percent quality review of the data entries. Any questions that arose at this time were directed toward and answered by field personnel.

2.2 Analysis

Species Groupings

Tetra Tech considered two primary groups of interest: raptors and non-raptors. Tetra Tech defined raptors as vultures, hawks, eagles, falcons, and owls. As turkey vulture flight behavior is similar to raptors and as they are often included as raptors in other studies, Tetra Tech has included them with raptors for the purpose of our analyses. Non-raptors were defined as all other species groups.

Avian Use

Tetra Tech derived avian use (mean use) of the Oliver Expansion WRA by calculating the average number of birds observed per 20-minute survey at each point. To evaluate the diversity and composition of avian species using the Oliver Expansion WRA, Tetra Tech first summarized the number of individuals (birds/20 min) and species. Tetra Tech

also calculated a measure of variability (90% confidence intervals) for all mean use values. In addition, the number of observations (obs/20 min) is also presented, where an observation can be either an individual bird or a discrete flock of birds. This information helps evaluate whether high mean use is driven by a single event (e.g., flock of birds moving through the rotor swept area). Because individual birds are not uniquely marked and identified, actual population size or abundance cannot be determined. One individual may be counted multiple times during a survey period or across survey periods. Therefore, avian use does not equate to abundance.

Flight Behavior

Tetra Tech evaluated flight behavior by calculating the proportion of flying birds observed below, within, or above the turbine rotor swept area (RSA). Turbines proposed for this site are GE 1.5 MW SLEs. Therefore, Tetra Tech used an RSA between 41.5 and 118.5 meters above ground. Tetra Tech considered a bird to have flown within the RSA if any of its recorded heights overlapped the RSA.

Encounter Rate

To estimate the rate at which a species flew through the anticipated RSA, Tetra Tech applied the following equation to every species observed in the WRA:

$$Encounter\ Rate = A*P_f*P_t$$

where A is the mean number of birds/20 min for a given species, P_f is the proportion of all activity observations for a given species that were flying; and P_t is the proportion flying observations that were within the turbine RSA for a given species. The encounter rate provides information on the rate at which a species moves through the RSA. This information is an important component in evaluating risk; however, this number alone does not indicate risk to a species.

Encounter rate is an index of birds flying within the RSA and may not equate to actual post-construction mortality. Species with a high encounter rate are at a higher risk of collision than species with a low risk, but it does not mean that mortality is certain. Other factors such as a species ability to detect turbine blades, flight maneuverability to avoid blades, and habitat selection also influence mortality; therefore, actual mortality may be higher or lower than indicated by the encounter rate (Orloff and Flannery 1992). Encounter rate is based on day-time observations of bird mean use and flight height. Values are sensitive to large flocks of birds flying within the RSA. Encounter rate also does not account for migrating behavior of nocturnal migrants.

Mortality estimates

Tetra Tech has not included mortality estimates as part of this report. The statistical relationship between pre-construction avian use and post-construction mortality remains poorly defined, thereby limiting the power to predict mortality based on use. Previous studies (e.g., Johnson 2007) have documented a significant positive relationship between use and mortality for raptors; however, these studies have been based on data sets from throughout the United States, contain several statistical inconsistencies, and likely have limited applicability on a regional scale. This limited applicability is due, in large part, to

the highly regional nature of avian mean use across North America (Arnett et al. 2007). Unfortunately, data on avian mortality at wind farms are lacking at regional scales in many parts of North America. Rather than attempt to draw conclusions from limited data sets, Tetra Tech takes a conservative approach and limits our discussion to patterns of avian use and mortality risk factors.

2.3 Raptor Nest Surveys

The purpose of raptor nest surveys is to estimate the number of active and inactive raptor nests in the project area. Biologists conducted the raptor nest survey across the project area before trees began to leaf out to increase visibility of raptor nests. Where possible, biologists also surveyed over an approximately 1-mile around the project area. Once a nest was located, the biologist returned during the raptor breeding season to collect data on species, location, and activity status. The activity status (i.e., active or inactive) was determined by the presence of an adult or young, active territory defense by an individual, or the presence of feathers, egg shells or droppings underneath the nest. In addition, biologists determined the nest condition and substrate. Biologists visited nests a minimum of two times, once to determine the location of the nest and once to determine if the nest was active. This second check also allowed biologists to detect late-nesting species such as Swainson's hawks. Raptor nest surveys provide an estimate of the number and species of raptors that use stick nests in the area. Ground nesting raptor species, such as northern harriers, were not surveyed.

2.4 Grouse Lek Surveys

Biologists conducted grouse lek surveys to identify areas of use by breeding prairie grouse in the Oliver Expansion WRA and surrounding area. Biologists conducted lek surveys from April 1 to May 9, 2008, each conducted from an hour before sunrise to 9:00 am by driving county roads through areas identified as potential lek habitat. Grouse lek habitat is classified as open, short grass vegetation with minimal amounts of agriculture. When roads did not provide coverage of areas with suitable habitat, biologists conducted walking surveys if landowner permission was granted. When conducting lek surveys, biologists stopped every half mile and listened for a minimum of five minutes for vocalizations of displaying males. On a calm morning, sharp-tailed grouse males may be heard at a distance of up to ¾ mile and prairie-chickens can be heard from up to one mile away. Biologists did not conduct listening stops when winds exceeded 10 mph or if there was any type of precipitation. If a lek was located and visible, the biologist observed the lek for 10 minutes to count the number of males and females. If displaying grouse were heard, but the lek was not visible, the biologist attempted to pinpoint the location by driving county roads.

3.0 RESULTS

3.1 Oliver Expansion WRA

Biologists surveyed about 17,877 acres of the Oliver Expansion WRA during point count surveys, covering 16.7 percent of its total area. The 36 point count locations were surveyed 12 times, resulting in a total of 432 total 20-minute surveys.

3.2 Species Composition

Biologists recorded a total of 4,581 birds of 68 identified species and 1 unidentified species group during the 432 fixed-point count surveys (**Table 2**). The most frequently observed birds seen were the western meadowlark (16.8 percent of all birds observed), red-winged blackbird (12.3 percent), and ring-necked pheasant (11.7 percent). Each remaining species comprised 9.3 percent or less of the total number of birds observed.

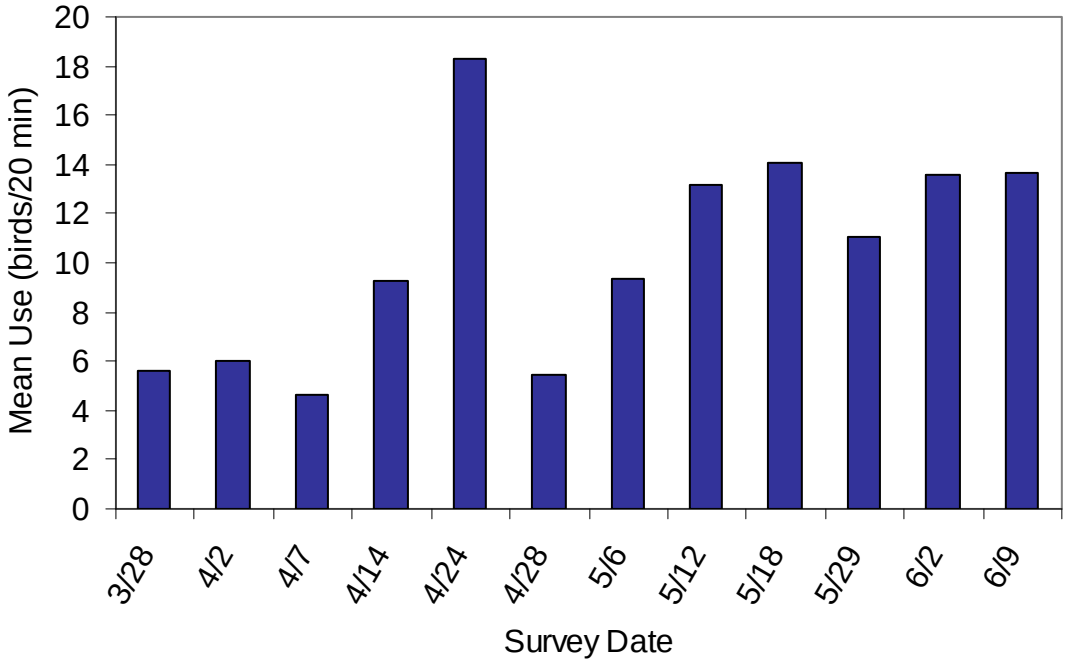
3.3 Avian Use

Overall mean bird use within the Oliver Expansion WRA was 10.60 birds/20 minute, ranging from zero to 505 birds/20 minute. Overall mean use by non-raptors was 10.35 birds/20 minute. The non-raptors with the highest mean use were the western meadowlark (1.78 birds/20 minute), red-winged blackbird (1.31 birds/20 minute), ring-necked pheasant (1.24/20 minute), horned lark (0.99 birds/20 minute), and European starling (0.91 birds/20 minute).

Among species groups, mean use was highest for songbirds (7.40 birds/20 minute; **Table 3**). The top species, western meadowlark, accounted for 24.0 percent of songbirds. Among gamebirds, the second highest species group (1.63 birds/20 minute), the most commonly observed species was ring-necked pheasant (1.24 birds/20 minute) (**Table 3**). Among the remaining non-raptor species groups, waterfowl, cranes/rails, and shorebirds had mean use values of 0.40 birds/20 minute, 0.33 birds/20 minute, and 0.30 birds/20 minute, respectively.

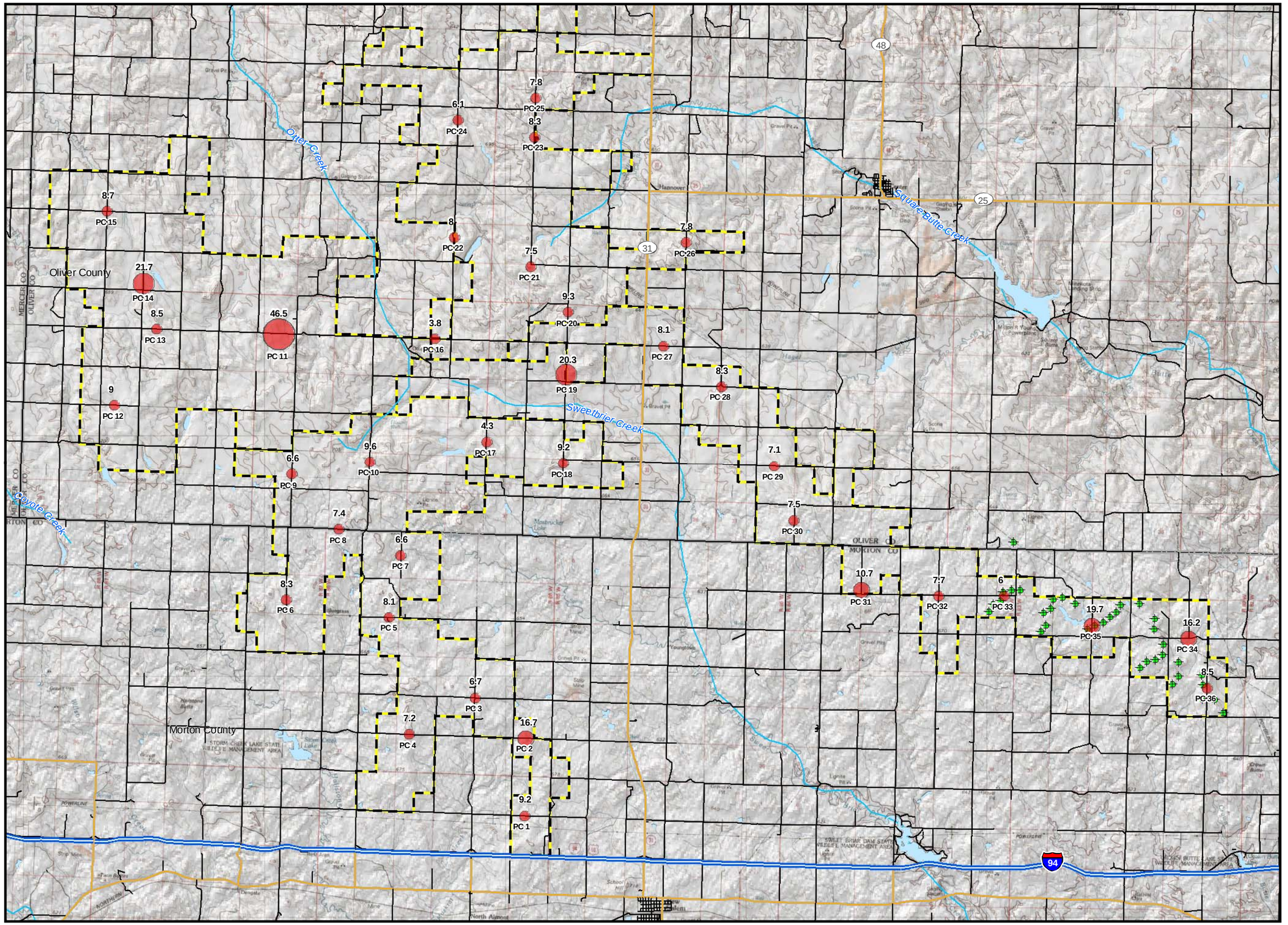
During survey 5 on April 25, the highest mean use was recorded at 18.33 birds/20 minutes. All surveys prior to survey 5 remained below 9.3 birds/20 minutes and the two surveys after survey five remained below 9.4 birds/20 minutes. Non-raptor mean use remained above 10.0 birds/20 minutes, beginning in mid-May until the end of the surveys in mid-June (**Figure 3**). Mean use for non-raptors was highest at point 11 (46.50 birds/20 minute) (**Figure 4**). Both red-winged blackbird (53.8 percent) and European starling (35.8 percent) accounted for the high mean use at point 11.

Figure 3: Mean non-raptor use by survey date (spring 2008)



Raptors are a group of special interest because of their propensity to fly at heights similar to those encompassed by a turbine RSA. Overall mean use for raptors was 0.26 birds/20 minute (**Table 3**). The raptors with the highest use were the red-tailed hawk (0.07 birds/20 minute), northern harrier (0.07 birds/20 minute), and Swainson's hawk (0.06 birds/20 minute). Mean use for each other raptor species was 0.03 birds/20 minute or fewer and included the great horned owl, American kestrel, turkey vulture, rough-legged hawk, and peregrine falcon. Mean use for raptors was highest at point 7 (1.17 birds/20 minute) and point 16 (1.08 birds/20 minutes) (**Figure 6**). The red-tailed hawk accounted for 71.4 percent of mean use at point 7 while the great horned owl accounted for all mean use at point 16. In general, raptor use remained fairly consistent throughout the Spring 2008 surveys (**Figure 5**).

Figure 4.
FPL Energy - Oliver Mean Non-Raptor Use by Point Count Location (spring 2008)
Oliver and Morton Counties, North Dakota
July 18, 2008



Non-Raptors per 20 Minutes

- 0 - 10
- 10.1 - 20
- 20.1 - 30
- 30.1 - 40
- 40.1 - 50

\# Mean Use Value
PC# Point Count Number
Proposed Turbine *

Oliver Expansion

- **Phases III, IV, and V**
- **County Boundary**
- **Stream**
- **Intermittent Stream**
- **Water Body**

Transportation

- **Limited Access**
- **Highway**
- **Major Road**
- **Other Road**

* only a portion of turbines shown

FPL Energy

1:150,000
NAD 83 UTM 14

Miles
0 0.5 1 2

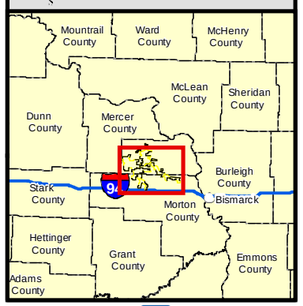


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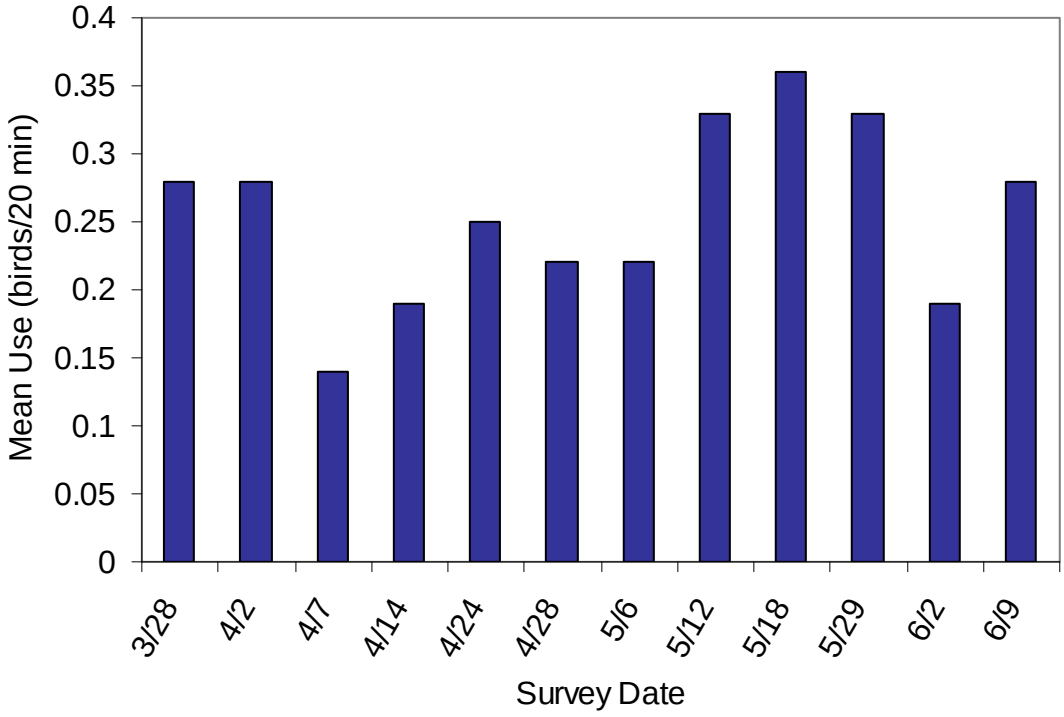
Figure 5: Mean raptor use by survey date (spring 2008)



3.4 Frequency of Occurrence

Songbirds were widely distributed throughout the Oliver Expansion WRA (**Table 3**); the western meadowlark (82.4 percent of all surveys), horned lark (55.1 percent), red-winged blackbird (25.7 percent), brown-headed cowbird (21.5 percent), and common grackle (18.3 percent) occurred most often (**Table 3**). These species were also detected at a majority of the point count survey locations (**Table 4**). All other songbird species were detected in less than 10 percent of surveys.

Gamebirds were the second most common species group observed during spring surveys. Ring-necked pheasants were observed most frequently (60.2 percent of all surveys; **Table 3**) and was observed at all point count locations (**Table 4**). Other gamebirds observed at a lower frequency were the sharp-tailed grouse and gray partridge.

Raptors were not amongst the most commonly observed species group during the spring surveys (**Table 3**). Among raptors, the northern harrier (6.3 percent of all surveys), red-tailed hawk (5.8 percent of all surveys), and Swainson's hawk (4.9 percent) were detected most frequently. These three species were widespread throughout the Oliver Expansion WRA but were not observed at all point count locations (**Table 4**). Each additional raptor species was detected in less than three percent of surveys.

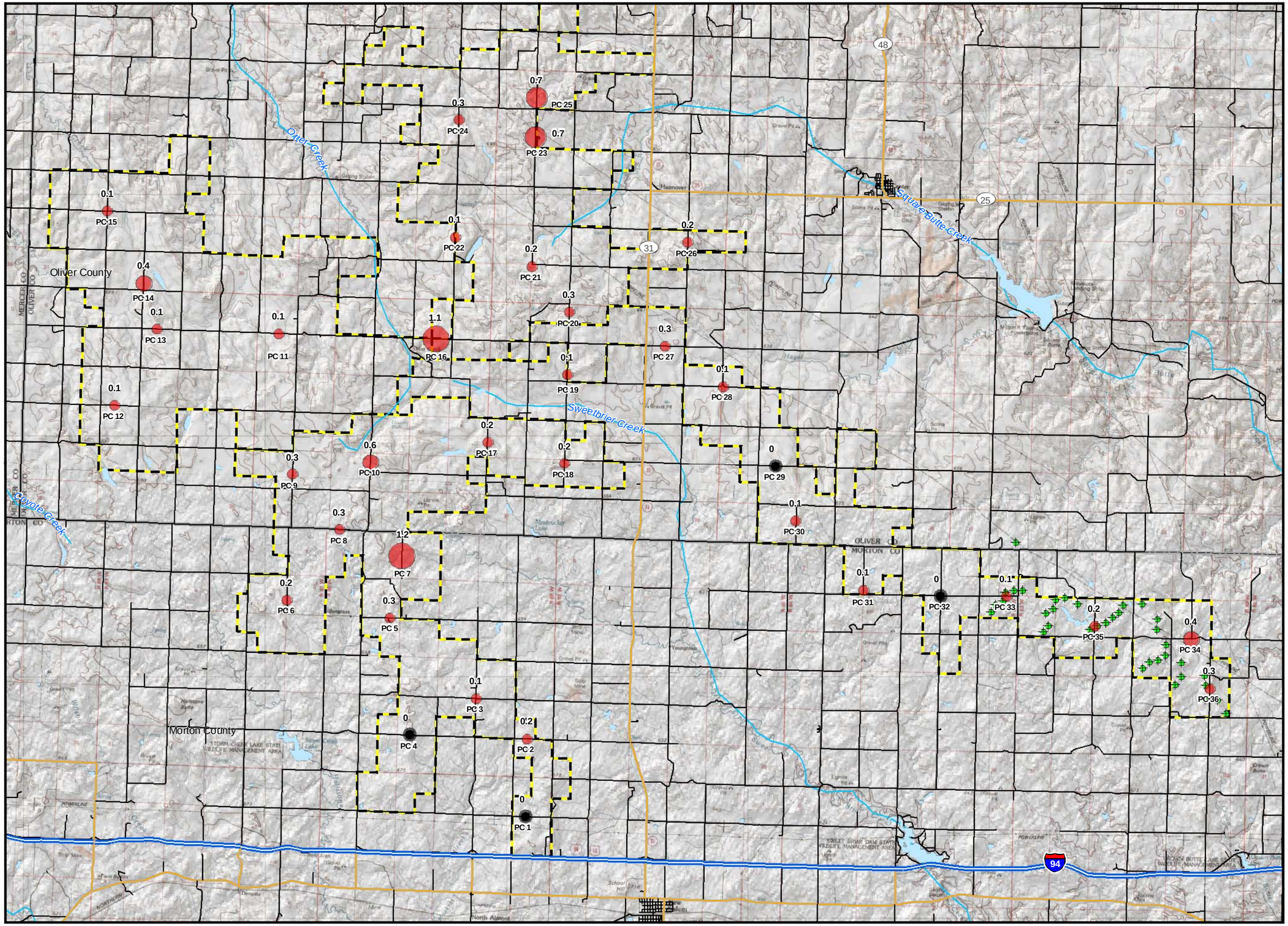


Figure 6.
FPL Energy - Oliver
Mean Raptor Use
by Point Count
Location (spring 2008)
Oliver and Morton Counties, North Dakota
July 18, 2008

Raptors per 20 Minutes

- Zero
- 0 - .3
- .31 - .6
- .61 - .9
- .91 - 1.2

\# Mean Use Value
PC# Point Count Number

Oliver Expansion

- Phases III, IV, and V
- Proposed Turbine *
- County Boundary
- Stream
- Intermittent Stream
- Water Body

Transportation

- Limited Access
- Highway
- Major Road
- Other Road

* only a portion of turbines shown

FPL Energy

1:150,000
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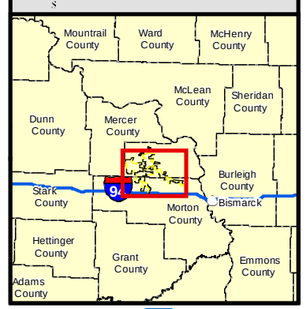
Miles
0 0.5 1 2



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3.5 Flight Height and Encounter Rate

During spring avian use surveys, biologists collected behavioral data for 98.8 percent of all birds observed during point count surveys. Biologists observed 51 percent of birds flying and collected flight height and direction data for 99 percent of observations. For flying non-raptor species, 88.4 percent flew below the anticipated RSA; 10.9 percent flew above the anticipated RSA; and 0.8 percent occurred within the anticipated RSA (**Table 5**). For flying raptor species, 67.9 percent flew below the RSA, 25.9 percent flew within, and 6.2 percent flew above (**Table 5**). Data on flight direction is located in **Appendix 1**.

Red-tailed hawk had the highest encounter rate (0.03 birds flying within the RSA/20 minute), followed by common grackle (0.02 birds flying within the RSA/20 minute), and Swainson's hawk (0.01 birds flying within the RSA/20 minute) (**Table 6**). All other species had very low encounter rates.

3.6 Incidental Observations

During incidental spring surveys, biologists documented 103 species for a total of 3,672 birds (**Table 7**). Cliff swallows were the most commonly recorded species during incidental surveys within the Oliver Expansion WRA (620 birds). Biologists observed ten raptor species as incidentals. The peregrine falcon was the only species observed during point counts that was not recorded as an incidental. Raptor species recorded as incidentals that were not observed during the point count surveys were the merlin, ferruginous hawk, and broad-winged hawk.

3.7 Raptor Nest Surveys

During the early spring, biologists identified 28 nests while trees were still without leaves (**Figure 7**; **Appendix 2**). Biologists revisited all nests at the end of the spring survey during the raptor nesting period. Fourteen of the 28 nests were active. Red-tailed hawks were the most common nesting species, accounting for seven of the active nests. Great-horned owls occupied five nests and Swainson's hawks occupied the remaining two nests. Nests were most commonly located in central portion of the project area. Nests were found in the trees.

3.8 Grouse Lek Surveys

During grouse lek surveys, biologists documented 15 sharp-tailed grouse leks (**Figure 7**; **Appendix 3**). The numbering system in **Appendix 3** for the recorded leks is not consecutive because of the method used by field personnel. All leks were located throughout Oliver Expansion WRA. Biologists encountered 125 individuals during the first round of surveys. During the second round of surveys, two of the leks observed in the first survey were inactive. All the other leks remained active during the duration of the surveys.

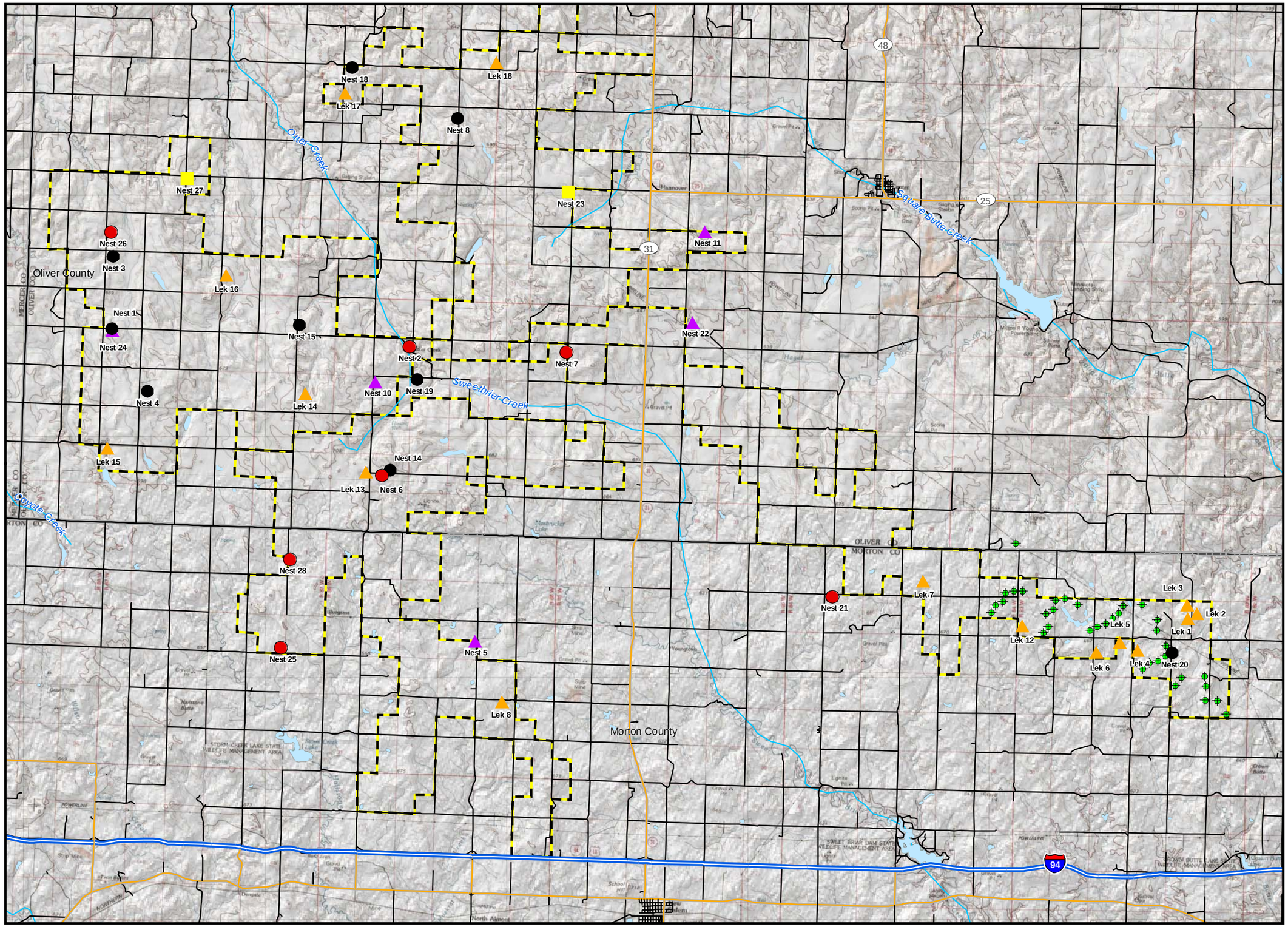


Figure 7. FPL Energy - Oliver Raptor Nest and Prairie Grouse Lek Locations (spring 2008)

Oliver and Morton Counties, North Dakota
July 18, 2008

Raptor Nest
- Red-tailed Hawk
- Great Horned Owl
- Swainson's Hawk
- Unknown

Grouse Lek
- Sharp-tailed Grouse
- Proposed Turbine *

Oliver Expansion
- Phases III, IV, and V
- County Boundary
- Stream
- Intermittent Stream
- Water Body

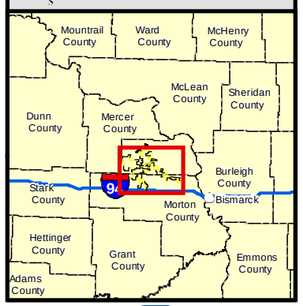
Transportation
- Limited Access
- Highway
- Major Road
- Other Road

* only a portion of turbines shown

FPL Energy

1:150,000
NAD 83 UTM 14

Miles
0 0.5 1 2



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4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Non-Raptor Use and Encounter Rate

Overall use by non-raptors at the Oliver Expansion WRA was moderate in the spring 2008 surveys (10.35 birds/20 minute; **Table 3**). The Oliver Expansion WRA ranked ninth out of 23 publicly available studies compared to non-raptor use rates in spring reported for existing wind energy facilities throughout the country (**Table 8**). Because studies of avian use do not share identical methodologies (e.g., length of survey period) and there is variance associated with the mean values, comparisons of avian use represent generalizations only. Songbirds had the highest mean use out of all groups and gamebirds had the second highest mean use, values which were driven by the three most commonly observed species: western meadowlark, red-winged blackbird, and ring-necked pheasant.

Western meadowlark had the highest mean use of all species observed. A two-year study of western meadowlark fatalities at the 31 turbine Diablo Winds Energy Facility in California from April 2005 to November 2007 estimated that fatalities from wind turbine interactions for western meadowlark were 1.734 deaths per megawatt per year, or 35.5 fatalities annually at the Diablo Winds Energy Facility (Smallwood 2008). During the spring 2008 surveys at the Oliver Expansion WRA, the encounter rate for this species was very low. Based on the relative abundance and stability of the western meadowlark population (Sauer et al. 2007), population-level impacts are not anticipated from potential meadowlark fatalities at the Oliver Expansion WRA.

Red-winged blackbirds had the second highest mean use of the species observed; however, they experienced a very low encounter rate. Red-winged blackbirds can occur in the Oliver Expansion WRA year-round and often travel in large flocks during the non-breeding season. Red-winged blackbird fatalities have also been recorded at wind energy facilities; however, mortality rates were lower than expected based on pre-construction avian use (Kerlinger et al. 2005). The red-winged blackbird can cause crop damage and is often regarded as an agricultural pest (Linz et al. 1996). In addition, red-winged blackbird populations are considered stable (Sauer et al. 2007), thereby minimizing the potential population-level impacts of fatalities.

Ring-necked pheasants had the third highest mean use of the species observed. Ring-necked pheasants are non-native to North Dakota and their population has been increasing at a trend of 3.8 percent from 1966 to 1994 (USGS 1995). At the Buffalo Ridge Wind Farm in Minnesota, ring-necked pheasant fatalities were found within the wind farm (WEST 2001); however this is not anticipated to be a problem at the Oliver Expansion WRA. Only 1.9 percent of ring-necked pheasants were observed flying during the spring surveys and all were observed flying below the RSA. Exposure risk for ring-necked pheasants is very low because of their propensity to remain on the ground. Because of their non-native status, and their increasing numbers in North Dakota, ring-necked pheasant fatalities are not likely to have population-level impacts.

4.2 Raptor Use and Encounter Rate

Overall raptor use at the Oliver Expansion WRA was very low compared to other species groups in the spring 2008 surveys (0.26 birds/20 minute). The Oliver Expansion WRA ranked thirty-second out of 34 studies compared to raptor use rates in spring reported for existing wind energy facilities throughout the country (**Table 8**). High raptor use has been associated with high raptor mortality at wind farms (Erickson 2007); however, the strength of the conclusion is based on two data points for high raptor use (>2.0 birds/20 minutes). Conversely, raptor mortality appears to be low when raptor use is low (<1.0 birds/20 minute; Erickson 2007). Continued monitoring and additional analysis of encounter rate and post-construction mortality data will help elucidate the relationship between these two variables. However, the data suggest that it is unlikely that there will be high levels of overall raptor mortality at the Oliver Expansion WRA.

Red-tailed hawks were the major contributor to overall raptor use; they breed within the WRA and were observed frequently. Red-tailed hawks had the highest encounter rate of all raptors (0.03 birds flying within the RSA/20 minute), this encounter rate is also the highest of the other rates in this study. However, these encounter rates are very low and not considered a cause for concern. Mortality of red-tailed hawks due to collisions with wind turbines has been documented at multiple sites (Johnson et al., 2002, Erickson et al., 2004, Erickson 2007), and may be higher than expected from pre-construction avian use surveys (Orloff and Flannery 1992); therefore, red-tailed hawk mortality events may occur at the Oliver Expansion WRA. However, the overall low mean use of red-tailed hawks within the WRA coupled with a stable population (Sauer et al. 2007) make it unlikely that mortality of red-tailed hawks will have population-level impacts.

Northern harriers, Swainson's hawks, great horned owls, American kestrels, turkey vultures, rough-legged hawks, and peregrine falcons were also observed at the Oliver Expansion WRA with low mean use rates of <0.08 birds/20 minute (**Table 3**).

4.3 Listed and Sensitive Species

There were no federally listed threatened and endangered species observed within the Oliver Expansion WRA during point count surveys.

The North Dakota Game and Fish Department (NDGFD) has identified 100 Species of Conservation Priority within North Dakota. These species are ranked in three priority levels based on such factors as known status, funding availability, and presence of breeding habitat within North Dakota (Hagen et al. 2005). The definitions of each rank are listed below:

> Level I: A species having a high level of conservation priority because of declining status either in North Dakota or across their range; or a high rate of occurrence in North Dakota constituting the core of the species' breeding range, but are at-risk range wide, and non-SWG [State Wildlife Grants] funding is not readily available to them.

Level II: Species having a moderate level of conservation priority; or a high level of conservation priority, but a substantial amount of non-State Wildlife Grant funding is available to them.

Level III: North Dakota's species having a moderate level of conservation priority, but are believed to be peripheral or do not breed in North Dakota. (Hagen et al. 2005).

There were thirteen of these species observed during the point count surveys. The chestnut-collared longspur (Level I), grasshopper sparrow (Level I), lark bunting (Level I), Sprague's pipit (Level I), Swainson's hawk (Level I), upland sandpiper (Level I), marbled godwit (Level I), bobolink (Level II), loggerhead shrike (Level II), northern harrier (Level II), northern pintail (Level II), sharp-tailed grouse (Level II), and peregrine falcon (Level III) were all observed during surveys.

The NDGFD Species of Conservation Priority that were observed within the WRA had an overall low mean use. The species with the highest mean use was the sharp-tailed grouse (0.33 birds/20 minute). All other species were below 0.20 birds/20 minutes and less than 90 individuals were observed during the 12 surveys. The Swainson's hawk (0.01 encounter rate) was the only species with a measurable encounter rate.

Species that are listed under the 100 Species of Conservation Priority are not afforded any formal protection by the state. There is no regulatory nexus with these species. However, species identified on this list are assigned a wildlife replacement value based on their level of conservation concern (NDGFD 2006). NDGFD has not applied these replacement values for wind projects as they were designed for chemical spills, oil spills, and other large scale impacts to species and their habitats. However, it cannot be assumed that a large-scale "take" of species through the operation of the wind farm will not trigger these replacement values.

4.4 Sharp-Tailed Grouse

Sharp-tailed grouse typically fly low to the ground and, therefore, are at low risk of collision with turbines or power lines. However, development in grouse habitat could result in direct habitat loss, habitat loss through avoidance, predator facilitation, and construction-related disturbance. Road development can also facilitate the movement of predators into the WRA (Frey and Conover 2006, Pescador and Peris 2007), potentially increasing predation on grouse nests. Research investigating the effects of wind turbines on prairie grouse leks is ongoing.

Considerations can be made to avoid or minimize impacts to quality grouse habitat and leks when siting roads and turbines. The United States Fish and Wildlife Service (USFWS 2004) recommends a conservative turbine setback distance of 5 miles from prairie grouse leks. Several ways developers can minimize disturbances to leks include decreasing the visibility of turbines from the leks, avoiding disturbing the habitat where the lek is located, and consulting with state and federal wildlife officials to determine

appropriate lek setback distances for the WRA. To further minimize disturbances to leks, construction between March 15 and June 1 should not occur during the early morning hours or evening period when grouse display.

4.5 Potential Impacts to Avian Species

The possible impacts to avian species from the construction and operation of the Oliver Expansion WRA are direct morality and injury from collisions with wind turbines and guy wires, temporary or permanent habitat loss, and displacement of birds from habitats near turbines (Drewitt and Langston 2006). Historically, raptor mortality has received the most attention. Raptor mortality at newer generation wind projects has been low relative to previous generation wind farms (Erickson et al. 2002). A number of mortality monitoring studies at newer generation wind projects have found fewer than five individual raptor mortalities (e.g., Johnson et al. 2002, Erickson et al. 2003, Kerns and Kerlinger 2004, Jain et al. 2007), but one study at the Stateline Wind Project in Oregon and Washington found as many as 17 dead raptors within a 2.5-year monitoring period (Erickson et al. 2004). Although raptor mortality is reduced, mortality may not be eliminated by advances in turbine technology and local micro-siting and site evaluation efforts are still necessary.

At newer generation wind energy facilities outside of California, approximately 80 percent of documented mortalities have been passerines (e.g., songbirds); of which 50 percent were night migrants (Erickson et al. 2002). It is estimated that less than 0.01 percent of migrant songbirds that pass over wind farms are killed, based on radar data and mortality monitoring at wind farms in Oregon, Washington, and Minnesota (Erickson 2007). Resident species may have lower mortality than migrants because many songbirds do not fly within the RSA. However, some resident species have behaviors that increase the risk of collisions with turbines because they fly within the RSA. For example, horned larks have been commonly found as fatalities at wind farms (Erickson et al. 2002). Mortality may be partially attributed to the fact that male horned larks perform flight songs in which the male climbs into a strong wind to heights of 80 to 250 meters (Pickwell 1931).

In addition to mortality associated with wind farms, concerns have been raised that bird species may avoid areas near turbines after the wind farm is in operation (Drewitt and Langston 2006). For example, at the Buffalo Ridge wind energy facility in Minnesota, densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines. It was suggested that the reduced density may be due to avoidance of turbine noise and maintenance activities, and reduced habitat quality due to the presence of access roads and large gravel pads surrounding the turbines (Leddy et al. 1999). Reduced abundance of grassland songbirds was found within 50 meters of a turbine pad for a wind farm in Washington and Oregon, but the investigators attributed displacement to the direct loss of habitat or reduced habitat quality and not the presence of the turbines (WEST and NWC 2004). Although breeding grassland songbirds have not shown strong avoidance to date, other species groups (e.g., prairie grouse) may respond differently based on avoidance of other anthropogenic features on the landscape (Pitman et al. 2005).

4.6 Oliver Expansion Project Area Conclusions and Recommendations

Although mortality events will likely occur at the Oliver Expansion WRA, the most commonly observed species – the western meadowlark, red-winged blackbird, and ring-necked pheasant – are all widespread species and have relatively stable populations (Sauer et al. 2007); therefore, individual mortalities are unlikely to have population-level consequences or receive a high level of scrutiny from state of federal wildlife agencies. Nocturnal migrants may pass through the Oliver Expansion WRA and would not be detected by the survey methods used in this study if the birds did not stop-over within the WRA. However, mortality of nocturnal migrants at the Oliver Expansion WRA is not expected to have population-level implications because less than 0.01 percent of nocturnal migrants that fly through wind farms are killed (Erickson 2007).

Raptor use at the Oliver Expansion WRA was very low when compared to other wind generation facilities (**Table 9**). Low raptor use at the Oliver Expansion WRA suggests that raptor mortality is anticipated to be low; however, mortality rates are variable between species and pre-construction mean use surveys may not equate to post-construction mortality. Red-tailed hawks were the most common raptor observed at the Oliver Expansion WRA. Red-tailed hawk mortalities have occurred at wind farms (Kerns and Kerlinger 2004, Anderson et al. 2005, Kerlinger et al. 2005); however, the low mean use and the stable populations make it unlikely that mortalities will have a population-level effect. These impacts likely could be minimized if turbines are sited away from areas of high raptor use, which are located in the western-central portion of the WRA (**Figure 6**). Active raptor nests are also considered an area that should be avoided to the extent practicable. Raptor nests within the WRA were concentrated west of County Road 31 (**Figure 7**). Only the red-tailed hawk, great horned owl, and Swainson's hawk (state ranked Level I species of concern) were observed nesting within the Oliver Expansion WRA. The following Best Management Practices and recommended studies should provide measures to minimize impacts to birds from the construction and operation of the Oliver Expansion WRA.

Best Management Practices

Several best management practices can be implemented at wind farm facilities in order to avoid and minimize potential impacts to avian species and habitat. These practices are important not only to reduce the potential for individuals to be injured or killed by turbines, transmission lines, or other wind farm components, but to also protect and enhance habitat for species of concern.

Project Specific Recommendations

- There are numerous sharp-tailed grouse leks throughout the WRA. Tetra Tech recommends continued consultation with state and federal agencies to determine the best course of action.

Standard Best Management Practices

- Studies have shown that birds, including bald eagles, are susceptible to electrocution by power lines (APLIC 2006). Therefore, the use of overhead

power lines should be minimized; when they are necessary, power poles should be fitted with bird perch guards to minimize bird use.

- The use of lights on turbines should be minimized when practicable in accordance with state, federal, and local requirements, because lights may attract migrating birds to the vicinity of turbines, particularly during certain weather conditions (Evans et al. 2007).
- Active raptor nests may require timing restrictions for construction or operation activities, or alterations to the turbine design plan. Raptor nests discovered during construction should be mapped and flagged. Turbines should be placed as far away from raptor nests as project and engineering constraints permit and avoid removal of trees. If the nest is identified to belong to a species of concern, it may be designated a 'no disturbance zone' during the construction phase (APLIC and USFWS 2005, APLIC 2006). Turbines should be placed out of a direct line of sight of the nest, if possible.
- Habitat loss is typically the leading cause of population declines in a number of species of concern. Bird species are dependent on the native plants for food, cover, and breeding habitat. Degraded vegetative communities or the presence of invasive plant species can reduce the amount of available quality habitat for birds in these areas. In order to decrease the loss of bird habitat, the following practices are recommended:
  - To the greatest extent possible, minimize impacts to native vegetation and riparian areas during design and construction of turbines and associated infrastructure.
  - If native vegetation is disturbed or removed during construction of roads or turbines, these areas should be reseeded or planted with native material.
  - Where practical, existing degraded habitat could also be enhanced through the removal and replacement of invasive species with plants native to the site.
- To maintain high quality native habitats used by birds, a management plan should be developed to prevent the spread of noxious weeds throughout the Oliver Expansion WRA or adjacent areas during construction and ongoing operations. Any area that is disturbed or altered should be managed appropriately to avoid the introduction or spread of noxious species. This practice is important to reduce detrimental impacts to avian habitat. The appropriate weed control board should be consulted to develop this plan.

Additional Recommended Studies

- Fall surveys are recommended to determine the use patterns continue.
- Post-construction mortality monitoring is recommended to quantify impacts to avian species.

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TABLES

Table 1. Oliver Wind Resource Area, Spring 2008 point count survey dates.

Survey number	Date
1	March 28
1	March 29
2	April 2
2	April 3
2	April 4
3	April 7
3	April 8
4	April 14
4	April 15
5	April 24
5	April 25
6	April 28
6	April 29
7	May 6
7	May 7
7	May 8
8	May 12
8	May 13
8	May 14
9	May 18
9	May 19
9	May 20
10	May 29
10	May 30
11	June 2
11	June 3
11	June 6
12	June 9
12	June 10
12	June 11

Table 2. Avian species observed during Spring point count surveys at the OliverWind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
western meadowlark	768	453	1.78 (1.66 - 1.90)	82.4	16.8%
red-winged blackbird	564	114	1.31 (0.16 - 2.46)	25.7	12.3%
ring-necked pheasant	534	301	1.24 (1.10 - 1.38)	60.2	11.7%
horned lark	428	273	0.99 (0.88 - 1.10)	55.1	9.3%
European starling	391	23	0.91 (0.08 - 1.74)	5.3	8.5%
common grackle	267	82	0.62 (0.47 - 0.77)	18.3	5.8%
brown-headed cowbird	201	99	0.47 (0.38 - 0.56)	21.5	4.4%
sharp-tailed grouse	144	31	0.33 (0.17 - 0.49)	6.7	3.1%
sandhill crane	142	3	0.33 (-0.16 - 0.82)	0.5	3.1%
Canada goose	119	11	0.28 (-0.10 - 0.66)	2.5	2.6%
mourning dove	90	58	0.21 (0.16 - 0.26)	13.2	2.0%
upland sandpiper	83	64	0.19 (0.14 - 0.24)	12.0	1.8%
chestnut-collared longspur	78	43	0.18 (0.12 - 0.24)	8.8	1.7%
American robin	52	34	0.12 (0.08 - 0.16)	7.6	1.1%
savannah sparrow	44	31	0.10 (0.06 - 0.14)	6.5	1.0%
mallard	41	22	0.09 (0.05 - 0.13)	4.4	0.9%
western kingbird	40	29	0.09 (0.06 - 0.12)	6.5	0.9%
clay-colored sparrow	39	22	0.09 (0.04 - 0.14)	4.2	0.9%
eastern kingbird	38	31	0.09 (0.06 - 0.12)	6.5	0.8%
white-crowned sparrow	32	2	0.07 (-0.04 - 0.18)	0.5	0.7%
red-tailed hawk	32	26	0.07 (0.04 - 0.10)	5.8	0.7%
American tree sparrow	32	7	0.07 (0.01 - 0.13)	1.6	0.7%
northern harrier	31	29	0.07 (0.05 - 0.09)	6.3	0.7%
killdeer	28	24	0.06 (0.04 - 0.08)	5.6	0.6%
house sparrow	28	21	0.06 (0.04 - 0.08)	4.9	0.6%
vesper sparrow	25	20	0.06 (0.03 - 0.09)	4.2	0.5%
Swainson’s hawk	25	23	0.06 (0.04 - 0.08)	4.9	0.5%

Table 2. Avian species observed during Spring point count surveys at the OliverWind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
gray partridge	24	13	0.06 (0.03 - 0.09)	3.0	0.5%
barn swallow	23	20	0.05 (0.03 - 0.07)	4.6	0.5%
brown thrasher	21	20	0.05 (0.03 - 0.07)	4.6	0.5%
American crow	17	8	0.04 (0.01 - 0.07)	1.9	0.4%
Brewer's blackbird	16	5	0.04 (0.01 - 0.07)	0.9	0.3%
bobolink	16	11	0.04 (0.02 - 0.06)	2.3	0.3%
American redstart	15	1	0.03 (-0.03 - 0.09)	0.2	0.3%
great horned owl	13	9	0.03 (0.01 - 0.05)	2.1	0.3%
yellow warbler	11	10	0.03 (0.02 - 0.04)	2.3	0.2%
Wilson's snipe	10	10	0.02 (0.01 - 0.03)	2.3	0.2%
grasshopper sparrow	10	10	0.02 (0.01 - 0.03)	2.1	0.2%
rock pigeon	8	4	0.02 (0.00 - 0.04)	0.9	0.2%
marbled godwit	8	5	0.02 (0.00 - 0.04)	1.2	0.2%
least flycatcher	8	8	0.02 (0.01 - 0.03)	1.9	0.2%
American goldfinch	8	8	0.02 (0.01 - 0.03)	1.9	0.2%
chipping sparrow	7	5	0.02 (0.01 - 0.03)	1.2	0.2%
ring-billed gull	6	4	0.01 (0.00 - 0.02)	0.9	0.1%
gadwall	6	3	0.01 (0.00 - 0.02)	0.7	0.1%
northern pintail	5	4	0.01 (0.00 - 0.02)	0.9	0.1%
northern flicker	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
loggerhead shrike	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
American kestrel	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
orchard oriole	4	4	0.01 (0.00 - 0.02)	0.9	0.1%
lark sparrow	4	4	0.01 (0.00 - 0.02)	0.9	0.1%
unidentified songbird	3	2	0.01 (0.00 - 0.02)	0.5	0.1%
common yellowthroat	3	3	0.01 (0.00 - 0.02)	0.7	0.1%
blue-winged teal	3	1	0.01 (0.00 - 0.02)	0.2	0.1%

Table 2. Avian species observed during Spring point count surveys at the OliverWind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
warbling vireo	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
turkey vulture	2	1	0.00 (-0.01 - 0.01)	0.2	0.0%
song sparrow	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
Say's phoebe	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
rough-legged hawk	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
lark bunting	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
tree swallow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Swainson's thrush	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
spotted towhee	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Sprague's pipit	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
peregrine falcon	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
ovenbird	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Lincoln's sparrow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
hairy woodpecker	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
cliff swallow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Grand Total	**4581**	**2083**	**10.60** (8.51-12.70)		

Table 3. Avian species, by species grouping, observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
Songbirds					
western meadowlark	768	453	1.78 (1.66 - 1.90)	82.4	16.8%
red-winged blackbird	564	114	1.31 (0.16 - 2.46)	25.7	12.3%
horned lark	428	273	0.99 (0.88 - 1.10)	55.1	9.3%
European starling	391	23	0.91 (0.08 - 1.74)	5.3	8.5%
common grackle	267	82	0.62 (0.47 - 0.77)	18.3	5.8%
brown-headed cowbird	201	99	0.47 (0.38 - 0.56)	21.5	4.4%
chestnut-collared longspur	78	43	0.18 (0.12 - 0.24)	8.8	1.7%
American robin	52	34	0.12 (0.08 - 0.16)	7.6	1.1%
savannah sparrow	44	31	0.10 (0.06 - 0.14)	6.5	1.0%
western kingbird	40	29	0.09 (0.06 - 0.12)	6.5	0.9%
clay-colored sparrow	39	22	0.09 (0.04 - 0.14)	4.2	0.9%
eastern kingbird	38	31	0.09 (0.06 - 0.12)	6.5	0.8%
white-crowned sparrow	32	2	0.07 (-0.04 - 0.18)	0.5	0.7%
American tree sparrow	32	7	0.07 (0.01 - 0.13)	1.6	0.7%
house sparrow	28	21	0.06 (0.04 - 0.08)	4.9	0.6%
vesper sparrow	25	20	0.06 (0.03 - 0.09)	4.2	0.5%
barn swallow	23	20	0.05 (0.03 - 0.07)	4.6	0.5%
brown thrasher	21	20	0.05 (0.03 - 0.07)	4.6	0.5%
Brewer's blackbird	16	5	0.04 (0.01 - 0.07)	0.9	0.3%
bobolink	16	11	0.04 (0.02 - 0.06)	2.3	0.3%
American redstart	15	1	0.03 (-0.03 - 0.09)	0.2	0.3%
yellow warbler	11	10	0.03 (0.02 - 0.04)	2.3	0.2%
grasshopper sparrow	10	10	0.02 (0.01 - 0.03)	2.1	0.2%

Table 3. Avian species, by species grouping, observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
least flycatcher	8	8	0.02 (0.01 - 0.03)	1.9	0.2%
American goldfinch	8	8	0.02 (0.01 - 0.03)	1.9	0.2%
chipping sparrow	7	5	0.02 (0.01 - 0.03)	1.2	0.2%
loggerhead shrike	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
orchard oriole	4	4	0.01 (0.00 - 0.02)	0.9	0.1%
lark sparrow	4	4	0.01 (0.00 - 0.02)	0.9	0.1%
unidentified songbird	3	2	0.01 (0.00 - 0.02)	0.5	0.1%
common yellowthroat	3	3	0.01 (0.00 - 0.02)	0.7	0.1%
warbling vireo	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
song sparrow	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
Say's phoebe	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
lark bunting	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
tree swallow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Swainson’s thrush	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
spotted towhee	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Sprague's pipit	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
ovenbird	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Lincoln’s sparrow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
cliff swallow	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Group Total	**3196**	**1415**	**7.40** (5.43-9.37)		**69.8%**
Raptors/Vultures/Owls					
red-tailed hawk	32	26	0.07 (0.04 - 0.10)	5.8	0.7%
northern harrier	31	29	0.07 (0.05 - 0.09)	6.3	0.7%
Swainson’s hawk	25	23	0.06 (0.04 - 0.08)	4.9	0.5%

Table 3. Avian species, by species grouping, observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
great horned owl	13	9	0.03 (0.01 - 0.05)	2.1	0.3%
American kestrel	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
turkey vulture	2	1	0.00 (-0.01 - 0.01)	0.2	0.0%
rough-legged hawk	2	2	0.00 (-0.01 - 0.01)	0.5	0.0%
peregrine falcon	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Group Total	**111**	**96**	**0.26** (0.21-0.31)		**2.4%**
Waterfowl					
Canada goose	119	11	0.28 (-0.10 - 0.66)	2.5	2.6%
mallard	41	22	0.09 (0.05 - 0.13)	4.4	0.9%
gadwall	6	3	0.01 (0.00 - 0.02)	0.7	0.1%
northern pintail	5	4	0.01 (0.00 - 0.02)	0.9	0.1%
blue-winged teal	3	1	0.01 (0.00 - 0.02)	0.2	0.1%
Group Total	**174**	**41**	**0.40** (0.02-0.78)		**3.8%**
Woodpeckers					
northern flicker	5	5	0.01 (0.00 - 0.02)	1.2	0.1%
hairy woodpecker	1	1	0.00 (0.00 - 0.00)	0.2	0.0%
Group Total	**6**	**6**	**0.01** (0.00-0.02)		**0.1%**
Crows and Allies					
American crow	17	8	0.04 (0.01 - 0.07)	1.9	0.4%
Group Total	**17**	**8**	**0.04** (0.01-0.07)		**0.4%**
Cranes/Rails					
sandhill crane	142	3	0.33 (-0.16 - 0.82)	0.5	3.1%
Group Total	**142**	**3**	**0.33** (-0.16-0.82)		**3.1%**

Table 3. Avian species, by species grouping, observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
Gamebirds					
ring-necked pheasant	534	301	1.24 (1.10 - 1.38)	60.2	11.7%
sharp-tailed grouse	144	31	0.33 (0.17 - 0.49)	6.7	3.1%
gray partridge	24	13	0.06 (0.03 - 0.09)	3.0	0.5%
Group Total	**702**	**345**	**1.63** (1.38-1.88)		**15.3%**
Gulls/Terns					
ring-billed gull	6	4	0.01 (0.00 - 0.02)	0.9	0.1%
Group Total	**6**	**4**	**0.01** (0.00-0.02)		**0.1%**
Pigeons/Doves					
mourning dove	90	58	0.21 (0.16 - 0.26)	13.2	2.0%
rock pigeon	8	4	0.02 (0.00 - 0.04)	0.9	0.2%
Group Total	**98**	**62**	**0.23** (0.17-0.29)		**2.1%**
Shorebirds					
upland sandpiper	83	64	0.19 (0.14 - 0.24)	12.0	1.8%
killdeer	28	24	0.06 (0.04 - 0.08)	5.6	0.6%
Wilson's snipe	10	10	0.02 (0.01 - 0.03)	2.3	0.2%
marbled godwit	8	5	0.02 (0.00 - 0.04)	1.2	0.2%
Group Total	**129**	**103**	**0.30** (0.24-0.36)		**2.8%**
Grand Total	**4581**	**2083**	**10.60** (8.51-12.70)		

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
western meadowlark	768	453	22	17	21	26	19	14	19	14	20	24	15	23
red-winged blackbird	564	114	9	11	11	15	1	3	7	3	18	17	300	10
ring-necked pheasant	534	301	19	9	12	12	13	20	14	13	13	13	10	16
horned lark	428	273	19	13	11	6	6	13	13	23	10	6	5	7
European starling	391	23	0	0	0	0	3	0	0	0	0	0	200	0
common grackle	267	82	6	24	1	5	8	3	0	1	0	11	0	12
brown-headed cowbird	201	99	0	5	2	11	4	7	1	4	9	5	5	10
sharp-tailed grouse	144	31	16	11	0	4	0	0	0	21	0	1	0	1
sandhill crane	142	3	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	119	11	0	100	0	0	0	0	2	0	0	5	0	0
mourning dove	90	58	8	0	3	1	12	2	0	0	0	1	10	0
upland sandpiper	83	64	5	1	2	1	4	3	2	1	1	6	1	6
chestnut-collared longspur	78	43	0	0	0	0	0	0	0	0	0	1	0	2
American robin	52	34	0	0	2	0	9	5	0	1	0	2	2	0
savannah sparrow	44	31	0	2	0	1	0	0	9	0	0	2	0	1
mallard	41	22	4	4	6	0	0	0	0	0	5	7	0	0
western kingbird	40	29	0	0	0	0	2	0	2	0	0	0	0	3
clay-colored sparrow	39	22	0	0	0	0	1	0	0	2	0	0	0	0
eastern kingbird	38	31	0	0	0	1	0	2	0	0	0	2	0	1
white-crowned sparrow	32	2	0	0	0	0	0	0	0	0	0	0	0	0
red-tailed hawk	32	26	0	0	0	0	1	0	10	0	0	3	0	0
American tree sparrow	32	7	0	0	0	0	0	20	0	0	0	0	0	0
northern harrier	31	29	0	2	0	0	0	2	2	3	2	2	1	0
killdeer	28	24	0	0	1	2	0	1	0	0	1	1	0	1
house sparrow	28	21	0	0	0	0	5	0	0	0	0	0	0	0

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
vesper sparrow	25	20	0	0	0	0	2	1	0	1	0	0	0	0
Swainson's hawk	25	23	0	0	1	0	0	0	1	0	0	0	0	1
gray partridge	24	13	2	1	0	0	0	0	0	2	0	0	0	0
barn swallow	23	20	0	1	0	0	1	1	2	1	1	3	0	2
brown thrasher	21	20	0	0	0	0	3	1	0	0	0	2	2	1
American crow	17	8	0	0	0	0	0	0	0	0	0	0	0	0
Brewer's blackbird	16	5	0	0	0	0	0	0	0	0	0	0	0	9
bobolink	16	11	0	1	0	0	0	0	8	0	0	0	0	1
American redstart	15	1	0	0	0	0	0	0	0	0	0	0	0	0
great horned owl	13	9	0	0	0	0	0	0	0	0	0	0	0	0
yellow warbler	11	10	0	0	0	1	1	0	0	0	0	0	0	0
Wilson's snipe	10	10	0	0	0	0	1	1	0	0	0	1	0	0
grasshopper sparrow	10	10	0	0	0	0	0	0	0	0	0	0	0	0
rock pigeon	8	4	0	0	0	0	0	0	0	0	0	0	5	0
marbled godwit	8	5	0	0	3	0	0	0	0	0	1	1	0	0
least flycatcher	8	8	0	0	0	0	0	0	0	0	0	0	0	0
American goldfinch	8	8	0	0	1	0	1	1	0	0	0	1	1	0
chipping sparrow	7	5	0	0	0	0	0	0	0	0	0	0	0	0
ring-billed gull	6	4	0	0	0	0	0	0	0	1	0	0	0	0
gadwall	6	3	0	0	2	0	0	0	0	0	0	2	0	0
northern pintail	5	4	0	0	1	0	0	0	0	0	0	0	0	0
northern flicker	5	5	0	0	0	0	0	0	0	0	0	0	0	0
loggerhead shrike	5	5	0	0	1	0	0	0	0	0	0	0	1	1
American kestrel	5	5	0	0	0	0	1	0	0	0	1	0	0	0
orchard oriole	4	4	0	0	0	0	0	0	0	0	0	0	1	0

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
lark sparrow	4	4	0	0	0	0	0	1	0	0	0	1	0	0
unidentified songbird	3	2	0	0	0	0	0	0	0	0	0	0	0	0
common yellowthroat	3	3	0	0	0	0	0	0	0	0	0	0	0	0
blue-winged teal	3	1	0	0	0	0	0	0	0	0	0	0	0	0
warbling vireo	2	2	0	0	0	0	0	0	0	0	0	0	0	0
turkey vulture	2	1	0	0	0	0	0	0	0	0	0	2	0	0
song sparrow	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Say's phoebe	2	2	0	0	0	0	0	0	0	0	0	0	0	0
rough-legged hawk	2	2	0	0	0	0	1	0	1	0	0	0	0	0
lark bunting	2	2	0	0	0	0	0	1	0	0	0	0	0	0
tree swallow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Swainson’s thrush	1	1	0	0	0	0	1	0	0	0	0	0	0	0
spotted towhee	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Sprague's pipit	1	1	0	0	0	0	0	0	0	0	0	0	0	1
peregrine falcon	1	1	0	0	0	0	0	0	0	0	0	0	0	0
ovenbird	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lincoln’s sparrow	1	1	0	0	0	0	0	0	0	1	0	0	0	0
hairy woodpecker	1	1	0	0	0	0	0	0	0	0	0	0	0	0
cliff swallow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	**4581**	**2083**	**110**	**202**	**81**	**86**	**100**	**102**	**93**	**92**	**82**	**122**	**559**	**109**

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			13	14	15	16	17	18	19	20	21	22	23	24
western meadowlark	768	453	26	21	17	16	18	19	14	32	34	18	17	20
red-winged blackbird	564	114	14	1	6	1	0	5	54	1	0	11	5	1
ring-necked pheasant	534	301	12	20	17	9	14	11	24	11	8	10	16	12
horned lark	428	273	8	2	10	3	4	17	5	11	17	13	8	4
European starling	391	23	8	140	0	0	0	2	26	0	0	0	0	1
common grackle	267	82	9	13	19	0	0	35	42	8	0	6	13	5
brown-headed cowbird	201	99	6	0	7	4	3	1	1	12	5	13	9	6
sharp-tailed grouse	144	31	0	0	0	1	1	0	0	0	7	0	0	0
sandhill crane	142	3	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	119	11	1	0	0	0	0	2	2	0	0	2	0	0
mourning dove	90	58	1	10	3	2	1	1	7	0	0	2	3	2
upland sandpiper	83	64	4	1	1	1	2	0	2	8	2	2	0	1
chestnut-collared longspur	78	43	0	0	0	0	1	0	1	22	7	7	4	0
American robin	52	34	3	5	1	0	0	2	8	0	0	0	1	3
savannah sparrow	44	31	0	0	0	1	1	0	0	0	8	0	5	1
mallard	41	22	2	0	0	0	0	2	0	0	0	0	0	0
western kingbird	40	29	1	7	4	2	5	1	0	0	0	0	2	2
clay-colored sparrow	39	22	0	5	0	0	0	0	0	0	0	0	2	0
eastern kingbird	38	31	1	0	2	1	2	2	0	2	0	0	1	0
white-crowned sparrow	32	2	0	0	0	0	0	0	32	0	0	0	0	0
red-tailed hawk	32	26	0	1	0	0	0	0	4	2	1	1	4	1
American tree sparrow	32	7	0	0	0	0	0	0	0	0	0	0	1	1
northern harrier	31	29	0	0	1	0	0	1	0	0	1	0	0	2
killdeer	28	24	0	0	0	0	0	3	1	0	0	1	0	4
house sparrow	28	21	0	9	0	0	0	1	0	0	0	0	0	0

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			13	14	15	16	17	18	19	20	21	22	23	24
vesper sparrow	25	20	4	0	1	1	0	0	0	1	0	1	4	0
Swainson's hawk	25	23	1	1	0	0	2	1	2	1	0	0	3	0
gray partridge	24	13	0	0	4	0	0	0	0	0	0	0	0	0
barn swallow	23	20	0	0	0	0	0	0	0	1	0	1	0	2
brown thrasher	21	20	0	0	2	0	0	0	0	0	0	0	0	2
American crow	17	8	0	1	3	0	0	0	0	1	0	8	4	0
Brewer's blackbird	16	5	0	0	0	0	0	0	0	0	0	0	0	0
bobolink	16	11	0	0	0	1	0	0	0	0	0	0	1	0
American redstart	15	1	0	15	0	0	0	0	0	0	0	0	0	0
great horned owl	13	9	0	0	0	13	0	0	0	0	0	0	0	0
yellow warbler	11	10	0	5	0	0	0	0	2	0	0	0	0	0
Wilson's snipe	10	10	0	0	0	0	0	0	2	0	0	0	0	3
grasshopper sparrow	10	10	0	0	0	0	0	0	0	0	2	0	1	0
rock pigeon	8	4	0	1	0	0	0	0	2	0	0	0	0	0
marbled godwit	8	5	2	0	0	0	0	0	0	0	0	0	0	0
least flycatcher	8	8	0	2	2	0	0	0	1	0	0	0	2	0
American goldfinch	8	8	0	0	0	0	0	1	1	0	0	0	0	0
chipping sparrow	7	5	0	1	0	0	0	0	6	0	0	0	0	0
ring-billed gull	6	4	0	0	0	0	0	0	0	0	0	0	0	0
gadwall	6	3	0	0	0	0	0	0	0	0	0	0	0	0
northern pintail	5	4	0	0	0	0	0	2	0	0	0	0	0	0
northern flicker	5	5	0	0	0	1	0	0	1	0	0	0	0	2
loggerhead shrike	5	5	0	0	0	1	0	0	0	0	0	0	0	0
American kestrel	5	5	0	3	0	0	0	0	0	0	0	0	0	0
orchard oriole	4	4	0	0	1	0	0	0	1	0	0	0	0	0

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			13	14	15	16	17	18	19	20	21	22	23	24
lark sparrow	4	4	0	0	0	0	0	0	1	0	0	0	0	0
unidentified songbird	3	2	0	0	0	0	0	2	0	0	0	1	0	0
common yellowthroat	3	3	0	0	1	0	0	0	2	0	0	0	0	0
blue-winged teal	3	1	0	0	0	0	0	0	3	0	0	0	0	0
warbling vireo	2	2	0	0	1	0	0	0	1	0	0	0	0	0
turkey vulture	2	1	0	0	0	0	0	0	0	0	0	0	0	0
song sparrow	2	2	0	0	1	0	0	0	1	0	0	0	0	0
Say's phoebe	2	2	0	1	0	0	0	1	0	0	0	0	0	0
rough-legged hawk	2	2	0	0	0	0	0	0	0	0	0	0	0	0
lark bunting	2	2	0	0	0	0	0	0	0	1	0	0	0	0
tree swallow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Swainson’s thrush	1	1	0	0	0	0	0	0	0	0	0	0	0	0
spotted towhee	1	1	0	0	0	0	0	0	0	0	0	0	1	0
Sprague's pipit	1	1	0	0	0	0	0	0	0	0	0	0	0	0
peregrine falcon	1	1	0	0	0	0	0	0	0	0	0	0	1	0
ovenbird	1	1	0	0	0	0	0	0	1	0	0	0	0	0
Lincoln’s sparrow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
hairy woodpecker	1	1	0	0	1	0	0	0	0	0	0	0	0	0
cliff swallow	1	1	0	0	0	0	0	0	0	0	0	0	0	1
Grand Total	**4581**	**2083**	**103**	**265**	**105**	**58**	**54**	**112**	**250**	**114**	**92**	**97**	**108**	**76**

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			25	26	27	28	29	30	31	32	33	34	35	36
western meadowlark	768	453	28	25	22	15	30	18	27	25	10	37	24	21
red-winged blackbird	564	114	3	2	12	2	5	1	10	5	0	7	10	3
ring-necked pheasant	534	301	9	21	26	20	19	8	21	15	5	37	11	14
horned lark	428	273	11	10	7	9	12	30	18	16	51	11	12	7
European starling	391	23	0	0	0	1	0	0	0	0	0	7	1	2
common grackle	267	82	7	5	0	8	10	8	5	1	0	1	0	1
brown-headed cowbird	201	99	2	1	4	10	3	9	6	6	1	9	17	3
sharp-tailed grouse	144	31	0	3	2	0	0	0	0	0	2	62	12	0
sandhill crane	142	3	0	0	0	0	0	0	0	0	0	0	128	14
Canada goose	119	11	0	0	1	0	2	2	0	0	0	0	0	0
mourning dove	90	58	0	3	2	2	0	1	0	0	0	0	5	8
upland sandpiper	83	64	3	4	1	0	1	3	7	5	0	2	0	0
chestnut-collared longspur	78	43	2	2	0	0	1	1	12	12	0	0	3	0
American robin	52	34	0	1	0	3	0	0	0	0	0	0	0	4
savannah sparrow	44	31	10	0	0	0	0	1	0	0	0	0	2	0
mallard	41	22	2	2	3	1	0	0	0	0	0	3	0	0
western kingbird	40	29	0	1	1	1	1	0	3	0	0	1	1	0
clay-colored sparrow	39	22	5	5	13	1	0	0	0	0	0	0	0	5
eastern kingbird	38	31	4	0	1	1	0	1	2	3	0	6	2	1
white-crowned sparrow	32	2	0	0	0	0	0	0	0	0	0	0	0	0
red-tailed hawk	32	26	0	0	2	0	0	0	0	0	0	1	0	1
American tree sparrow	32	7	0	0	0	0	0	0	8	0	0	0	0	2
northern harrier	31	29	1	0	1	0	0	1	0	0	1	4	2	2
killdeer	28	24	0	0	0	1	0	3	1	0	2	1	1	3
house sparrow	28	21	0	0	0	13	0	0	0	0	0	0	0	0

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			25	26	27	28	29	30	31	32	33	34	35	36
vesper sparrow	25	20	0	4	0	0	0	0	0	0	0	0	4	1
Swainson's hawk	25	23	7	2	0	1	0	0	1	0	0	0	0	0
gray partridge	24	13	0	2	0	2	0	4	3	2	0	2	0	0
barn swallow	23	20	0	0	0	2	0	0	0	0	0	2	1	2
brown thrasher	21	20	0	0	0	4	0	0	1	0	0	0	1	2
American crow	17	8	0	0	0	0	0	0	0	0	0	0	0	0
Brewer's blackbird	16	5	0	0	0	0	0	0	0	0	0	0	0	7
bobolink	16	11	1	0	0	0	0	0	0	0	0	2	0	1
American redstart	15	1	0	0	0	0	0	0	0	0	0	0	0	0
great horned owl	13	9	0	0	0	0	0	0	0	0	0	0	0	0
yellow warbler	11	10	0	0	0	2	0	0	0	0	0	0	0	0
Wilson's snipe	10	10	0	0	1	0	1	0	0	0	0	0	0	0
grasshopper sparrow	10	10	5	1	1	0	0	0	0	0	0	0	0	0
rock pigeon	8	4	0	0	0	0	0	0	0	0	0	0	0	0
marbled godwit	8	5	0	0	0	0	0	0	0	1	0	0	0	0
least flycatcher	8	8	0	0	0	0	0	0	0	0	0	0	1	0
American goldfinch	8	8	0	0	0	1	0	0	0	0	0	0	0	0
chipping sparrow	7	5	0	0	0	0	0	0	0	0	0	0	0	0
ring-billed gull	6	4	0	0	0	0	0	0	3	1	1	0	0	0
gadwall	6	3	0	0	0	0	0	0	0	0	0	2	0	0
northern pintail	5	4	0	1	0	0	0	0	1	0	0	0	0	0
northern flicker	5	5	0	0	0	0	0	0	0	0	0	1	0	0
loggerhead shrike	5	5	0	1	0	0	0	0	0	0	0	0	0	0
American kestrel	5	5	0	0	0	0	0	0	0	0	0	0	0	0
orchard oriole	4	4	0	0	0	0	0	0	0	0	0	0	0	1

Table 4. Avian species observed by point during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			25	26	27	28	29	30	31	32	33	34	35	36
lark sparrow	4	4	1	0	0	0	0	0	0	0	0	0	0	0
unidentified songbird	3	2	0	0	0	0	0	0	0	0	0	0	0	0
common yellowthroat	3	3	0	0	0	0	0	0	0	0	0	0	0	0
blue-winged teal	3	1	0	0	0	0	0	0	0	0	0	0	0	0
warbling vireo	2	2	0	0	0	0	0	0	0	0	0	0	0	0
turkey vulture	2	1	0	0	0	0	0	0	0	0	0	0	0	0
song sparrow	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Say's phoebe	2	2	0	0	0	0	0	0	0	0	0	0	0	0
rough-legged hawk	2	2	0	0	0	0	0	0	0	0	0	0	0	0
lark bunting	2	2	0	0	0	0	0	0	0	0	0	0	0	0
tree swallow	1	1	0	0	0	0	0	0	0	0	0	1	0	0
Swainson’s thrush	1	1	0	0	0	0	0	0	0	0	0	0	0	0
spotted towhee	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Sprague's pipit	1	1	0	0	0	0	0	0	0	0	0	0	0	0
peregrine falcon	1	1	0	0	0	0	0	0	0	0	0	0	0	0
ovenbird	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lincoln’s sparrow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
hairy woodpecker	1	1	0	0	0	0	0	0	0	0	0	0	0	0
cliff swallow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	**4581**	**2083**	**101**	**96**	**100**	**100**	**85**	**91**	**129**	**92**	**73**	**199**	**238**	**105**

Table 5. Summary of avian flight heights (includes flying birds only) in relation to the turbine rotor swept area (RSA)[1] during Spring point count surveys at the Oliver Wind Resource Area, 2008.

	Observations		Individuals	
	Number	**Percentage**	**Number**	**Percentage**
Non-raptors				
Above RSA (>118.5m)	5	0.8%	243	10.9%
Below RSA (<41.5m)	607	97.9%	1974	88.4%
Within RSA (41.5m–118.5m)	8	1.3%	17	0.8%
Raptors/Vultures/Owls				
Above RSA (>118.5m)	5	6.9%	5	6.2%
Below RSA (<41.5m)	50	69.4%	55	67.9%
Within RSA (41.5m–118.5m)	17	23.6%	21	25.9%

[1]These values assume a rotor diameter of 77 (m) and a hub height of 80 (m)

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Wind Resource Area, during Spring 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
red-tailed hawk	0.03	0.07 (0.04 - 0.10)	81.3	38.5	46.2	15.4
common grackle	0.02	0.62 (0.47 - 0.77)	95.1	97.2	2.8	0.0
Swainson's hawk	0.01	0.06 (0.04 - 0.08)	72.0	72.2	27.8	0.0
ring-billed gull	0.00	0.01 (0.00 - 0.02)	83.3	40.0	60.0	0.0
Canada goose	0.00	0.28 (-0.10 - 0.66)	92.4	5.6	1.9	92.6
American crow	0.00	0.04 (0.01 - 0.07)	88.2	80.0	13.3	6.7
mallard	0.00	0.09 (0.05 - 0.13)	56.1	91.3	8.7	0.0
red-winged blackbird	0.00	1.31 (0.16 - 2.46)	92.2	99.8	0.2	0.0
northern harrier	0.00	0.07 (0.05 - 0.09)	93.5	93.1	3.4	3.4
yellow warbler	0.00	0.03 (0.02 - 0.04)	45.5	100.0	0.0	0.0
Wilson's snipe	0.00	0.02 (0.01 - 0.03)	40.0	100.0	0.0	0.0
western meadowlark	0.00	1.78 (1.66 - 1.90)	7.4	100.0	0.0	0.0
western kingbird	0.00	0.09 (0.06 - 0.12)	85.0	100.0	0.0	0.0
white-crowned sparrow	0.00	0.07 (-0.04 - 0.18)	93.8	100.0	0.0	0.0
warbling vireo	0.00	0.00 (-0.01 - 0.01)	0.0	0.0	0.0	0.0
vesper sparrow	0.00	0.06 (0.03 - 0.09)	20.0	100.0	0.0	0.0
upland sandpiper	0.00	0.19 (0.14 - 0.24)	8.4	100.0	0.0	0.0
unidentified songbird	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
turkey vulture	0.00	0.00 (-0.01 - 0.01)	100.0	0.0	100.0	0.0
tree swallow	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
Swainson's thrush	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
sharp-tailed grouse	0.00	0.33 (0.17 - 0.49)	59.0	100.0	0.0	0.0
spotted towhee	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
Sprague's pipit	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
song sparrow	0.00	0.00 (-0.01 - 0.01)	0.0	0.0	0.0	0.0
savannah sparrow	0.00	0.10 (0.06 - 0.14)	29.5	100.0	0.0	0.0

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Wind Resource Area, during Spring 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
Say's phoebe	0.00	0.00 (-0.01 - 0.01)	100.0	100.0	0.0	0.0
sandhill crane	0.00	0.33 (-0.16 - 0.82)	100.0	0.0	0.0	100.0
rock pigeon	0.00	0.02 (0.00 - 0.04)	100.0	100.0	0.0	0.0
ring-necked pheasant	0.00	1.24 (1.10 - 1.38)	1.9	100.0	0.0	0.0
rough-legged hawk	0.00	0.00 (-0.01 - 0.01)	100.0	50.0	50.0	0.0
peregrine falcon	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
ovenbird	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
orchard oriole	0.00	0.01 (0.00 - 0.02)	25.0	100.0	0.0	0.0
northern pintail	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
northern flicker	0.00	0.01 (0.00 - 0.02)	80.0	100.0	0.0	0.0
mourning dove	0.00	0.21 (0.16 - 0.26)	57.8	100.0	0.0	0.0
marbled godwit	0.00	0.02 (0.00 - 0.04)	50.0	100.0	0.0	0.0
loggerhead shrike	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
Lincoln's sparrow	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
least flycatcher	0.00	0.02 (0.01 - 0.03)	37.5	100.0	0.0	0.0
lark sparrow	0.00	0.01 (0.00 - 0.02)	25.0	100.0	0.0	0.0
lark bunting	0.00	0.00 (-0.01 - 0.01)	50.0	100.0	0.0	0.0
killdeer	0.00	0.06 (0.04 - 0.08)	39.3	100.0	0.0	0.0
house sparrow	0.00	0.06 (0.04 - 0.08)	21.4	100.0	0.0	0.0
horned lark	0.00	0.99 (0.88 - 1.10)	17.3	100.0	0.0	0.0
hairy woodpecker	0.00	0.00 (0.00 - 0.00)	0.0	0.0	0.0	0.0
grasshopper sparrow	0.00	0.02 (0.01 - 0.03)	30.0	100.0	0.0	0.0
gray partridge	0.00	0.06 (0.03 - 0.09)	62.5	100.0	0.0	0.0
great horned owl	0.00	0.03 (0.01 - 0.05)	0.0	0.0	0.0	0.0
gadwall	0.00	0.01 (0.00 - 0.02)	0.0	0.0	0.0	0.0
European starling	0.00	0.91 (0.08 - 1.74)	87.2	100.0	0.0	0.0

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Wind Resource Area, during Spring 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
eastern kingbird	0.00	0.09 (0.06 - 0.12)	89.5	100.0	0.0	0.0
common yellowthroat	0.00	0.01 (0.00 - 0.02)	0.0	0.0	0.0	0.0
cliff swallow	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
chipping sparrow	0.00	0.02 (0.01 - 0.03)	0.0	0.0	0.0	0.0
clay-colored sparrow	0.00	0.09 (0.04 - 0.14)	56.4	100.0	0.0	0.0
chestnut-collared longspur	0.00	0.18 (0.12 - 0.24)	17.9	100.0	0.0	0.0
blue-winged teal	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
brown thrasher	0.00	0.05 (0.03 - 0.07)	28.6	100.0	0.0	0.0
Brewer's blackbird	0.00	0.04 (0.01 - 0.07)	87.5	100.0	0.0	0.0
bobolink	0.00	0.04 (0.02 - 0.06)	75.0	100.0	0.0	0.0
brown-headed cowbird	0.00	0.47 (0.38 - 0.56)	91.5	100.0	0.0	0.0
barn swallow	0.00	0.05 (0.03 - 0.07)	100.0	100.0	0.0	0.0
American tree sparrow	0.00	0.07 (0.01 - 0.13)	93.8	100.0	0.0	0.0
American robin	0.00	0.12 (0.08 - 0.16)	65.4	100.0	0.0	0.0
American redstart	0.00	0.03 (-0.03 - 0.09)	100.0	100.0	0.0	0.0
American kestrel	0.00	0.01 (0.00 - 0.02)	80.0	100.0	0.0	0.0
American goldfinch	0.00	0.02 (0.01 - 0.03)	25.0	0.0	0.0	0.0

[1]These values assume a rotor diameter of 77 (m) and a hub height of 80 (m)

Table 7. Incidental observations of birds during Spring point counts at the Oliver Wind Resource Area, 2008.

Species	Number of individuals
cliff swallow	620
Canada goose	542
blue-winged teal	273
red-winged blackbird	255
sandhill crane	250
mallard	191
Brewer's blackbird	175
northern pintail	169
clay-colored sparrow	127
northern shoveler	76
common grackle	75
double-crested cormorant	72
gadwall	54
American white pelican	48
American coot	48
green-winged teal	47
Lapland longspur	40
marbled godwit	34
red-tailed hawk	31
European starling	30
gray partridge	29
northern harrier	27
sharp-tailed grouse	26
Swainson’s hawk	24
American wigeon	24
lark sparrow	23
savannah sparrow	22
mourning dove	21
upland sandpiper	19
white-crowned sparrow	14
redhead	12
Wilson's phalarope	11
canvasback	11
vesper sparrow	10
yellow-headed blackbird	9
willet	9
marsh wren	9
stilt sandpiper	8
loggerhead shrike	8
great horned owl	8
bank swallow	8

Table 7. Incidental observations of birds during Spring point counts at the Oliver Wind Resource Area, 2008.

Species	Number of individuals
white-rumped sandpiper	7
sora	7
ruddy duck	7
long-billed dowitcher	7
brown thrasher	7
tree swallow	6
rough-legged hawk	6
least flycatcher	6
Harris' sparrow	6
yellow-rumped warbler	5
Sprague's pipit	5
ring-necked duck	5
lesser scaup	5
least sandpiper	5
common yellowthroat	5
American kestrel	5
Wilson's snipe	4
ring-billed gull	4
lesser yellowlegs	4
great blue heron	4
barn swallow	4
yellow warbler	3
turkey vulture	3
spotted sandpiper	3
Say's phoebe	3
orchard oriole	3
northern flicker	3
eared grebe	3
Virginia rail	2
song sparrow	2
solitary sandpiper	2
pied-billed grebe	2
merlin	2
lark bunting	2
hooded merganser	2
grasshopper sparrow	2
dark-eyed junco	2
bufflehead	2
black tern	2
American goldfinch	2
	2

Table 7. Incidental observations of birds during Spring point counts at the Oliver Wind Resource Area, 2008.

Species	Number of individuals
yellow-bellied sapsucker	1
white-throated sparrow	1
willow flycatcher	1
pectoral sandpiper	1
orange-crowned warbler	1
northern rough-winged swallow	1
Nashville warbler	1
Lincoln's sparrow	1
house wren	1
green honeycreeper	1
gray-cheeked thrush	1
Forster's tern	1
ferruginous hawk	1
eastern kingbird	1
downy woodpecker	1
chipping sparrow	1
chestnut-collared longspur	1
Caspian tern	1
broad-winged hawk	1
black-crowned night-heron	1
Baird's sandpiper	1
American tree sparrow	1
Grand Total	**3672**

Table 8. Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Duration of Survey (minutes)	Plot Radius	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann				
Altamont Pass, CA	3.80	3.00	4.60	3.00							10	800m	Orloff and Flannery (1992)	x 2
Cotterel Mountain, ID	1.69	1.89	1.49	0.18		14.26	11.22	7.65	8.86		20	800m	USDI, BLM (2005)	
Hoctor Ridge, WA	1.42	1.33				10.00	17.92				20	800m	Johnson et al. (2006b)	
Lower Linden Ranch, WA	1.37										20	800m	Johnson et al. (2007d)	
Kittitas Valley, WA	1.01	1.03	0.73								20	800m	Erickson et al. (2003b)	
Klickitat County PEIS study area, WA	0.96	1.12									20	800m	Johnson et al. (2006)	
Columbia Hills, WA	0.94	1.34	0.78	0.26							20	800m	Erickson et al. (2002)	
Combine study of: Kittitas Valley; Desert Claim; Wild Horse, WA	0.89	0.85	0.76	0.51	0.75	11.72	8.18	7.99	15.64	10.88	20	800m	Young et al. (2003)	0
Buffalo Ridge Phase II, MN	0.84	0.69	0.83	0.10							20	800m	Erickson et al. (2002)	
Elkhorn, OR	0.81	1.56	0.79			29.43	12.15	20.36			20	800m	WEST (2005b)	
Combine Hills, OR	0.80	0.56	0.44	0.64		5.96	2.63	1.34	2.68		30	800m	Young et al. (2002b)	x 0.67

Table 8. Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Duration of Survey (minutes)	Plot Radius	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann				
Windy Point, WA	0.79			0.77		16.41			13.55		20	800m	Johnson et al. (2006a)	
Windy Flats, WA	0.77	0.88	0.82	0.86		21.51	13.96	16.03	24.56		20	800m	Johnson et al. (2007b)	
Hatchet Ridge, CA	0.70	1.03	0.91	0.12	0.69					5.65	30	800m	Young et al. (2007b)	x0.67
Buffalo Ridge, MN	0.68	0.52	0.69	0.44							20	800m	Erickson et al. (2002)	
Buffalo Ridge Phase I, MN	0.65	0.43	0.76	0.13							20	800m	Erickson et al. (2002)	
Buffalo Ridge Phase III, MN	0.64	0.54	0.85	0.18							20	800m	Erickson et al. (2002)	
Stateline Wind EIS, OR/WA	0.59	0.40	0.25	0.42		7.09	5.47	29.34	9.04		20	800m	URS and West (2001)	
Foote Creek WEC, WY	0.49	0.76	0.97	0.21							40	800m	Johnson et al. (2000)	x 0.5
Klondike Phase I, OR	0.47	0.39	0.38	0.56							20	800m	Erickson et al. (2002)	
White Creek, WA	0.46	0.87	0.56	0.38		9.91	9.10	15.24	11.01		20	800m	Kronner et al. (2005b)	
Wild Horse, WA	0.46	0.46	0.31	0.14		5.78	5.78	4.02	3.59		30	800m	Erickson et al. (2003)	x 0.67
Shepherds Flat, OR	0.44	0.49	0.55	0.32		8.98	14.71	5.22	3.97		20	800m	Welch and Schleder (2006)	
Bighorn Site, WA	0.40	0.44				9.72	10.04				20	800m	Johnson and Erickson (2004)	

Table 8. Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Duration of Survey (minutes)	Plot Radius	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann				
Leaning Juniper, OR	0.39	1.07	0.53	0.24		11.36	5.68	19.09	47.00		20	800m	Kronner et al. (2005)	
Biglow Canyon WRA, OR	0.37	0.34	0.11	0.25		6.76	5.09	6.71	17.07		30	800m	WEST (2005)	x 0.67
Nine Canyon, WA	0.35	0.20	0.16	0.31							20	800m	Erickson et al. (2002)	
Sand Ridge, WA	0.34	0.46				6.19	5.21				20	800m	Johnson et al. (2007c)	
Biglow Canyon project area, OR	0.31	0.39	0.19	0.32		10.17	3.34	7.18	11.66		30	800m	WEST (2005a)	x 0.67
Maiden, WA	0.30	0.35	0.62	0.15		4.58	4.71	11.93	8.58		30	800m	Young et al. (2002)	x 0.67
Vantage, WA	0.29	0.40	0.14	0.15		10.57	8.83	3.70	4.90		20	800m	Jefferey et al. (2007)	
Stateline Wind, OR/WA	0.28	0.26	0.16	0.02	0.22					23.08	10	800m	Erickson et al. (2004)	x 2
Oliver Expansion, ND	**0.26**					**10.35**					**20**	**800m**	**This study**	
Zintel Canyon, WA	0.19	0.30	0.70	0.51							20	800m	Erickson et al. (2002)	
Dry Lake, AZ	0.08	0.14	0.21	0.14	0.15	8.10	11.02	16.10	18.00	13.52	30	800m	Young et al. (2007)	x0.67
High Winds, CA					6.72					474[a]	20	800m	Kerlinger et al. (2005)	

[a] Mostly unidentified blackbirds.

[b] Multiplication factor to standardize mean use to birds/20 min.

APPENDICES

Appendix 1. Flight directions of birds observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
red-winged blackbird	518	88	15.8	1.4	6.6	0.6	6.6	0.6	65.4	1.2	1.9
European starling	341	18	2.1	58.9	30.5	0.0	4.4	3.5	0.3	0.3	0.0
common grackle	252	75	21.0	0.4	26.2	0.4	11.9	11.5	28.6	0.0	0.0
brown-headed cowbird	184	84	23.9	1.6	19.0	1.6	28.8	0.0	22.3	1.6	1.1
sandhill crane	142	3	80.3	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canada goose	108	5	94.4	0.0	0.0	1.9	0.0	0.0	1.9	0.0	1.9
sharp-tailed grouse	84	22	13.1	2.4	16.7	0.0	46.4	0.0	20.2	1.2	0.0
horned lark	71	33	35.2	2.8	21.1	0.0	21.1	0.0	19.7	0.0	0.0
western meadowlark	57	36	15.8	1.8	12.3	0.0	26.3	0.0	40.4	3.5	0.0
mourning dove	52	26	23.1	0.0	21.2	5.8	21.2	0.0	17.3	11.5	0.0
western kingbird	34	23	32.4	0.0	11.8	0.0	23.5	0.0	8.8	0.0	23.5
eastern kingbird	34	28	17.6	0.0	20.6	0.0	5.9	0.0	17.6	0.0	38.2
American robin	34	20	26.5	0.0	29.4	0.0	26.5	0.0	11.8	0.0	5.9
white-crowned sparrow	30	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American tree sparrow	30	5	26.7	0.0	0.0	0.0	33.3	0.0	40.0	0.0	0.0
northern harrier	29	28	31.0	6.9	3.4	3.4	13.8	6.9	31.0	3.4	0.0
red-tailed hawk	26	21	23.1	3.8	0.0	3.8	23.1	7.7	15.4	3.8	19.2
mallard	23	12	4.3	4.3	17.4	8.7	17.4	13.0	34.8	0.0	0.0
barn swallow	23	20	26.1	4.3	13.0	4.3	30.4	0.0	13.0	0.0	8.7
clay-colored sparrow	22	8	50.0	0.0	22.7	0.0	13.6	0.0	13.6	0.0	0.0
Swainson’s hawk	18	16	0.0	0.0	5.6	0.0	16.7	11.1	33.3	22.2	11.1
gray partridge	15	8	0.0	0.0	13.3	0.0	60.0	0.0	13.3	13.3	0.0

Appendix 1. Flight directions of birds observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
American redstart	15	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
American crow	15	6	26.7	0.0	0.0	0.0	13.3	6.7	0.0	53.3	0.0
Brewer's blackbird	14	4	57.1	0.0	28.6	0.0	0.0	0.0	14.3	0.0	0.0
savannah sparrow	13	8	0.0	0.0	7.7	0.0	23.1	0.0	69.2	0.0	0.0
bobolink	12	7	8.3	0.0	0.0	0.0	16.7	0.0	33.3	0.0	41.7
ring-necked pheasant	10	6	70.0	0.0	0.0	0.0	20.0	0.0	10.0	0.0	0.0
chestnut-collared longspur	10	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
killdeer	9	6	11.1	0.0	66.7	0.0	22.2	0.0	0.0	0.0	0.0
rock pigeon	8	4	62.5	25.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0
upland sandpiper	6	4	33.3	0.0	16.7	33.3	0.0	0.0	16.7	0.0	0.0
house sparrow	6	4	0.0	0.0	66.7	0.0	33.3	0.0	0.0	0.0	0.0
brown thrasher	6	6	16.7	0.0	33.3	16.7	33.3	0.0	0.0	0.0	0.0
vesper sparrow	5	3	80.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0
ring-billed gull	5	3	40.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0
northern pintail	5	4	20.0	0.0	60.0	0.0	20.0	0.0	0.0	0.0	0.0
loggerhead shrike	5	5	20.0	0.0	20.0	0.0	40.0	0.0	20.0	0.0	0.0
yellow warbler	4	3	0.0	0.0	50.0	0.0	25.0	0.0	25.0	0.0	0.0
northern flicker	4	4	25.0	0.0	25.0	0.0	50.0	0.0	0.0	0.0	0.0
marbled godwit	4	2	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	75.0
American kestrel	4	4	25.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	0.0
unidentified songbird	3	2	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	66.7
least flycatcher	3	3	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0

Appendix 1. Flight directions of birds observed during Spring point count surveys at the Oliver Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
grasshopper sparrow	3	3	0.0	0.0	66.7	0.0	0.0	33.3	0.0	0.0	0.0
blue-winged teal	3	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
turkey vulture	2	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Say's phoebe	2	2	50.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
rough-legged hawk	2	2	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
Wilson's snipe	1	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
tree swallow	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
orchard oriole	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Lincoln’s sparrow	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
lark sparrow	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
lark bunting	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
cliff swallow	1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Grand Total	**2312**	**689**	**25.8**	**10.9**	**15.9**	**0.9**	**13.2**	**2.4**	**26.3**	**1.6**	**2.9**

Appendix 2: Raptor nests observed at the Oliver Wind Resource Area, 2008.

Nest Number	Dates Surveyed	Species	Status	Substrate	Nest Height (m)	Nest Condition
1	5/6/2008 5/13/2008	NA	Inactive	TREE	1	Good
2	5/14/2008 5/16/2008	red-tailed hawk	Active	TREE	2	Good
3	4/22/2008 5/10/2008	NA	Inactive	TREE	3	Good
4	4/29/2008 5/5/2008	NA	Inactive	TREE	4	Unknown
5	4/10/2008 4/18/2008	great horned owl	Active	TREE	5	Good
6	5/5/2008 4/9/2008	red-tailed hawk	Active	TREE	6	Good
7	5/6/2008 5/8/2008	red-tailed hawk	Active	TREE	7	Excellent
8	5/6/2008 5/10/2008	NA	Inactive	TREE	8	Poor
10	4/22/2008 5/5/2008	great horned owl	Active	RUSSIAN	10	Excellent
11	5/9/2008 5/12/2008	great horned owl	Active	TREE	11	Good
14	4/10/2008 4/24/2008	NA	Inactive	TREE	14	Good
15	4/28/2008 5/5/2008	NA	Inactive	TREE	15	Good
18	5/1/2008 5/5/2008	NA	Inactive	TREE	18	Good

Appendix 2: Raptor nests observed at the Oliver Wind Resource Area, 2008.

Nest Number	Dates Surveyed	Species	Status	Substrate	Nest Height (m)	Nest Condition
19	5/1/2008 5/6/2008	NA	Inactive	TREE	19	Good
20	5/5/2008 5/14/2008	NA	Inactive	TREE	20	Remnant
21	5/5/2008 5/7/2008	red-tailed hawk	Active	TREE	21	Good
22	5/5/2008 5/17/2008	great horned owl	Active	TREE	22	Excellent
23	5/6/2008 5/8/2008	Swainson's hawk	Active	TREE	23	Excellent
24	5/6/2008 5/13/2008	great horned owl	Active	TREE	24	Excellent
25	5/7/2008 5/15/2008	red-tailed hawk	Active	TREE	25	Excellent
26	5/7/2008 5/13/2008	red-tailed hawk	Active	TREE	26	Good
27	5/7/2008 5/12/2008	Swainson's hawk	Active	TREE	27	Good
28	5/16/2008 5/20/2008	red-tailed hawk	Active	TREE	28	Good

Appendix 3 Grouse surveys at the Oliver Wind Resource Area, 2008.

Lek Number	Survey #	Survey date	Survey time	Species	Status	# Total	# Males	# Females	# Unknown*
1									
	1	4/1/2008	0722	sharp-tailed grouse	Active	20	20	0	0
	2	4/17/2008	0700	sharp-tailed grouse	Active	26	0	0	26
	3	4/25/2008	0654	sharp-tailed grouse	Active	20	0	0	20
	4	5/9/2008	0840	sharp-tailed grouse	Active	25	0	0	25
2									
	1	4/1/2008	0730	sharp-tailed grouse	Active	2	0	0	2
	2	4/17/2008	0706	sharp-tailed grouse	Inactive	0	0	0	0
3									
	1	4/1/2008	0730	sharp-tailed grouse	Active	2	0	0	2
	2	4/4/2008	0700	sharp-tailed grouse	Inactive	0	0	0	0
4									
	1	4/1/2008	0830	sharp-tailed grouse	Active	5	5	0	0
	2	4/10/2008	0800	sharp-tailed grouse	Active	7	0	0	7
5									
	1	4/2/2008	0700	sharp-tailed grouse	Active	8	8	0	0
	2	4/10/2008	0820	sharp-tailed grouse	Active	8	5	0	3
6									
	1	4/2/2008	0735	sharp-tailed grouse	Active	2	0	0	2
	2	4/17/2008	0730	sharp-tailed grouse	Active	4	4	0	0
	3	5/9/2008	0905	sharp-tailed grouse	Active	10	0	0	10
7									
	1	4/3/2008	0740	sharp-tailed grouse	Active	5	5	0	-
	2	4/10/2008	0700	sharp-tailed grouse	Active	10	0	0	10
8									
	1	4/18/2008	0712	sharp-tailed grouse	Active	11	6	5	0
	2	4/25/2008	0820	sharp-tailed grouse	Active	12	0	0	12
12									
	1	4/25/2008	0736	sharp-tailed grouse	Active	2	2	0	-
	2	5/9/2008	0925	sharp-tailed grouse	Active	5	0	0	5
13									
	1	4/25/2008	0850	sharp-tailed grouse	Active	8	0	0	8
	2	4/28/2008	0730	sharp-tailed grouse	Active	4	0	0	4

Appendix 3 Grouse surveys at the Oliver Wind Resource Area, 2008.

Lek Number	Survey #	Survey date	Survey time	Species	Status	# Total	# Males	# Females	# Unknown*
14									
	1	4/28/2008	0800	sharp-tailed grouse	Active	9	3	0	6
	2	5/6/2008	0950	sharp-tailed grouse	Active	9	0	0	9
	3	5/7/2008	0800	sharp-tailed grouse	Active	7	0	0	7
15									
	1	4/29/2008	0700	sharp-tailed grouse	Active	8	2	2	4
	2	5/7/2008	0715	sharp-tailed grouse	Active	9	0	0	9
16									
	1	4/29/2008	0845	sharp-tailed grouse	Active	10	5	5	0
	2	5/7/2008	0820	sharp-tailed grouse	Active	10	0	0	10
17									
	1	5/5/2008	0730	sharp-tailed grouse	Active	8	3	0	5
	2	5/10/2008	0800	sharp-tailed grouse	Active	7	0	0	7
18									
	1	5/6/2008	0825	sharp-tailed grouse	Active	25	0	0	25
	2	5/9/2008	0800	sharp-tailed grouse	Active	24	0	0	24

*A - indicates the presence of an unknown number of birds

2008 Fall Avian Survey

Oliver Expansion Wind Resource Area
Phases III, IV, and V
Oliver and Morton Counties, North Dakota

Prepared for

FPL Energy, LLC

December 2008

TETRA TECH EC, INC.

EXECUTIVE SUMMARY

Tetra Tech EC, Inc. (Tetra Tech) was contracted by FPL Energy, LLC (FPL Energy) to undertake fall avian use surveys for the proposed Oliver Expansion (Phases III, IV, and V) Wind Resource Area (WRA) in Oliver and Morton Counties, North Dakota. The studies were conducted to identify potential avian impacts associated with building and operating the wind conversion facility. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines, as well as displacement due to the presence of the associated structures. Weekly surveys were performed at the Oliver Expansion WRA between August 14 and November 4, 2008, which included the late-summer through mid-fall seasons. Fixed point count surveys (800-meter [m] radius) were conducted at 36 points distributed throughout the Oliver Expansion WRA.

A total of 59 identified species consisting of 4,806 birds were observed within the Oliver Expansion WRA. Overall mean bird use within the Oliver Expansion WRA was 10.27 birds/20 minutes (min) and ranged from 0 to 409 birds per 20-min point count. Comparing bird use rates in fall from existing wind energy facilities throughout the country with publicly available data, the Oliver Expansion WRA ranked 11th out of 21 surveys for non-raptor use and 21st out of 31 surveys for raptor use. Mean use for non-raptors very similar in the spring (10.35 birds/20 min) as in the fall (9.78 birds/20 min; Figure ES-1a); in contrast, mean use for raptors was nearly twice as high in the fall (0.49 birds/20min) as it was in the spring (0.26 birds/20 min; Figure ES-1b).

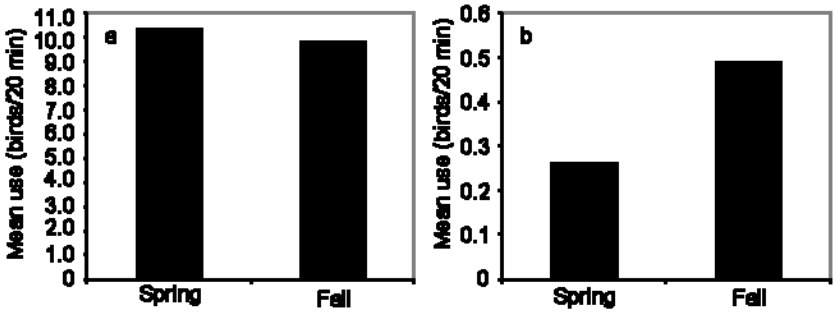

Figure ES-1. Mean raptor and non-raptor use by season.

Songbirds had the highest mean use out of all species groups observed (8.28 birds/20 min). The most commonly observed species were the European starling (1.63 birds/20 min), Brewer's blackbird (1.18 birds/20 min), and horned lark (0.91 birds/20 min). The European starling is a widespread non-native species and has a relatively stable population; as a result, local mortality may not have population-level consequences. The European starling is considered a pest species and not protected under the Migratory Bird Treaty Act. In contrast, the Brewer's blackbird is concentrated in the western portion of the United States; however, this species also has a relatively stable population and local mortality may not have population-level consequences (Sauer et al. 2008). The horned lark is the most common species found dead at wind farms, and the population is declining in the United States and North Dakota; however, local mortality may not have population-level consequences.

Red-tailed hawks were the most commonly observed raptor in the Oliver Expansion WRA (0.23 birds/20 min). Red-tailed hawks are vulnerable to mortality from turbine collisions. The relatively low mean use of red-tailed hawks within the WRA coupled with a stable to increasing population makes it unlikely that mortality of red-tailed hawks will have population-level impacts.

During both spring and fall surveys, songbirds had the highest mean use of all species groups, followed by game birds; waterfowl ranked third in the spring and raptors ranked third in the fall (Table ES-1).

Table ES-1. Summary of mean use by avian group and season

Group	Spring	Fall
Crows & allies	0.04	0.02
Cranes/Rails	0.33	0
Game birds	1.63	0.68
Gulls/Terns	0.01	0.02
Pigeons/Doves	0.23	0.45
Raptors	0.26	0.49
Shorebirds	0.30	0.06
Songbirds	7.40	8.28
Waterfowl	0.40	0.22
Woodpeckers	0.01	0.04

Listed and Sensitive Species

There were no federally listed species observed during the fall 2008 point count surveys in the Oliver Expansion WRA. However, all native and migratory birds are protected under the Migratory Bird Treaty Act. North Dakota does not have a state list of threatened and endangered species; however, it lists 100 Species of Conservation Priority. These species are ranked in three priority levels, Level I being the most in need of conservation efforts, based on such factors as known status, funding availability, and presence of breeding habitat within North Dakota. There were thirteen of these species observed during the point count surveys. The chestnut-collared longspur (Level I), grasshopper sparrow (Level I), Franklin's gull (Level I), Sprague's pipit (Level I), Swainson's hawk (Level I), ferruginous hawk (Level I), upland sandpiper (Level I), bobolink (Level II), loggerhead shrike (Level II), northern harrier (Level II), prairie falcon (Level II), short-eared owl (Level II), and sharp-tailed grouse (Level II) were all observed during surveys.

A total of four sandhill crane surveys were conducted at weekly intervals from October 16 to November 6, 2004 within the Oliver Expansion WRA. There were no sandhill or whooping cranes observed during these surveys.

Table ES-2. Fall avian use summary

Variable	Result	Details
Non-raptors		
Mean use	9.78 birds/20 min	Rank: 11th out of 21 studies (Table 8)
Number of species with high encounter rates (>1.0 birds/20 min)	Two	European starling and Brewer's blackbird
Federally listed[1] species observed within the WRA	No	
State-listed species[2] within the WRA	Yes	Sharp-tailed grouse, chestnut-collared longspur, grasshopper sparrow, Franklin's gull, upland sandpiper, bobolink, Sprague's pipit, and loggerhead shrike. (Section 4.3)
State-listed species within RSA	No	
Raptors		
Mean use	0.49 birds/20 min	Rank: 21st out of 31 studies (Table 8)
Number of species with high encounter rates (>1.0 birds/20 min)	None	
Eagles observed within the WRA	No	
Federally listed species observed within the WRA	No	
State-listed species within the WRA	Yes	Swainson's hawk, northern harrier, prairie falcon, short-eared owl, and ferruginous hawk (Section 4.3)
State-listed species within the RSA	Yes	Swainson's hawk
Habitat		
Native habitat likely to be affected by development	Yes	Native prairie
Lakes (waterfowl attractant)	Yes	Multiple
Wetlands (attractant for cranes, waterfowl, and other water-based species)	Yes	Prairie pothole wetlands
Cliffs (raptor nesting and traveling)	No	
River (permanent water source, migration corridor)	No	
Known refuges or habitat features that may funnel migrants	No	

[1]Federally listed species include threatened, endangered, or candidate species designations.

[2]State-listed species include threatened, endangered, candidate, species of concern, and species of conservation concern designations. State species listed are those in addition to federally listed species.

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1.0 INTRODUCTION

FPL Energy, LLC (FPL Energy) is planning to develop a wind energy conversion facility in central North Dakota in Oliver and Morton Counties. The Oliver Expansion (Phases III, IV, and V) Wind Resource Area (WRA) is located on private and state-owned land (Figure 1). FPL Energy is committed to environmental due diligence and has contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct a fall avian migration survey at the Oliver Expansion WRA to quantify local avian use in the area and to identify potential avian impacts associated with building and operating the proposed facility.

Based on the latest project boundary dated October 10, 2008, the Oliver Expansion WRA is approximately 188,000 acres and is located in the Northwestern Great Plains ecoregion. Landscape types within this ecoregion include western mixed-grass/short-grass prairie, planted or tame grassland, upland deciduous forest, and associated wetlands. Land use within the rural WRA consists primarily of farming, livestock grazing, and related agricultural operations. Residences and abandoned farmsteads are scattered throughout the WRA. The area also contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Patches of trees and shrubs exist throughout the WRA, located primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

Wind energy provides a clean, renewable energy source that is in high demand. As wind power has become more common, the need to address potential environmental impacts has increased. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines, as well as displacement due to the presence of the associated structures (Erickson et al. 2005, Drewitt and Langston 2006, Arnett et al. 2007). Specifically, migrant passerines (e.g., songbirds) are found more often in post-construction mortality monitoring compared to other groups of birds (Erickson et al. 2001, Drewitt and Langston 2006, Johnson et al. 2007a, Strickland and Morrison 2008).

North Dakota has 353 documented bird species and is situated within the Central Flyway, one of the main bird migratory routes (USFWS 2008). The Central Flyway runs through the central portion of the United States and, consequently, the Oliver Expansion WRA. Most birds move along the Central Flyway from Canada through the central states, eventually reaching the Gulf of Mexico before migrating south to Central or South America (USFWS 2008).

Figure 1
FPL Energy
Oliver Expansion
Wind Resource Area
Location Map
Oliver and Morton Counties, North Dakota
December 08, 2008

Phases III, IV, and V[1]

County Boundary

Stream

Intermittent Stream

Water Body

Transportation

Interstate

US Highway

State Highway

[1]Project Boundary - 10/10/08

TtEC GIS Technician: Eric Lubell

FPL Energy

1:500,000

NAD 83 UTM 14

Miles

0 2.5 5 10

TETRA TECH EC,INC

Lake Sakakawea
Fort Stevenson State Park
Audubon Lake
McLean County
Sheridan County
Mercer County
Dunn County
Beulah
Spring Creek
Knife River
Turtle Creek
Painted Woods Creek
Deep Creek
Elm Creek
Coyote Creek
Otter Creek
Oliver County
Square Butte Creek
West Branch Apple Creek
East Branch Apple Creek
Burleigh County
Haymarsh Creek
Sweetbrier Creek
Stark County
Heart River
Government Creek
Big Muddy Creek
Heart Butte Creek
Morton County
Bismarck
Apple Creek
Random Creek
Little Heart River
Grant County
Thirtymile Creek
Hettinger County
Antelope Creek
Lake Oahe
Emmons County

P:\GIS_PROJECTS\FPL\Oliver\maps\Avian_Survey\2008_Survey_Reports\Fall_2008\FPL_Oliver_Figure1_WRA_Location_Map_120208.mxd - Last Accessed: 12/8/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

2.0 METHODS

To evaluate avian risk at wind energy facilities, standardized protocols for pre-construction point counts have been established and were used during this study. Data collected from these counts can then be used to identify species or species groups of concern and may provide additional information for micro-siting to minimize impacts to birds. To facilitate identifying species at risk, results in this report are presented in terms of species groupings, and highlight federally listed species, state-listed species, and species of concern.

2.1 Diurnal Fixed-point and Incidental Avian Use Surveys

Fixed-point Surveys

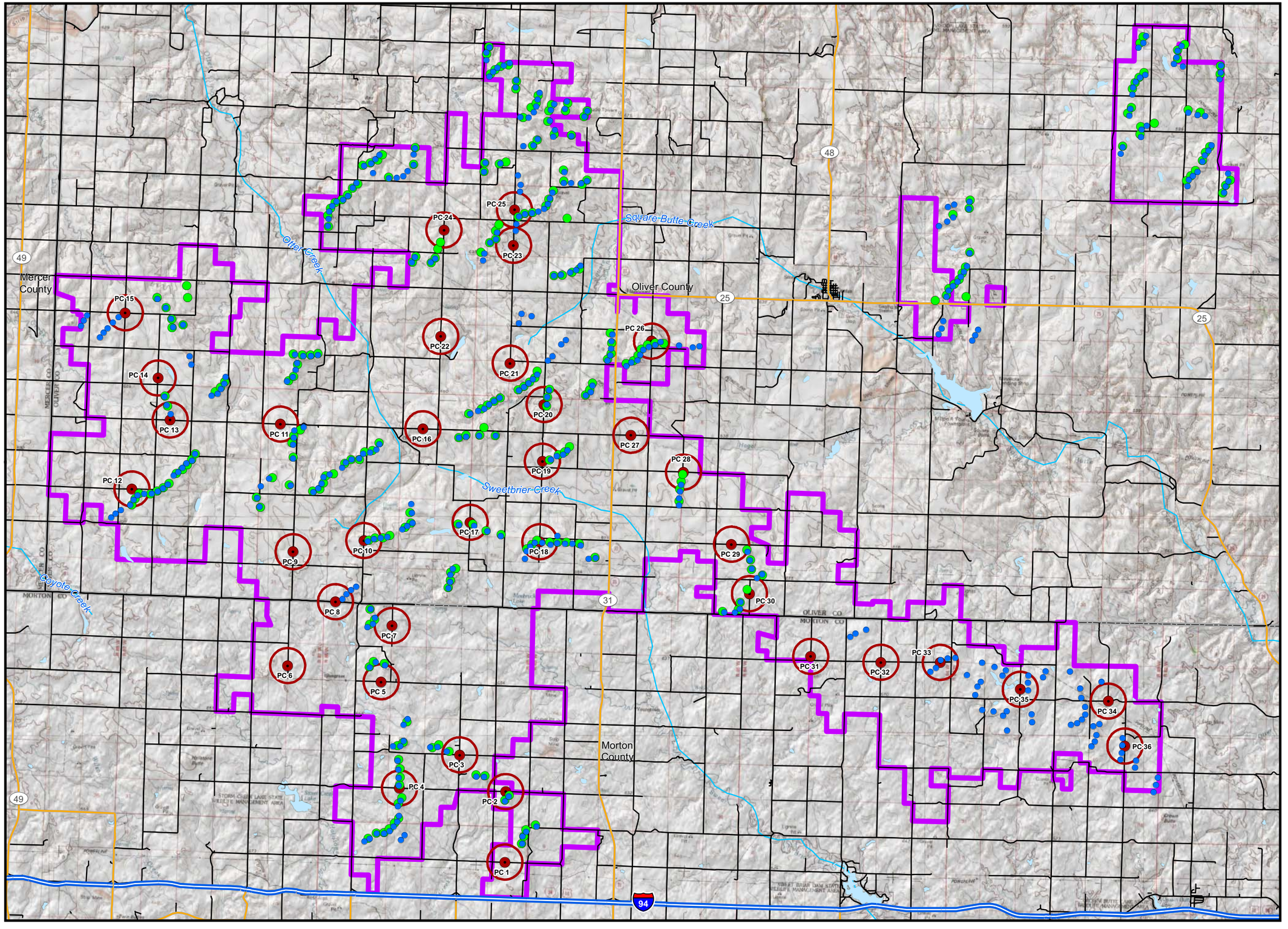
Experienced field biologists (ornithologists) conducted 20-minute (min) point count surveys at 36 locations within the Oliver Expansion WRA to evaluate avian use, behavior, and species composition during fall migration (Figure 2). These point count locations were the same as those surveyed during spring 2008. Survey dates encompass the late-summer through mid-fall migration season; biologists conducted weekly surveys from August 14 to November 4 (Table 1). Tetra Tech distributed the survey locations throughout the WRA and chose locations that maximized the 360-degree sight distance for the observer and covered a diversity of habitats.

Ornithologists collected data on all birds observed within an 800-meter (m) radius circle centered on the point count location. The ornithologists also recorded incidental observations, such as birds detected outside of the 800-m radius or while the observer was moving between point count locations. Surveys at each point lasted for 20 minutes, during which time the biologist continuously scanned for birds and recorded any visual or auditory observations. Biologists collected the following data: species, number of individuals, time, height aboveground, behavior, and flight direction. Data on flight direction can be found in Appendix 1. The biologists estimated flight heights and distances using existing meteorological towers, local transmission lines, and topographic maps for reference.

The survey protocol used in this study is designed to collect data on all bird species and to provide results that are comparable with other studies of avian use at wind farms rather than to target specific taxa. The benefit of using this method is that it estimates avian use throughout the day and captures activity by a variety of bird species. During the breeding season, and to a lesser extent during fall and winter, songbirds are most active in the morning and can be difficult to detect during the afternoon. In contrast, raptors become active as the sunlight heats the air and creates thermals, which individuals use for soaring (Ballam 1984). Thus, raptors are more readily detected several hours after sunrise. Therefore, the survey method used in this study is appropriate for characterizing the bird community using the WRA during this time of year.

Figure 2
FPL Energy
Oliver Expansion
Point Count Location Map

Oliver and Morton Counties, North Dakota
December 08, 2008



- Proposed GEsle Turbine[1]
- Proposed Siemens Turbine[2]
- Avian Survey Point
- Survey Point - 800m buffer

Oliver Expansion

- Phases III, IV, and V[3]
- County Boundary
- Stream
- Intermittent Stream
- Water Body

Transportation

- Interstate
- Major Road
- Other Road

[1]400 Turbines - 8/13/08
[2]261 Turbines - 8/13/08
[3]Project Boundary - 10/10/08

TtEC GIS Technician: Eric Lubell

FPL Energy

1:165,000
NAD 83 UTM 14

Miles
0 0.75 1.5 3

TETRA TECH EC,INC

P:\GIS_PROJECTS\FPL\Oliver\maps\Avian_Survey\2008_Survey_Reports\Fall_2008\FPL_Oliver_Figure2_Point_Count_Location_Map_120208.mxd - Last Accessed: 12/8/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

Tetra Tech chose 20-min survey periods because they provide adequate time to detect both raptors and non-raptors. However, time periods of 20 min may lead to double-counting of songbirds (i.e., counting the same individual more than once) because individuals may appear and disappear from view. For example, if a horned lark is detected perched on a fence then disappears from view and, 6 minutes later, a horned lark is seen flying, these birds are recorded as separate observations because it is not possible to distinguish individuals. Double-counting of birds is not problematic for this type of survey because the objective is to document use in terms of number of birds noted per 20-min survey, not number of distinct individual birds.

Detectability varies among species and potentially not all individuals within the 800-m survey were counted. This variation in detectability results in an overestimate of mean use in conspicuous species and an underestimate of mean use in reclusive species (Thompson 2002). Birds not easily identifiable, such as those seen under low light conditions or small birds seen at a distance, were identified to the lowest taxonomic level possible. Hence, unidentified birds are included in the results.

Incidental Observations

Incidental observations included observations that occurred 1) during travel between points, 2) before or after the official 20-min survey period, and 3) outside of the 800-m radius circular plot. Biologists recorded these observations on separate data sheets and these data were not used in the formal analysis; however, a summary of incidental birds is presented to provide additional information about species found in the local area.

Data Quality Assurance/Quality Control

Tetra Tech implemented quality assurance and quality control measures during all stages of data collection, analysis, and report preparation. To ensure legibility and completeness of data sheets, each biologist reviewed, and clarified if needed, all data sheets before data entry into a Filemaker™ relational database for data storage and analysis. Prior to analysis, an independent reviewer conducted a 100-percent quality review of the data entries. Any questions that arose at this time were directed toward and answered by field personnel.

2.2 Analysis

Species Groupings

Tetra Tech considered two primary groups of interest: raptors and non-raptors. Tetra Tech defined raptors as vultures, hawks, eagles, falcons, and owls. As turkey vulture flight behavior is similar to raptors and as they are often included as raptors in other studies, Tetra Tech has included them with raptors for the purpose of our analyses. Non-raptors were defined as all other species groups.

Avian Use of the Oliver Expansion WRA

Tetra Tech derived avian use (mean use) of the Oliver Expansion WRA by calculating the average number of birds observed per 20-min survey at each point. To evaluate the

diversity and composition of avian species using the Oliver Expansion WRA, Tetra Tech first summarized the number of individuals (birds/20 min) and species. Tetra Tech also calculated a measure of variability (90 percent confidence intervals) for all mean use values. In addition, the number of observations (observations/20 min) is also presented, where an observation can be either an individual bird or a discrete flock of birds. This information helps evaluate whether high mean use is driven by a single event (e.g., flock of birds moving through the rotor swept area). Because individual birds are not uniquely marked and identified, actual population size or abundance cannot be determined. One individual may be counted multiple times during a survey period or across survey periods. Therefore, avian use does not equate to abundance.

Flight Behavior

Tetra Tech evaluated flight behavior by calculating the proportion of flying birds observed below, within, or above the turbine rotor swept area (RSA). The turbine type proposed for this site is the GE 1.5 MW sle. Therefore, Tetra Tech used an RSA between 41.5 and 118.5 meters above ground. Tetra Tech considered a bird to have flown within the RSA if any of its recorded heights overlapped the RSA.

Encounter Rate

To estimate the rate at which a species flew through the anticipated RSA, Tetra Tech applied the following equation to every species observed in the WRA:

$$Encounter\ Rate = A*P_f*P_t$$

where A is the mean number of birds/20 min for a given species, P_f is the proportion of all activity observations for a given species that were flying; and P_t is the proportion flying observations that were within the turbine RSA for a given species. The encounter rate provides information on the rate at which a species moves through the RSA. This information is an important component in evaluating risk; however, this number alone does not indicate risk to a species.

Encounter rate is an index of birds flying within the RSA and may not equate to actual post-construction mortality. Species with a high encounter rate are at a higher risk of collision than species with a low encounter rate, but it does not mean that mortality is certain. Other factors such as a species' ability to detect turbine blades, flight maneuverability to avoid blades, and habitat selection also influence mortality; therefore, actual mortality may be higher or lower than indicated by the encounter rate (Orloff and Flannery 1992). Encounter rate is based on day-time observations of bird mean use and flight height. Values are sensitive to large flocks of birds flying within the RSA; that is, a species will have a high encounter rate even if only seen a few times in large flying flocks. Encounter rate also does not account for migrating behavior of nocturnal migrants.

Mortality Estimates

Tetra Tech has not included mortality estimates as part of this report. The statistical relationship between pre-construction avian use and post-construction mortality remains poorly defined, thereby limiting our power to predict mortality based on use. Previous

studies (e.g., Johnson 2007) have documented a significant positive relationship between use and mortality for raptors; however, these studies have been based on data sets from throughout the U.S., contain several statistical inconsistencies, and likely have limited applicability on a regional scale. This limited applicability is due, in large part, to the highly regional nature of avian mean use across North America (Arnett et al. 2007). Unfortunately, data on avian mortality at wind farms are lacking at regional scales in many parts of North America. Rather than attempt to draw conclusions from limited data sets, Tetra Tech takes a conservative approach and limits discussion to patterns of avian use and mortality risk factors.

2.3 Crane Surveys

Attractiveness of the WRA to Whooping Cranes

A desktop landscape scale analysis to assess the potential occurrence and risk for whooping cranes was conducted in February 2008. This analysis evaluated the biological and landscape features of the Oliver Expansion WRA that may influence use by whooping cranes for foraging or roosting, which may place them at risk. The analysis involved 1) determining the acreage of wetlands on the WRA, 2) comparing the proportion of the WRA in wetlands to the proportion of wetlands in a 10-mile radius of the WRA and 3) determining the proportion of wetlands on the WRA within 1 km of an agricultural field.

Tetra Tech used GAP data for North Dakota to determine the total acreage of wetlands of any size within the WRA and within 10 miles of the WRA. 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 10-mile area around the WRA that was wetlands (excluding the WRA). Tetra Tec divided the proportion of the WRA that was wetlands by the proportion of the 10-mile buffer that was wetlands to determine if the WRA contained more wetlands than the surrounding area.

To quantify the amount of roosting and foraging habitat in the WRA, GAP landcover data was obtained for North Dakota. Water features and the spatial extent of waters were verified with National Wetlands Inventory data (NWI) and hydrologic features represented on USGS topographic maps. Riparian areas were not large enough for whooping crane use and were not used in the analysis, but wetlands of all sizes were included due to the varied size of wetlands that whooping cranes use for roosting (Austin and Richert 2001). Tetra Tech limited its 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 acre (Austin and Richert 2001).

This likelihood analysis indicated that the Oliver Expansion WRA was located with the central whooping crane migration corridor. On a landscape scale, the Oliver Expansion WRA contains fewer wetlands than does the surrounding area (assesses as a 10-mile buffer). As a result, whooping cranes should not find the Oliver Expansion WRA as attractive as the surrounding landscape. However, 10 observational records of whooping

cranes exist within 10 miles of the WRA suggesting that birds have the potential to be on the ground in the area.

Whooping Crane Surrogate Surveys

Whooping cranes are most at risk when they stop-over during migration and move between their foraging and roosting sites. For some species, evaluating the risk of presence is done by conducting species-specific survey. However, whooping crane surveys are rarely effective at capturing whooping crane use of an area because of the small number of individuals of that species and the wide migration corridor used in North Dakota. Therefore, as with many rare species, it can be useful to use a surrogate species. Whooping cranes and sandhill cranes have similar stopover needs during migration; therefore, stop-over sites used by sandhill cranes indicate potential whooping crane stop-over areas. Because sandhill cranes migrate in larger groups, however, they require larger wetlands than whooping cranes; thus, the presence of sandhill cranes indicates a potential stop-over location for whooping cranes but whooping cranes may also use smaller wetlands.

Sandhill crane surveys (4 total surveys of the project area) were conducted between October 16, and November 6, 2008. Ground searches were conducted throughout the day starting at one-half hour before sunrise and ending at sunset. Sandhill crane surveys were conducted by driving all the roads within the vicinity of the WRA, stopping at good vantage points, and using both visual and audio cues to assess the presence of cranes. On a calm morning, sandhill cranes may be heard at a distance of 2.5 miles (Tacha et al. 1992). A minimum of five minutes was spent at each listening stop and binoculars were employed to scan the surrounding terrain to visually identify sandhill cranes. Stops were also made at suspected foraging habitat such as row crops and wheat fields and known staging areas. Surveys utilized all established avian point count locations as listening stops. Stops were not conducted during excessively harsh weather conditions. Daily records of travel within the study area, and location of stops, were mapped.

If observed, the total number of cranes, behavior, age, and flight direction to and from the area were noted. In addition, in the event of an observation, GPS coordinates were recorded for each flock and digital photographs taken in all cardinal directions (i.e., to aid in habitat description, record topography, and determine surrounding area); and crane location sketched onto a hardcopy topographic map.

3.0 RESULTS

3.1 Oliver Expansion WRA

The 800-m radius point counts surveyed about 17,877 acres of the Oliver Expansion WRA, covering 9.5 percent of its total area. The 36 point count locations were surveyed 13 times, resulting in 468 total 20-min surveys.

3.2 Species Composition

Biologists recorded a total of 4,806 birds of 59 identified species during the 468 fixed-point count surveys (Table 2). The most frequently observed species were the European

starling (15.9 percent of all birds observed), Brewer's blackbird (11.5 percent), horned lark (8.9 percent), red-winged blackbird (7.6 percent), Lapland longspur (6.5 percent), and western meadowlark (5.9 percent). Each remaining species comprised less than five percent of the total number of birds observed.

3.3 Avian Use

Overall mean bird use within the Oliver Expansion WRA was 10.27 birds/20 min and ranged from 0 to 409 birds per 20-min point count. Overall mean use by non-raptors was 9.78 birds/20 min. The non-raptors with the highest mean use were the European starling (1.63 birds/20 min) and Brewer's blackbird (1.18 birds/20 min; Table 2).

Among species groups, mean use was highest for songbirds (8.28 birds/20 min; Table 3). The most commonly observed species, European starling, accounted for 19.7 percent of individuals in this species group. However, the 764 birds comprised only 26 observations indicating they were traveling in large flocks. Among gamebirds, the second highest species group (0.68 birds/20 min), commonly observed species included two introduced species, the ring-necked pheasant (0.28 birds/20 min) and gray partridge (0.20 birds/20 min), and the native sharp-tailed grouse (0.19 birds/20 min; Table 3). Among the remaining species groups, raptors/vultures/owls and pigeons/doves had the next highest mean use values of 0.49 birds/20 min and 0.45 birds/20 min, respectively.

Non-raptor mean use was highest on September 23 (17.75 birds/20 min; Figure 3). Mean use by non-raptors peaked on this date and began to decline towards the end of the survey. Mean use for non-raptors was highest at point 29 (45.31 birds/20 min) and observations at this point included red-winged blackbird (300 individuals) and Brewer's blackbird (175 individuals; Table 4; Figure 4).

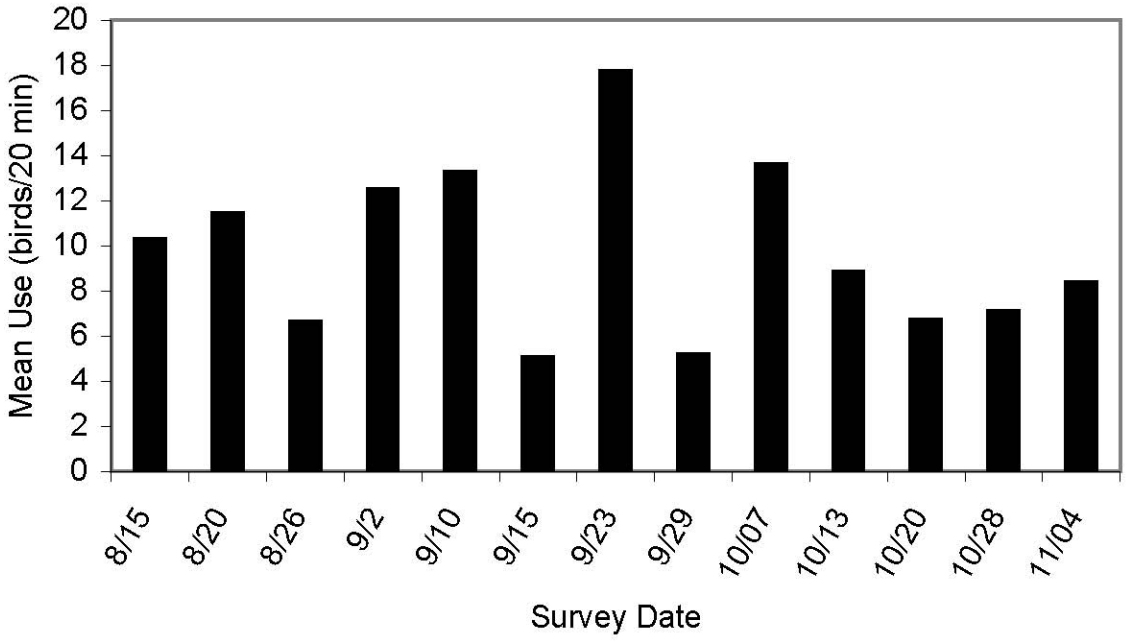


Figure 3. Mean non-raptor use by survey date (fall 2008)

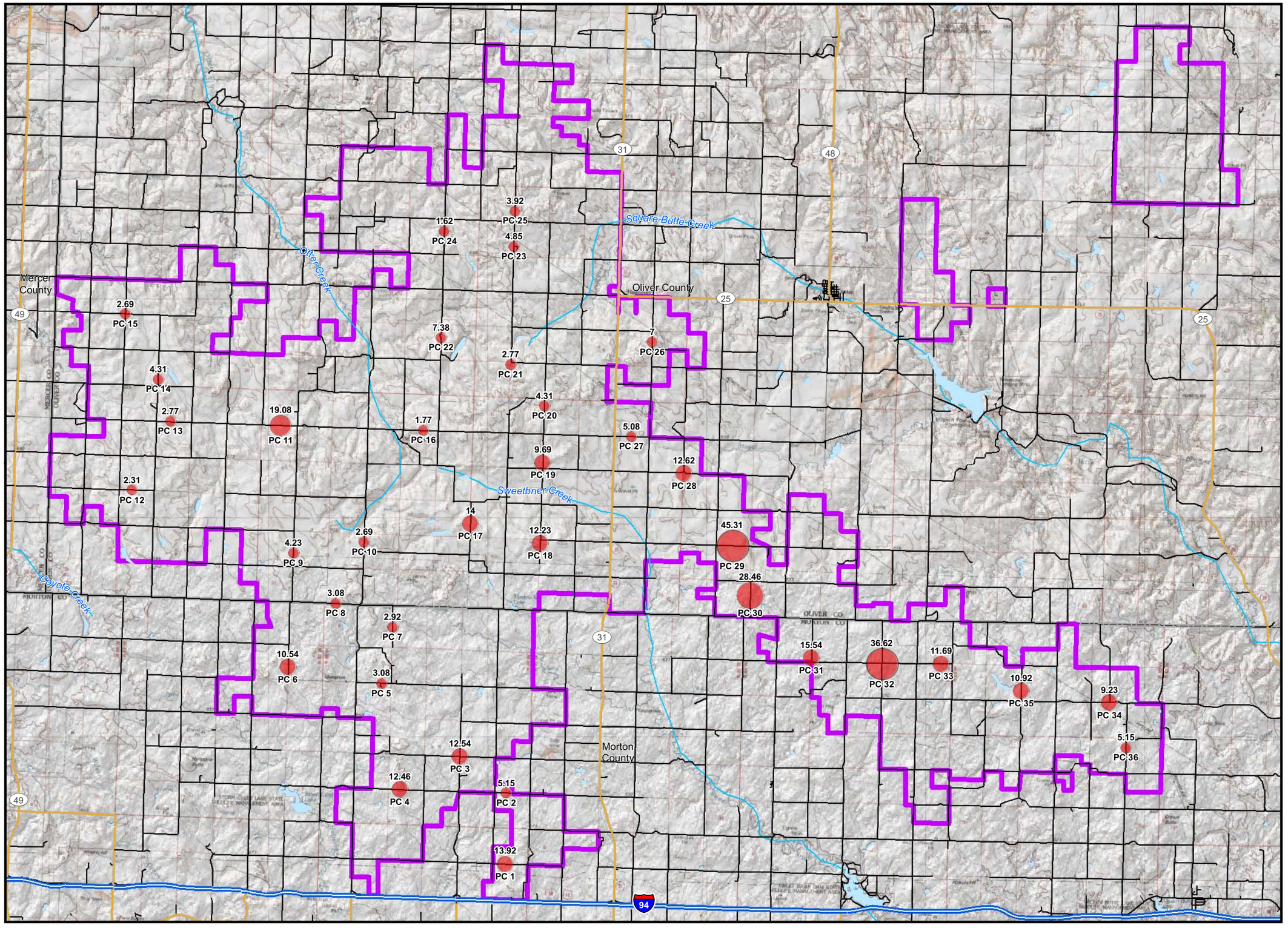


Figure 4
FPL Energy
Oliver Expansion
Mean Non-Raptor Use by Point Count Location (fall 2008)
Oliver and Morton Counties, North Dakota
December 08, 2008

Non-Raptors per 20 Minutes

- 0.01 - 9
- 9.01 - 18
- 18.01 - 27
- 27.01 - 36
- 36.1 - 45.31

\# Mean Use Value
PC# Point Count Number

Oliver Expansion

- Phases III, IV, and V[1]
- County Boundary
- Stream
- Intermittent Stream
- Water Body

Transportation

- Limited Access
- Highway
- Major Road
- Other Road

[1]Project Boundary - 10/10/08
TtEC GIS Technician: Eric Lubell

FPL Energy
1:165,000
NAD 83 UTM 14
Miles
0 0.75 1.5 3

TETRA TECH EC,INC

Raptors are a group of special interest because of their propensity to fly at heights similar to those encompassed by a turbine RSA. Overall mean use for raptors was 0.49 birds/20 min (Table 3). The raptors with the highest use were the red-tailed hawk (0.23 birds/20 min), Swainson's hawk (0.11 birds/20 min), northern harrier (0.06 birds/20 min), and the American kestrel (0.04 birds/20 min). Mean use for each other raptor species was 0.01 birds/20 min or fewer: prairie falcon, rough-legged hawk, great horned owl, ferruginous hawk, Cooper's hawk, and short-eared owl.

Mean use by raptors was highest on September 10 and September 23 (0.97 birds/20 min) (Figure 5). Mean use by raptors declined rapidly after the first week of October. Mean use by raptors was highest at point count locations 15 and 19 (Figure 6). A total of seven Swainson's hawks were observed at point 15 and four American kestrels, two great horned owls, and two Swainson's hawks were observed at point 19 (Table 4).

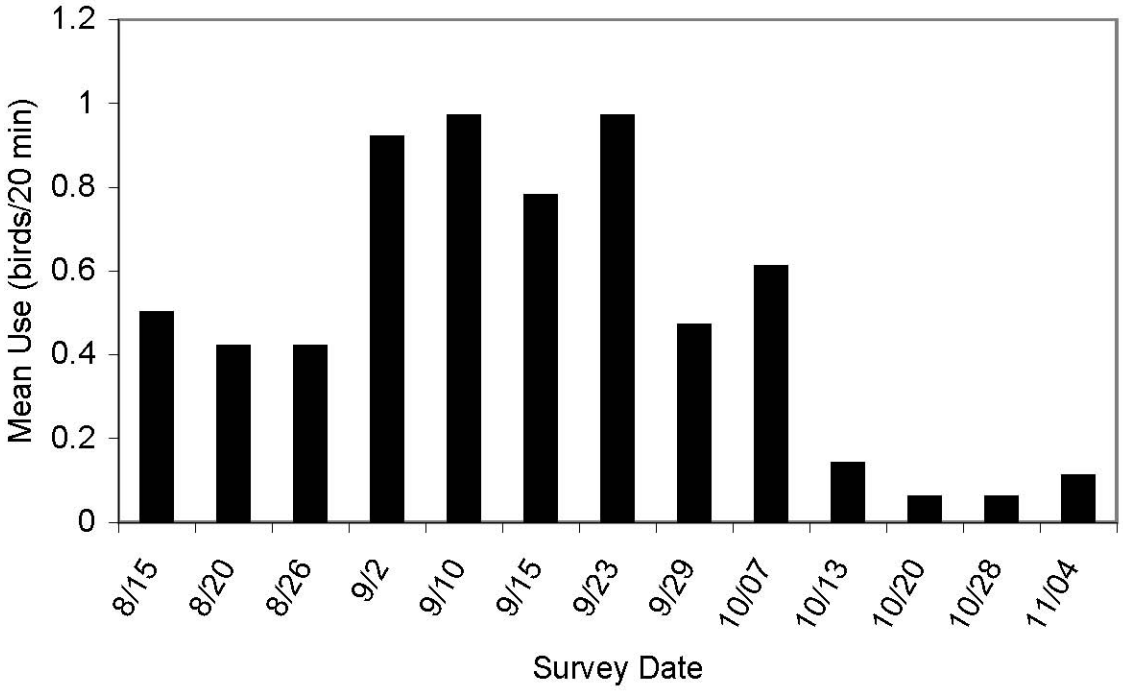


Figure 5. Mean raptor use by survey date (fall 2008)

3.4 Frequency of Occurrence

Songbirds were observed in the majority of surveys and were widely distributed throughout the Oliver Expansion WRA (Table 4); the horned lark (33.8 percent of all surveys) and western meadowlark (26.9 percent) occurred the most often (Table 3). Each other songbird species was detected in less than 20 percent of the surveys.

P:\GIS_PROJECTS\FPL\Oliver\maps\Avian_Survey\2008_Survey_Reports\Fall_2008\FPL_Oliver_Figure6_Mean_RaptorUse_by_PointCount_Location_Map_120208.mxd - Last Accessed: 12/8/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

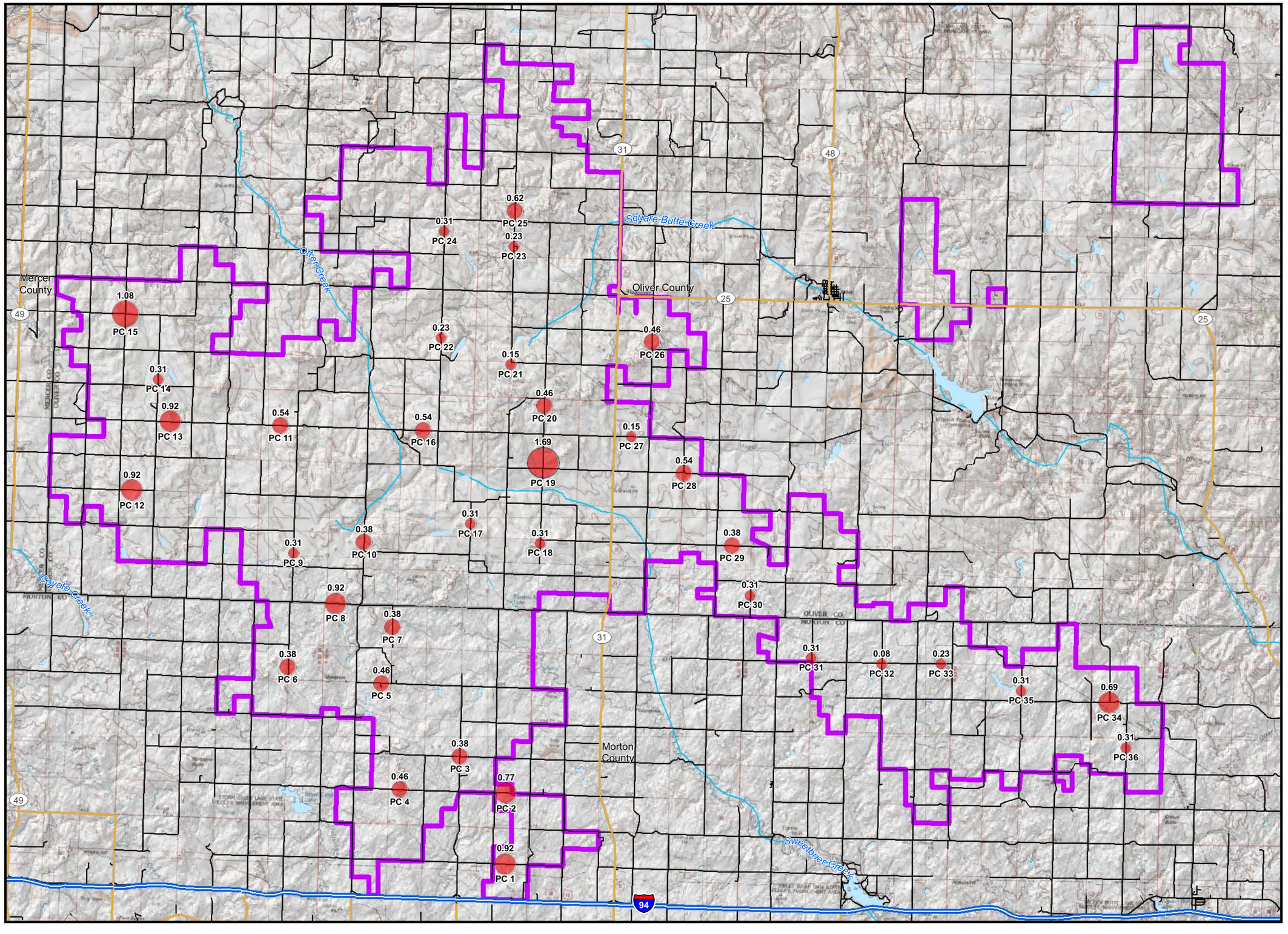


Figure 6
FPL Energy
Oliver Expansion
Mean Raptor Use
by Point Count
Location (fall 2008)
Oliver and Morton Counties,
North Dakota
December 08, 2008

Raptors per 20 Minutes

- 0.01 - 0.34
- 0.341 - 0.67
- 0.671 - 1.01
- 1.011 - 1.35
- 1.351 - 1.69

\# Mean Use Value
PC# Point Count Number

Oliver Expansion

- Phases III, IV, and V[1]
- County Boundary
- Stream
- Intermittent Stream
- Water Body

Transportation

- Limited Access
- Highway
- Major Road
- Other Road

[1]Project Boundary - 10/10/08
TtEC GIS Technician: Eric Lubell

FPL Energy
1:165,000
NAD 83 UTM 14
Miles
0 0.75 1.5 3

TETRA TECH EC,INC

Gamebirds were the second most frequently observed species group during fall surveys. Ring-necked pheasants were observed most often (10.7 percent of all surveys; Table 3). Other gamebirds observed at lower frequencies were the gray partridge and sharp-tailed grouse.

Raptors were not amongst the most frequently observed species groups during the fall surveys. Among raptors, the red-tailed hawk (19 percent of all surveys) and Swainson's hawk (7.9 percent) were detected most frequently (Table 3). Red-tailed hawks and Swainson's hawks were widespread in the Oliver Expansion WRA but were not observed at all point count locations (Table 4). However, the red-tailed hawk was observed at all locations except for point count locations 22 and 32. The remaining raptor species were detected in less than 6 percent of surveys.

3.5 Flight Height and Encounter Rate

During fall avian use surveys, biologists collected behavioral data for 100 percent of all birds observed during point count surveys. Biologists observed 89 percent of birds flying and collected flight height data for 99.8 percent and flight direction for 99.9 percent of observations. Of non-raptor species observed flying, 100 percent flew below the anticipated RSA (Table 5). Of raptor species observed flying, 1.1 percent flew within the anticipated RSA and 98.9 percent flew below the anticipated RSA. Data on flight direction are located in Appendix 1.

Swainson's hawk and red-tailed hawk had an encounter rate of less than 0.01 birds flying within the RSA/20 min (Table 6). Encounter rates were zero for all other species because they were never observed flying within the RSA.

3.6 Incidental Observations

Ornithologists documented 101 species and a total of 12,964 birds as incidental observations (Table 7). The Canada goose was the most commonly recorded species as an incidental observation within the Oliver Expansion WRA (2,616 birds). Biologists documented a large number of waterfowl near the Storm Creek Wildlife Management Area and at Danzig Dam located approximately 2 miles to the southwest of the WRA. Biologists observed four raptor species as incidentals that were not observed during the point count surveys: turkey vulture, merlin, peregrine falcon, and northern goshawk.

3.7 Crane Surveys

There were no sandhill or whooping cranes observed during the surveys conducted from October 16 to November 6, 2008.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Non-Raptor Use and Encounter Rate

Overall use by non-raptors at the Oliver Expansion WRA was high compared to raptors in the fall 2008 surveys (9.78 birds/20 min; Table 3). Comparing fall non-raptor use rates reported for existing wind energy facilities throughout the country with publicly available

data, the Oliver Expansion WRA ranked 11th out of 21 studies (Table 8; Figure 7). Because studies of avian use do not share identical methodologies (e.g., length of survey period) and there is variance associated with the mean values, comparisons of avian use represent generalizations only.

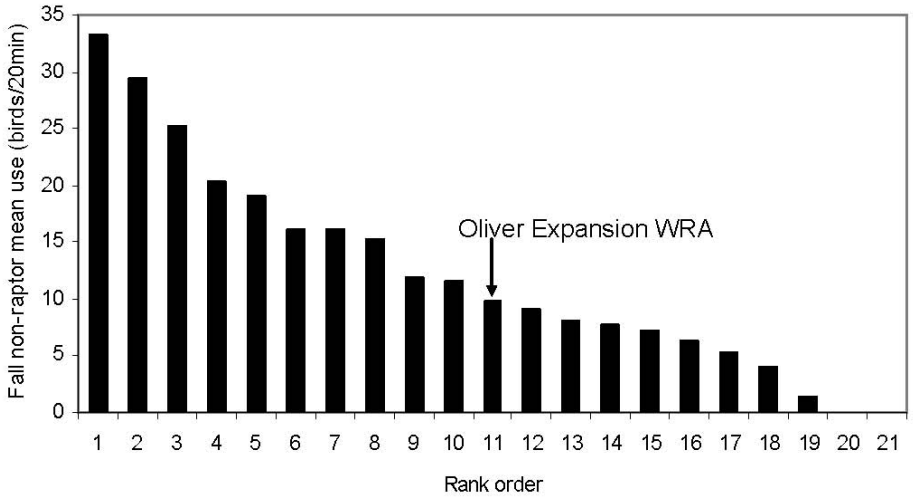


Figure 7. Comparison of non-raptor mean use at Oliver Expansion WRA to other mean use studies at wind projects.

Songbirds had the highest mean use out of all groups, a value which was driven by the European starling and Brewer's blackbird The European starling is a widespread non-native species widely regarded as a pest and is not protected under the MBTA. This species has a relatively stable population and, as a result, local mortality may not have population-level consequences. In contrast, the Brewer's blackbird's range is concentrated in the western portion of the United States; however, this species also has a relatively stable population and local mortality may not have population-level consequences (Sauer et al. 2008).

Brewer's blackbird had the second highest mean use of all species observed. They were observed presumably migrating through the Oliver Expansion WRA in large flocks. The Oliver Expansion WRA is on the eastern edge of this species' range. The Brewer's blackbirds observed during the fall surveys had an encounter rate of zero, flying below the RSA 100 percent of the time. Wind farms across the country that have conducted post-construction fatality studies have rarely encountered Brewer's blackbird fatalities due to collisions with turbines (Kerlinger et al. 2006). This species is not expected to experience population-level consequences due to construction of the Oliver Expansion WRA.

The horned lark is a widespread species and is declining region wide. The Audubon Society ranks the horned lark 18th out of 20 declining common bird species. According to the North American Breeding Bird Survey, the horned lark population is declining at

2.4% per year in the United States and by 4.0% per year in North Dakota (Sauer et al. 2008). The horned lark is the most common species found as a fatality at wind facilities in the Columbia Plateau of Oregon and Washington where it comprises more than 35% of all fatalities (Johnson 2007). In a two-year post-construction study at the High Winds Project Site in California, observers detected 163 individual bird fatalities from turbine collisions, of which 10.4 percent were horned larks (Kerlinger et al. 2006). Given these patterns, horned lark fatalities will likely occur at the Oliver Expansion WRA. Although the population declines in this species are likely independent of wind energy development, additive mortality at the Oliver Expansion WRA could contribute to the population decline given no changes in other demographic rates for this species.

4.2 Raptor Use and Encounter Rate

Overall raptor use at the Oliver Expansion WRA was low compared to other species groups in the fall 2008 surveys (0.49 birds/20 min). The Oliver Expansion WRA ranked 21st out of 31 studies comparing raptor use rates in fall reported for existing wind energy facilities throughout the country with publicly available data (Table 8; Figure 8). The low raptor use within the RSA might be due to the presence of low cloud ceilings on many survey days; on these occasions, poor visibility may have prevented biologists from seeing raptors that were within the RSA. High raptor use has been associated with high raptor mortality at wind farms (Erickson 2007); however, the strength of the conclusion is based on two data points for high raptor use (greater than 2.0 birds/20 min). Conversely, raptor mortality appears to be low when raptor use is low, as defined by Erickson (2007) as less than 1.0 birds/20 min, which is the case for raptor use at the Oliver Expansion WRA. However, raptor mortality may be of concern for this site, because red-tailed hawks (see detailed discussion below) are susceptible to turbine collision. Continued monitoring and additional analysis of encounter rate and post-construction mortality data will help elucidate the relationship between these two variables.

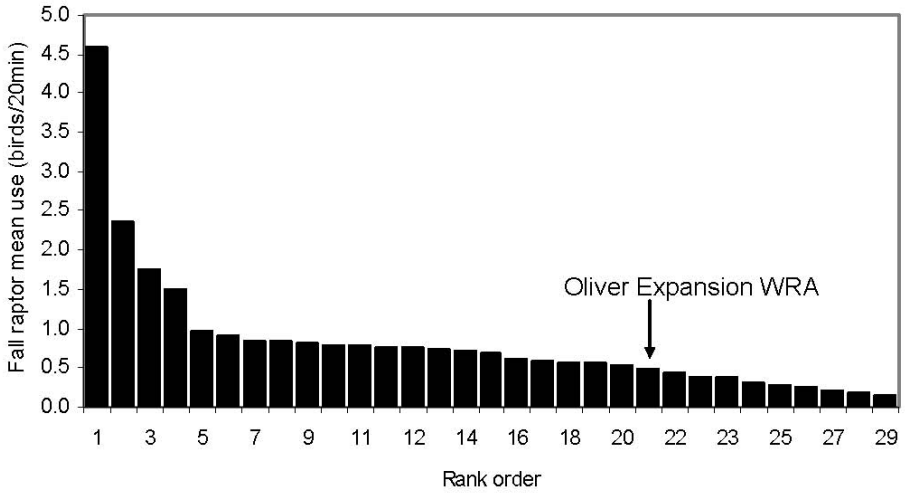


Figure 8. Comparison of raptor mean use at Oliver Expansion WRA to other mean use studies at wind projects.

Red-tailed hawks were the most commonly observed raptor species during avian surveys. Although red-tailed hawks were commonly observed, they were never observed flying within the WRA. However, mortality studies at other wind farm sites have indicated that red-tailed hawks are vulnerable to mortality from turbine collisions (Kerns and Kerlinger 2004, Anderson et al. 2005, Kerlinger et al. 2006). Mortality of red-tailed hawks due to collisions with wind turbines has been documented at multiple sites (Johnson et al. 2002, Erickson et al., 2004, Erickson 2007), and may be higher than expected from pre-construction avian use surveys (Orloff and Flannery 1992); therefore, red-tailed hawk mortality events may occur at the Oliver Expansion WRA. However, the overall low mean use of red-tailed hawks within the WRA coupled with a stable to increasing population (Sauer et al. 2008) makes it unlikely that mortality of red-tailed hawks will have population-level impacts.

Rough-legged hawks, prairie falcons, American kestrels, Swainson's hawks, northern harriers, Cooper's hawk, ferruginous hawks, short-eared owls, and great horned owls were also observed at the Oliver Expansion WRA but, like the red-tailed hawk, were never observed flying within the RSA, thereby minimizing the potential for negative turbine-related impacts to these species. Mean use by raptors was highest at point count locations 1, 8, 15, and 19. However, the habitat at these points is not unique on the landscape and this data should not be used to guide turbine siting.

4.3 Comparison of spring and fall surveys

Spring and fall surveys in 2008 yielded very similar results. Spring surveys detected 68 species and 4,581 birds compared to 59 species and 4,806 birds during the fall. Songbirds were the most frequently observed species groups during both seasons. Most importantly, encounter rates were very low in both seasons. Although birds were more frequently observed flying within the RSA during the spring surveys, only 3 species (red-tailed hawk, Swainson's hawk, common grackle) had encounter rates greater than zero and these values were very low (all less than 0.04 birds flying within the RSA/20 min). No species detected during the fall surveys had an encounter rate greater than zero.

4.4 Listed and Sensitive Species

As in the spring 2008 surveys, there were no federally listed threatened and endangered species observed within the Oliver Expansion WRA during the fall surveys. However, all migratory and native species are protected by the Migratory Bird Treaty Act.

The North Dakota Game and Fish Department (NDGFD) has identified 100 Species of Conservation Priority within North Dakota. These species are ranked in three priority levels based on such factors as known status, funding availability, and presence of breeding habitat within North Dakota (Hagen et al. 2005). The definitions of each rank are listed below:

> Level I: A species having a high level of conservation priority because of declining status either in North Dakota or across their range; or a high rate of occurrence in North Dakota constituting the core of the species' breeding range,

> but are at-risk range wide, and non-SWG [State Wildlife Grants] funding is not readily available to them.
>
> Level II: Species having a moderate level of conservation priority; or a high level of conservation priority, but a substantial amount of non-State Wildlife Grant funding is available to them.
>
> Level III: North Dakota's species having a moderate level of conservation priority, but are believed to be peripheral or do not breed in North Dakota. (Hagen et al. 2005).

Species that are listed under the 100 Species of Conservation Priority are not afforded any formal protection by the state. However, species identified on this list are assigned a wildlife replacement value based on their level (NDGFD 2006). NDGFD has not yet applied these replacement values to avian fatalities at wind projects. However, it cannot be assumed that a large-scale "take" of species through the operation of a wind farm will not trigger the application of these replacement values.

There were thirteen species of conservation concern observed during the fall point count surveys. The chestnut-collared longspur (Level I), grasshopper sparrow (Level I), Franklin's gull (Level I), Sprague's pipit (Level I), Swainson's hawk (Level I), ferruginous hawk (Level I), upland sandpiper (Level I), bobolink (Level II), loggerhead shrike (Level II), northern harrier (Level II), prairie falcon (Level II), short-eared owl (Level II), and sharp-tailed grouse (Level II) were all observed during surveys. Most of these species were also detected during spring surveys.

The NDGFD Species of Conservation Priority that were observed within the WRA had an overall low mean use. The species with the highest mean use was the sharp-tailed grouse (0.19 birds/20 minute). All other species were below 0.15 birds/20 minutes. None of the species had a measurable encounter rate.

During spring native prairie and sharp-tailed grouse lek location surveys, Tetra Tech estimated that approximately 36 percent of the WRA could be classified as native prairie (including tame grasslands) and detected 15 active leks. Both of these observations suggest there is a potential for negative impacts of project development on grassland species.

Sharp-tailed grouse typically fly low to the ground and, therefore, are at low risk of collision with turbines or power lines. However, development in grouse habitat could result in direct habitat loss, potential habitat loss through avoidance, potential predator facilitation, and construction-related disturbance. Road development can also facilitate the movement of some predators into the WRA (Frey and Conover 2006, Pescador and Peris 2007), potentially increasing predation on grouse nests. Research investigating the effects of wind turbines on prairie grouse leks is ongoing.

4.5 Potential Impacts to Avian Species

The possible impacts to avian species from the construction and operation of the Oliver Expansion WRA are direct morality and injury from collisions with wind turbines and guy wires, temporary or permanent habitat loss, and displacement of birds from habitats near turbines (Drewitt and Langston 2006). Historically, raptor mortality has received the most attention. Raptor mortality at newer generation wind projects has been low relative to the previous generation of wind farms (Erickson et al. 2002). A number of mortality monitoring studies at newer generation wind projects have found fewer than five individual raptor mortalities (e.g., Johnson et al. 2002, Erickson et al. 2003a, Kerns and Kerlinger 2004, Jain et al. 2007). Although raptor mortality is reduced, mortality may not be eliminated by advances in turbine technology and local micro-siting and site evaluation efforts are still necessary.

At newer generation wind energy facilities outside of California, approximately 80 percent of documented mortalities have been passerines (e.g., songbirds); of which 50 percent were nocturnal migrants (Erickson et al. 2002). It is estimated that less than 0.01 percent of migrant songbirds that pass over wind farms are killed, based on radar data and mortality monitoring at wind farms in Oregon, Washington, and Minnesota (Erickson 2007). Resident species may have lower mortality than migrants because many songbirds do not fly within the RSA. However, some resident species have behaviors that increase the risk of collisions with turbines because they fly within the RSA. For example, horned larks have been commonly found as fatalities at wind farms (Erickson et al. 2002). Mortality may be partially attributed to the fact that male horned larks perform flight songs by climbing to heights of 80 to 250 m (Pickwell 1931).

In addition to mortality associated with wind farms, concerns have been raised that some bird species may avoid areas near turbines after the wind farm is in operation (Drewitt and Langston 2006). For example, at the Buffalo Ridge wind energy facility in Minnesota, densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines. It was suggested that the reduced density may be due to avoidance of turbine noise and maintenance activities, and reduced habitat quality due to the presence of access roads and large gravel pads surrounding the turbines (Leddy et al. 1999). Reduced abundance of grassland songbirds was found within 50 m of a turbine pad for a wind farm in Washington and Oregon, but the investigators attributed displacement to the direct loss of habitat or reduced habitat quality and not the presence of the turbines (WEST and NWC 2004). Recent research in North Dakota (Shaffer and Johnson, unpublished data) suggests that certain grassland songbird species may avoid turbines by as much as 200 m but the analysis is not yet complete on these data. None of these studies have addressed whether or not these avoidance effects are temporary (i.e., the birds may habituate to the presence of turbines over time) or permanent.

Particular concern over avoidance issues has been raised with respect to prairie grouse species. Pitman (2005) demonstrated that lesser prairie-chickens (*Tympanuchus pallidicinctus*) tend to avoid anthropogenic features on the landscape when choosing nest locations and recommended a 1-km development buffer around suitable breeding habitat.

The USFWS recommends a 5-mile buffer surrounding active lek locations for all prairie grouse species (Manville 2004); however, there is considerable disagreement about the validity of this distance and more research is needed to assess the role that setback distances will play in prairie grouse management.

Finally, almost all native birds are protected under the Migratory Bird Treaty Act (MBTA) of 1918. Under the MBTA it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product. Despite extensive liability provisions, the USFWS has narrowly interpreted its permitting authority. "As currently written, USFWS's regulations establish a permitting scheme for a variety of intentional activities, such as hunting, falconry, certain import and export activities, depredation control, and scientific research. But…there is no permitting scheme for the incidental take of migratory birds during otherwise lawful activities" (Beveridge 2005). There is no permitting framework (i.e., incidental take permits) that allow a wind company to protect itself from liability at wind facilities; however, the USFWS does not usually take action if good faith efforts have been made to minimize impacts. To date, no wind development company has officially been charged for violations of the MBTA.

4.6 Oliver Expansion WRA Conclusions

Fall non-raptor use at the Oliver Expansion WRA ranked 11th out of 21 mean use studies at other wind generation facilities, primarily due to high use by European starling, Brewer's blackbird, and horned larks. Although mortality events will likely occur at the Oliver Expansion WRA, the most commonly observed species—the European starling, a non-native species not protected under the Migratory Bird Treaty Act, and Brewer's blackbird—have relatively stable populations (Sauer et al. 2008); therefore, individual mortalities are unlikely to have population-level consequences or receive a high level of scrutiny from state or federal wildlife agencies. Although widespread, horned lark populations are declining region wide. Individuals of this species are commonly reported as fatalities during post-construction monitoring and fatalities will likely occur at the Oliver Expansion WRA. Although the population declines in this species are likely independent of wind energy development, additive mortality at the Oliver Expansion WRA could contribute to the population decline given no changes in other demographic rates for this species.

Nocturnal migrants may pass through the Oliver Expansion WRA and would not be detected by the survey methods used in this study if the birds did not stop-over within the WRA. However, mortality of nocturnal migrants at the Oliver Expansion WRA is not expected to have population-level implications because less than 0.01 percent of nocturnal migrants that fly through wind farms are killed (Erickson 2007).

An earlier desktop analysis performed by Tetra Tech indicated the potential that the Oliver WRA could provide suitable stop-over habitat for migrating whooping cranes. However, whooping crane surveys are rarely effective at capturing whooping crane use of an area because of the small number of individuals of that species and the wide

migration corridor used in North Dakota. Therefore, as with many rare species, it can be useful to use a surrogate species. Whooping cranes and sandhill cranes have similar stopover needs during migration; therefore, stop-over sites used by sandhill cranes indicate potential whooping crane stop-over areas. No sandhill or whooping cranes were detected during the fall surveys. As sandhill cranes migrate in larger groups, however, they require larger wetlands than whooping cranes; hence, the lack of sandhill crane detections during fall 2008 does not mean that the WRA is unusable by whooping cranes.

Fall raptor use at the Oliver Expansion WRA ranked 21st out of 31 mean use studies at other wind generation facilities. The level of raptor use at the Oliver Expansion WRA suggests that raptor mortality is anticipated to be low, especially based on the results by Young et al. (2003). Red-tailed hawks were the most common raptors observed at the Oliver Expansion WRA and fatalities of this species has occurred at wind farms (Kerns and Kerlinger 2004, Anderson et al. 2005, Kerlinger et al. 2006). However, the overall numbers of red-tailed hawks detected at the Oliver Expansion WRA were low, thereby minimizing the probability of negative interactions with turbines.

Species that are listed under the 100 Species of Conservation Priority are not afforded any formal protection by the state. However, species identified on this list are assigned a wildlife replacement value based on their level (NDGFD 2006). NDGFD has not yet applied these replacement values to avian fatalities at wind projects. However, it cannot be assumed that a large-scale "take" of species through the operation of a wind farm will not trigger the application of these replacement values.

There were thirteen North Dakota Species of Conservation Priority observed during the fall point count surveys: chestnut-collared longspur (Level I), grasshopper sparrow (Level I), Franklin's gull (Level I), Sprague's pipit (Level I), Swainson's hawk (Level I), ferruginous hawk (Level I), upland sandpiper (Level I), bobolink (Level II), loggerhead shrike (Level II), northern harrier (Level II), prairie falcon (Level II), short-eared owl (Level II), and sharp-tailed grouse (Level II). These species are not afforded state-level regulatory protection as a result of this listing; however, all of these species are protected by the MBTA.

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TABLES

Table 1. Oliver Expansion Wind Resource Area, Fall 2008 point count survey dates.

Survey number	Date
1	August 14
1	August 15
1	August 16
2	August 19
2	August 20
2	August 21
3	August 25
3	August 26
4	September 2
4	September 3
5	September 9
5	September 10
6	September 15
6	September 16
7	September 22
7	September 23
8	September 29
8	September 30
9	October 6
9	October 7
10	October 13
10	October 14
11	October 20
11	October 21
12	October 27
12	October 28
13	November 3
13	November 4

Table 2. Avian species observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
European starling	764	26	1.63 (0.14-3.12)	5.6	15.9%
Brewer's blackbird	551	6	1.18 (0.16-2.20)	1.3	11.5%
horned lark	426	175	0.91 (0.67-1.15)	33.8	8.9%
red-winged blackbird	366	7	0.78 (0.00-1.85)	1.5	7.6%
Lapland longspur	310	16	0.66 (0.19-1.13)	3.4	6.5%
western meadowlark	283	157	0.60 (0.48-0.72)	26.9	5.9%
savannah sparrow	211	56	0.45 (0.27-0.63)	10.9	4.4%
mourning dove	191	63	0.41 (0.27-0.55)	11.8	4.0%
house sparrow	183	16	0.39 (0.02-0.76)	3.2	3.8%
ring-necked pheasant	132	56	0.28 (0.19-0.37)	10.7	2.7%
western kingbird	126	48	0.27 (0.18-0.36)	8.1	2.6%
eastern kingbird	110	60	0.24 (0.18-0.30)	10.9	2.3%
red-tailed hawk	109	100	0.23 (0.19-0.27)	19.0	2.3%
gray partridge	95	9	0.20 (0.07-0.33)	1.9	2.0%
American robin	94	26	0.20 (0.11-0.29)	5.1	2.0%
sharp-tailed grouse	89	13	0.19 (0.00-0.38)	2.4	1.9%
barn swallow	86	31	0.18 (0.07-0.29)	6.4	1.8%
Canada goose	83	3	0.18 (0.00-0.47)	0.4	1.7%
chestnut-collared longspur	65	5	0.14 (0.00-0.32)	1.1	1.4%
brown-headed cowbird	63	3	0.13 (0.00-0.32)	0.6	1.3%
clay-colored sparrow	59	13	0.13 (0.06-0.20)	2.1	1.2%
Swainson’s hawk	51	43	0.11 (0.08-0.14)	7.9	1.1%
snow bunting	36	2	0.08 (0.00-0.19)	0.4	0.7%
vesper sparrow	31	22	0.07 (0.04-0.10)	4.7	0.6%
American tree sparrow	31	8	0.07 (0.02-0.12)	1.7	0.6%
northern harrier	26	25	0.06 (0.04-0.08)	5.1	0.5%
killdeer	23	11	0.05 (0.01-0.09)	2.4	0.5%

Table 2. Avian species observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
rock pigeon	20	5	0.04 (0.00-0.08)	1.1	0.4%
northern flicker	20	9	0.04 (0.00-0.08)	1.7	0.4%
American kestrel	19	16	0.04 (0.02-0.06)	3.4	0.4%
gadwall	17	1	0.04 (0.00-0.10)	0.2	0.4%
American crow	17	3	0.04 (0.00-0.08)	0.6	0.4%
common grackle	16	8	0.03 (0.01-0.05)	1.7	0.3%
American goldfinch	12	9	0.03 (0.01-0.05)	1.7	0.2%
American pipit	9	1	0.02 (0.00-0.05)	0.2	0.2%
grasshopper sparrow	8	6	0.02 (0.01-0.03)	1.1	0.2%
Franklin's gull	8	1	0.02 (0.00-0.05)	0.2	0.2%
prairie falcon	7	7	0.01 (0.00-0.02)	1.5	0.1%
rough-legged hawk	6	6	0.01 (0.00-0.02)	1.1	0.1%
yellow-rumped warbler	5	3	0.01 (0.00-0.02)	0.6	0.1%
Say's phoebe	5	5	0.01 (0.00-0.02)	0.9	0.1%
upland sandpiper	4	4	0.01 (0.00-0.02)	0.9	0.1%
great horned owl	4	4	0.01 (0.00-0.02)	0.9	0.1%
ferruginous hawk	4	4	0.01 (0.00-0.02)	0.9	0.1%
Cooper's hawk	4	2	0.01 (0.00-0.02)	0.4	0.1%
chipping sparrow	4	1	0.01 (0.00-0.02)	0.2	0.1%
bobolink	4	2	0.01 (0.00-0.02)	0.4	0.1%
Sprague's pipit	3	3	0.01 (0.00-0.02)	0.6	0.1%
orchard oriole	2	2	0.00 (0.00-0.00)	0.4	0.0%
northern shrike	2	2	0.00 (0.00-0.00)	0.4	0.0%
mallard	2	1	0.00 (0.00-0.01)	0.2	0.0%
Harris' sparrow	2	1	0.00 (0.00-0.01)	0.2	0.0%
dark-eyed junco	2	2	0.00 (0.00-0.00)	0.4	0.0%
yellow warbler	1	1	0.00 (0.00-0.00)	0.2	0.0%

Table 2. Avian species observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
white-throated sparrow	1	1	0.00 (0.00-0.00)	0.2	0.0%
short-eared owl	1	1	0.00 (0.00-0.00)	0.2	0.0%
loggerhead shrike	1	1	0.00 (0.00-0.00)	0.2	0.0%
least flycatcher	1	1	0.00 (0.00-0.00)	0.2	0.0%
brown thrasher	1	1	0.00 (0.00-0.00)	0.2	0.0%
Grand Total	**4806**	**1114**	**10.27** (7.98-12.56)		

Table 3. Avian species, by species grouping, observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
Songbirds					
European starling	764	26	1.63 (0.14-3.12)	5.6	15.9%
Brewer's blackbird	551	6	1.18 (0.16-2.20)	1.3	11.5%
horned lark	426	175	0.91 (0.67-1.15)	33.8	8.9%
red-winged blackbird	366	7	0.78 (0.00-1.85)	1.5	7.6%
Lapland longspur	310	16	0.66 (0.19-1.13)	3.4	6.5%
western meadowlark	283	157	0.60 (0.48-0.72)	26.9	5.9%
savannah sparrow	211	56	0.45 (0.27-0.63)	10.9	4.4%
house sparrow	183	16	0.39 (0.02-0.76)	3.2	3.8%
western kingbird	126	48	0.27 (0.18-0.36)	8.1	2.6%
eastern kingbird	110	60	0.24 (0.18-0.30)	10.9	2.3%
American robin	94	26	0.20 (0.11-0.29)	5.1	2.0%
barn swallow	86	31	0.18 (0.07-0.29)	6.4	1.8%
chestnut-collared longspur	65	5	0.14 (0.00-0.32)	1.1	1.4%
brown-headed cowbird	63	3	0.13 (0.00-0.32)	0.6	1.3%
clay-colored sparrow	59	13	0.13 (0.06-0.20)	2.1	1.2%
snow bunting	36	2	0.08 (0.00-0.19)	0.4	0.7%
vesper sparrow	31	22	0.07 (0.04-0.10)	4.7	0.6%
American tree sparrow	31	8	0.07 (0.02-0.12)	1.7	0.6%
common grackle	16	8	0.03 (0.01-0.05)	1.7	0.3%
American goldfinch	12	9	0.03 (0.01-0.05)	1.7	0.2%
American pipit	9	1	0.02 (0.00-0.05)	0.2	0.2%
grasshopper sparrow	8	6	0.02 (0.01-0.03)	1.1	0.2%
yellow-rumped warbler	5	3	0.01 (0.00-0.02)	0.6	0.1%

Table 3. Avian species, by species grouping, observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
Say's phoebe	5	5	0.01 (0.00-0.02)	0.9	0.1%
chipping sparrow	4	1	0.01 (0.00-0.02)	0.2	0.1%
bobolink	4	2	0.01 (0.00-0.02)	0.4	0.1%
Sprague's pipit	3	3	0.01 (0.00-0.02)	0.6	0.1%
orchard oriole	2	2	0.00 (0.00-0.00)	0.4	0.0%
northern shrike	2	2	0.00 (0.00-0.00)	0.4	0.0%
Harris' sparrow	2	1	0.00 (0.00-0.01)	0.2	0.0%
dark-eyed junco	2	2	0.00 (0.00-0.00)	0.4	0.0%
yellow warbler	1	1	0.00 (0.00-0.00)	0.2	0.0%
white-throated sparrow	1	1	0.00 (0.00-0.00)	0.2	0.0%
loggerhead shrike	1	1	0.00 (0.00-0.00)	0.2	0.0%
least flycatcher	1	1	0.00 (0.00-0.00)	0.2	0.0%
brown thrasher	1	1	0.00 (0.00-0.00)	0.2	0.0%
Group Total	**3874**	**727**	**8.28** (6.04-10.52)		**80.6%**
Gamebirds					
ring-necked pheasant	132	56	0.28 (0.19-0.37)	10.7	2.7%
gray partridge	95	9	0.20 (0.07-0.33)	1.9	2.0%
sharp-tailed grouse	89	13	0.19 (0.00-0.38)	2.4	1.9%
Group Total	**316**	**78**	**0.68** (0.44-0.92)		**6.6%**
Raptors/Vultures/Owls					
red-tailed hawk	109	100	0.23 (0.19-0.27)	19.0	2.3%
Swainson's hawk	51	43	0.11 (0.08-0.14)	7.9	1.1%
northern harrier	26	25	0.06 (0.04-0.08)	5.1	0.5%
American kestrel	19	16	0.04 (0.02-0.06)	3.4	0.4%

Table 3. Avian species, by species grouping, observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
prairie falcon	7	7	0.01 (0.00-0.02)	1.5	0.1%
rough-legged hawk	6	6	0.01 (0.00-0.02)	1.1	0.1%
great horned owl	4	4	0.01 (0.00-0.02)	0.9	0.1%
ferruginous hawk	4	4	0.01 (0.00-0.02)	0.9	0.1%
Cooper's hawk	4	2	0.01 (0.00-0.02)	0.4	0.1%
short-eared owl	1	1	0.00 (0.00-0.00)	0.2	0.0%
Group Total	**231**	**208**	**0.49** (0.43-0.55)		**4.8%**
Pigeons/Doves					
mourning dove	191	63	0.41 (0.27-0.55)	11.8	4.0%
rock pigeon	20	5	0.04 (0.00-0.08)	1.1	0.4%
Group Total	**211**	**68**	**0.45** (0.31-0.59)		**4.4%**
Waterfowl					
Canada goose	83	3	0.18 (0.00-0.47)	0.4	1.7%
gadwall	17	1	0.04 (0.00-0.10)	0.2	0.4%
mallard	2	1	0.00 (0.00-0.01)	0.2	0.0%
Group Total	**102**	**5**	**0.22** (0.00-0.51)		**2.1%**
Shorebirds					
killdeer	23	11	0.05 (0.01-0.09)	2.4	0.5%
upland sandpiper	4	4	0.01 (0.00-0.02)	0.9	0.1%
Group Total	**27**	**15**	**0.06** (0.02-0.10)		**0.6%**
Woodpeckers					
northern flicker	20	9	0.04 (0.00-0.08)	1.7	0.4%
Group Total	**20**	**9**	**0.04** (0.00-0.08)		**0.4%**
Crows and Allies					

Table 3. Avian species, by species grouping, observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species Grouping Species	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)	Frequency % of surveys detected	Percent Composition
American crow	17	3	0.04 (0.00-0.08)	0.6	0.4%
Group Total	**17**	**3**	**0.04** (0.00-0.08)		**0.4%**
Gulls/Terns					
Franklin's gull	8	1	0.02 (0.00-0.05)	0.2	0.2%
Group Total	**8**	**1**	**0.02** (0.00-0.05)		**0.2%**
Grand Total	**4806**	**1114**	**10.27** (7.98-12.56)		

Table 4. Avian species observed by point during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
European starling	764	26	2	0	53	4	2	0	0	0	0	0	1	0
Brewer's blackbird	551	6	0	0	0	0	0	0	0	0	1	0	175	0
horned lark	426	175	4	10	21	13	5	7	8	17	4	9	2	14
red-winged blackbird	366	7	0	0	0	0	1	56	0	0	0	0	0	0
Lapland longspur	310	16	100	0	0	16	0	0	0	1	1	20	0	0
western meadowlark	283	157	16	7	16	6	0	14	18	4	15	2	4	0
savannah sparrow	211	56	0	9	2	5	0	3	2	9	0	0	0	0
mourning dove	191	63	23	0	7	0	3	3	0	2	6	0	3	1
house sparrow	183	16	0	0	10	1	1	0	0	0	0	0	0	0
ring-necked pheasant	132	56	11	6	12	1	2	2	3	0	8	0	0	6
western kingbird	126	48	7	12	4	7	12	23	1	0	4	1	2	0
eastern kingbird	110	60	1	5	4	3	2	10	4	0	7	2	2	0
red-tailed hawk	109	100	6	2	2	3	2	3	1	4	1	4	3	6
gray partridge	95	9	11	0	0	17	0	0	0	0	0	0	0	0
American robin	94	26	2	0	28	0	6	3	0	3	0	0	0	0
sharp-tailed grouse	89	13	0	1	0	0	0	12	1	0	0	0	0	1
barn swallow	86	31	0	1	2	0	1	0	0	1	0	0	0	0
Canada goose	83	3	0	0	0	82	1	0	0	0	0	0	0	0
chestnut-collared longspur	65	5	0	0	0	0	0	0	0	0	0	0	0	0
brown-headed cowbird	63	3	0	0	0	0	0	0	0	0	0	0	54	0
clay-colored sparrow	59	13	0	4	4	5	0	0	0	0	0	0	0	0
Swainson’s hawk	51	43	4	6	1	0	4	1	0	6	0	0	1	2
snow bunting	36	2	0	0	0	0	0	0	0	0	0	0	0	6
vesper sparrow	31	22	0	0	0	1	0	1	0	3	0	0	0	0
American tree sparrow	31	8	0	12	0	0	0	0	0	0	0	0	0	0

Table 4. Avian species observed by point during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
northern harrier	26	25	1	2	1	1	0	0	1	1	2	0	0	3
killdeer	23	11	1	0	0	0	0	0	0	0	0	0	0	0
rock pigeon	20	5	0	0	0	0	0	0	0	0	0	0	0	0
northern flicker	20	9	1	0	0	0	0	1	0	0	0	0	0	0
American kestrel	19	16	0	0	1	0	0	0	2	1	1	1	1	0
gadwall	17	1	0	0	0	0	0	0	0	0	0	0	0	0
American crow	17	3	0	0	0	0	0	0	0	0	0	0	0	0
common grackle	16	8	0	0	0	0	0	0	0	0	0	1	1	0
American goldfinch	12	9	2	0	0	0	0	0	0	0	0	0	4	0
American pipit	9	1	0	0	0	0	0	0	0	0	9	0	0	0
grasshopper sparrow	8	6	0	0	0	0	0	0	0	0	0	0	0	0
Franklin’s gull	8	1	0	0	0	0	0	0	0	0	0	0	0	0
prairie falcon	7	7	1	0	0	0	0	0	1	0	0	0	0	0
rough-legged hawk	6	6	0	0	0	2	0	0	0	0	0	0	0	1
yellow-rumped warbler	5	3	0	0	0	0	3	0	1	0	0	0	0	0
Say's phoebe	5	5	0	0	0	0	0	0	0	0	0	0	0	0
upland sandpiper	4	4	0	0	0	0	0	0	0	0	0	0	0	0
great horned owl	4	4	0	0	0	0	0	1	0	0	0	0	0	0
ferruginous hawk	4	4	0	0	0	0	0	0	0	0	0	0	0	0
Cooper's hawk	4	2	0	0	0	0	0	0	0	0	0	0	2	0
chipping sparrow	4	1	0	0	0	0	0	0	0	0	0	0	0	0
bobolink	4	2	0	0	0	0	0	1	0	0	0	0	0	0
Sprague's pipit	3	3	0	0	0	0	1	0	0	0	0	0	0	1
orchard oriole	2	2	0	0	0	0	0	0	0	0	0	0	0	0
northern shrike	2	2	0	0	0	0	0	1	0	0	0	0	0	0

Table 4. Avian species observed by point during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
mallard	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Harris' sparrow	2	1	0	0	0	0	0	0	0	0	0	0	0	0
dark-eyed junco	2	2	0	0	0	1	0	0	0	0	0	0	0	0
yellow warbler	1	1	0	0	0	0	0	0	0	0	0	0	0	0
white-throated sparrow	1	1	0	0	0	0	0	0	0	0	0	0	0	0
short-eared owl	1	1	0	0	0	0	0	0	0	0	0	0	0	0
loggerhead shrike	1	1	0	0	0	0	0	0	0	0	0	0	0	1
least flycatcher	1	1	0	0	0	0	0	0	0	0	0	0	0	0
brown thrasher	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	**4806**	**1114**	**193**	**77**	**168**	**168**	**46**	**142**	**43**	**52**	**59**	**40**	**255**	**42**

Table 5. Summary of avian flight heights (includes flying birds only) in relation to the turbine rotor swept area (RSA)[1] during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

	Observations		Individuals	
	Number	**Percentage**	**Number**	**Percentage**
Non-raptors				
Below RSA (<41.5m)	620	100.0%	4068	100.0%
Raptors/Vultures/Owls				
Below RSA (<41.5m)	180	98.9%	199	98.5%
Within RSA (41.5m–118.5m)	2	1.1%	3	1.5%

[1]These values assume a rotor diameter of 77 (m) and a hub height of 80 (m)

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Expansion Wind Resource Area during fall 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
Swainson's hawk	0.00	0.11 (0.08 - 0.14)	84.3	95.3	4.7	0.0
red-tailed hawk	0.00	0.23 (0.19 - 0.27)	85.3	98.9	1.1	0.0
yellow warbler	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
yellow-rumped warbler	0.00	0.01 (0.00 - 0.02)	80.0	100.0	0.0	0.0
white-throated sparrow	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
western meadowlark	0.00	0.60 (0.48 - 0.72)	72.8	100.0	0.0	0.0
western kingbird	0.00	0.27 (0.18 - 0.36)	100.0	100.0	0.0	0.0
vesper sparrow	0.00	0.07 (0.04 - 0.10)	100.0	100.0	0.0	0.0
upland sandpiper	0.00	0.01 (0.00 - 0.02)	25.0	100.0	0.0	0.0
sharp-tailed grouse	0.00	0.19 (0.00 - 0.38)	92.1	100.0	0.0	0.0
Sprague's pipit	0.00	0.01 (0.00 - 0.02)	66.7	100.0	0.0	0.0
snow bunting	0.00	0.08 (0.00 - 0.19)	100.0	100.0	0.0	0.0
short-eared owl	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
savannah sparrow	0.00	0.45 (0.27 - 0.63)	100.0	100.0	0.0	0.0
Say's phoebe	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
red-winged blackbird	0.00	0.78 (0.00 - 1.85)	100.0	100.0	0.0	0.0
rock pigeon	0.00	0.04 (0.00 - 0.08)	50.0	100.0	0.0	0.0
ring-necked pheasant	0.00	0.28 (0.19 - 0.37)	5.3	100.0	0.0	0.0
rough-legged hawk	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
prairie falcon	0.00	0.01 (0.00 - 0.02)	85.7	100.0	0.0	0.0
orchard oriole	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
northern shrike	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
northern harrier	0.00	0.06 (0.04 - 0.08)	96.2	100.0	0.0	0.0
northern flicker	0.00	0.04 (0.00 - 0.08)	80.0	100.0	0.0	0.0
mourning dove	0.00	0.41 (0.27 - 0.55)	92.1	100.0	0.0	0.0
mallard	0.00	0.00 (0.00 - 0.01)	0.0	0.0	0.0	0.0

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Expansion Wind Resource Area during fall 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
loggerhead shrike	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
least flycatcher	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
Lapland longspur	0.00	0.66 (0.19 - 1.13)	98.7	100.0	0.0	0.0
killdeer	0.00	0.05 (0.01 - 0.09)	82.6	100.0	0.0	0.0
house sparrow	0.00	0.39 (0.02 - 0.76)	91.3	100.0	0.0	0.0
horned lark	0.00	0.91 (0.67 - 1.15)	80.0	100.0	0.0	0.0
Harris' sparrow	0.00	0.00 (0.00 - 0.01)	100.0	100.0	0.0	0.0
grasshopper sparrow	0.00	0.02 (0.01 - 0.03)	87.5	100.0	0.0	0.0
gray partridge	0.00	0.20 (0.07 - 0.33)	86.3	100.0	0.0	0.0
great horned owl	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
gadwall	0.00	0.04 (0.00 - 0.10)	100.0	100.0	0.0	0.0
Franklin’s gull	0.00	0.02 (0.00 - 0.05)	100.0	100.0	0.0	0.0
ferruginous hawk	0.00	0.01 (0.00 - 0.02)	75.0	100.0	0.0	0.0
European starling	0.00	1.63 (0.14 - 3.12)	99.5	100.0	0.0	0.0
eastern kingbird	0.00	0.24 (0.18 - 0.30)	86.4	100.0	0.0	0.0
dark-eyed junco	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
Cooper's hawk	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
common grackle	0.00	0.03 (0.01 - 0.05)	87.5	100.0	0.0	0.0
chipping sparrow	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
clay-colored sparrow	0.00	0.13 (0.06 - 0.20)	93.2	100.0	0.0	0.0
chestnut-collared longspur	0.00	0.14 (0.00 - 0.32)	98.5	100.0	0.0	0.0
Canada goose	0.00	0.18 (0.00 - 0.47)	0.0	0.0	0.0	0.0
brown thrasher	0.00	0.00 (0.00 - 0.00)	100.0	100.0	0.0	0.0
Brewer's blackbird	0.00	1.18 (0.16 - 2.20)	100.0	100.0	0.0	0.0
bobolink	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
brown-headed cowbird	0.00	0.13 (0.00 - 0.32)	100.0	100.0	0.0	0.0

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Oliver Expansion Wind Resource Area during fall 2008.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Below RSA	Percent Within RSA	Percent Above RSA
barn swallow	0.00	0.18 (0.07 - 0.29)	100.0	100.0	0.0	0.0
American tree sparrow	0.00	0.07 (0.02 - 0.12)	100.0	100.0	0.0	0.0
American robin	0.00	0.20 (0.11 - 0.29)	89.4	100.0	0.0	0.0
American pipit	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
American kestrel	0.00	0.04 (0.02 - 0.06)	89.5	100.0	0.0	0.0
American goldfinch	0.00	0.03 (0.01 - 0.05)	75.0	100.0	0.0	0.0
American crow	0.00	0.04 (0.00 - 0.08)	94.1	100.0	0.0	0.0

[1]These values assume a rotor diameter of 77 (m) and a hub height of 80 (m)

Table 7. Incidental observations of birds during fall point counts at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of individuals
Canada goose	2616
Lapland longspur	2000
mallard	1203
European starling	790
cackling goose	784
greater white-fronted goose	600
common grackle	556
green-winged teal	475
least sandpiper	359
gadwall	290
semipalmated sandpiper	287
Baird's sandpiper	207
pectoral sandpiper	199
American robin	198
ring-necked pheasant	166
killdeer	144
horned lark	131
double-crested cormorant	127
red-tailed hawk	126
mourning dove	118
American white pelican	102
American coot	102
lesser scaup	94
blue-winged teal	89
gray partridge	80
northern shoveler	79
yellow-rumped warbler	77
marbled godwit	62
barn swallow	62
redhead	58
savannah sparrow	56
canvasback	50
Swainson’s hawk	46
stilt sandpiper	42
brown-headed cowbird	40
pied-billed grebe	37
snow goose	31
yellow-headed blackbird	30
western meadowlark	30
sharp-tailed grouse	26
ruddy duck	26

Table 7. Incidental observations of birds during fall point counts at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of individuals
chestnut-collared longspur	25
northern harrier	23
great blue heron	22
western grebe	21
red-winged blackbird	21
American wigeon	21
ring-billed gull	19
American kestrel	18
white-throated sparrow	15
ring-necked duck	14
long-billed dowitcher	14
great horned owl	13
white-crowned sparrow	12
Wilson's phalarope	10
northern flicker	9
Say's phoebe	8
Sprague's pipit	6
northern pintail	6
vesper sparrow	5
turkey vulture	5
semipalmated plover	5
clay-colored sparrow	5
Brewer's blackbird	5
Leach's storm-petrel	4
great black-hawk	4
ferruginous hawk	4
prairie falcon	3
dark-eyed junco	3
black-crowned night-heron	3
American avocet	3
wood duck	2
western kingbird	2
tundra swan	2
rough-legged hawk	2
merlin	2
marsh wren	2
lesser yellowlegs	2
least flycatcher	2
Harris' sparrow	2
cliff swallow	2
bufflehead	2

Table 7. Incidental observations of birds during fall point counts at the Oliver Expansion Wind Resource Area, 2008.

Species	Number of individuals
brown thrasher	2
blue jay	2
yellow warbler	1
Wilson's warbler	1
Wilson's snipe	1
upland sandpiper	1
spotted sandpiper	1
sedge wren	1
short-eared owl	1
peregrine falcon	1
orange-crowned warbler	1
northern shrike	1
northern goshawk	1
Lincoln’s sparrow	1
Harlan's hawk	1
greater yellowlegs	1
eared grebe	1
bobolink	1
belted kingfisher	1
Grand Total	**12964**

Table 8. Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology. Project sites sorted by highest to lowest fall mean use by raptors.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Survey Duration (minutes) [a]	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann			
Altamont Pass, CA	3.80	3.00	4.60	3.00							10	Orloff and Flannery (1992)	x 2
Tehachapi Pass, CA	0.87	0.39	2.36	0.94	1.09	0.00	0.00	0.00	0.01	0.00	20	Erickson et al. (2002)	
Dairy Hills, NY	1.90		1.75			1.80		25.12			60	Young et al. (2006)	x0.50
Cotterel Mountain, ID	1.69	1.89	1.49	0.18		14.26	11.22	7.65	8.86		20	USDI and BLM (2005)	
Foote Creek WEC, WY	0.49	0.76	0.97	0.21							40	Johnson et al. (2000)	x 0.5
Hatchet Ridge, CA	0.70	1.03	0.91	0.12	0.69	5.24	6.94	6.32	4.03	5.65	30	Young et al. (2007a)	x0.67
Buffalo Ridge Phase III, MN	0.64	0.54	0.85	0.18							20	Erickson et al. (2002)	
Buffalo Ridge Phase II, MN	0.84	0.69	0.83	0.10							20	Erickson et al. (2002)	
Windy Flats, WA	0.77	0.88	0.82	0.86		21.51	13.96	16.03	24.56		20	Johnson et al. (2007b)	
Elkhorn, OR	0.81	1.56	0.79			29.43	12.15	20.36			20	WEST (2005a)	
Columbia Hills, WA	0.94	1.34	0.78	0.26							20	Erickson et al. (2002)	
Buffalo Ridge Phase I, MN	0.65	0.43	0.76	0.13							20	Erickson et al. (2002)	

[a] All surveys used an 800 meter plot radius.
[b] Multiplication factor to standardize mean use to birds/20 min.
[c] Mostly unidentified blackbirds.

Table 8. (cont.) Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology. Project sites sorted by highest to lowest fall mean use by raptors.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Survey Duration (minutes) [a]	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann			
Combine study of: Kittitas Valley; Desert Claim; Wild Horse, WA	0.89	0.85	0.76	0.51	0.75	11.72	8.18	7.99	15.64	10.88	20	Young et al. (2003)	
Kittitas Valley, WA	1.01	1.03	0.73			14.13	8.13	11.47			20	Erickson et al. (2003a)	
Zintel Canyon, WA	0.19	0.30	0.70	0.51							20	Erickson et al. (2002)	
Buffalo Ridge, MN	0.68	0.52	0.69	0.44							20	Erickson et al. (2002)	
Maiden, WA	0.30	0.35	0.62	0.15		4.58	4.71	11.93	8.58		30	Young et al. (2002a)	x 0.67
Sunshine Wind Park, AZ			0.58		0.00	9.12		33.29	37.50	0.00	30	WEST et al. (2006)	
White Creek, WA	0.46	0.87	0.56	0.38		9.91	9.10	15.24	11.01		20	Kronner et al. (2005a)	
Shepherds Flat, OR	0.44	0.49	0.55	0.32		8.98	14.71	5.22	3.97		20	Welch and Schleder (2006)	
Leaning Juniper, OR	0.39	1.07	0.53	0.24		11.36	5.68	19.09	47.00		20	Kronner et al. (2005b)	
Oliver, ND	0.26		0.49			10.35		9.78				This Study	
Combine Hills, OR	0.80	0.56	0.44	0.64		5.96	2.63	1.34	2.68		30	Young et al. (2002b)	x 0.67
Klondike Phase I, OR	0.47	0.39	0.38	0.56							20	Erickson et al. (2002)	
Golden Hills, OR	0.90	0.56	0.38	0.44	0.00	8.53	6.40	9.12	22.30	0.00	20	Jeffrey et al. (2007)	
Wild Horse, WA	0.46	0.46	0.31	0.14		5.78	5.78	4.02	3.59		30	Erickson et al. (2003b)	x 0.67

[a] All surveys used an 800 meter plot radius.
[b] Multiplication factor to standardize mean use to birds/20 min.
[c] Mostly unidentified blackbirds.

Table 8. (cont.) Comparison of raptor and other bird use per 20-minute survey with other studies of wind projects using the similar survey methodology. Project sites sorted by highest to lowest fall mean use by raptors.

Project Site	Mean Use by Raptors					Mean Use by Other Birds					Survey Duration (minutes) [a]	Reference	Correction factor [b]
	Spr	Sum	Fall	Win	Ann	Spr	Sum	Fall	Win	Ann			
Condon, OR	0.53	0.33	0.29	0.45	0.40	0.01	0.00	0.03	0.00	0.01	20	Erickson et al. (2002)	
Stateline Wind EIS, OR/WA	0.59	0.40	0.25	0.42		7.09	5.47	29.34	9.04		20	URS and West (2001)	
Dry Lake, AZ	0.08	0.14	0.21	0.14	0.15	8.10	11.02	16.10	18.00	13.52	30	Young et al. (2007b)	x0.67
Biglow Canyon project area, OR	0.31	0.39	0.19	0.32		10.17	3.34	7.18	11.66		30	WEST (2005b)	x 0.67
Stateline Wind, OR/WA	0.28	0.26	0.16	0.02	0.22					23.08	10	Erickson et al. (2004)	x 2
Klickitat County PEIS study area, WA	0.96	1.12				14.39	12.36				20	Johnson et al. (2006a)	
Bighorn Site, WA	0.40	0.44				9.72	10.04				20	Johnson and Erickson (2004)	
Hoctor Ridge, WA	1.42	1.33				10.00	17.92				20	Johnson et al. (2006b)	
Sand Ridge, WA	0.34	0.46				6.19	5.21				20	Johnson et al. (2007c)	
Lower Linden Ranch, WA	1.37					11.63					20	Johnson et al. (2007d)	
High Winds, CA					6.72					474[c]	20	Kerlinger et al. (2006)	
Klondike Phase III, OR				0.13					34.90		20	Mabee et al. (2005)	

[a] All surveys used an 800 meter plot radius.
[b] Multiplication factor to standardize mean use to birds/20 min.
[c] Mostly unidentified blackbirds.

APPENDIX

Appendix 1. Flight directions of birds observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
European starling	760	23	7.6	13.4	5.5	2.1	8.7	0.0	55.5	0.0	7.1
Brewer's blackbird	551	6	39.0	0.0	0.0	0.0	31.8	27.2	0.2	0.0	1.8
red-winged blackbird	366	7	0.8	0.0	0.3	0.0	15.3	0.0	0.8	82.0	0.8
horned lark	341	93	30.8	0.6	12.3	2.3	17.0	0.0	30.5	1.5	5.0
Lapland longspur	304	10	3.3	0.0	0.0	15.5	8.6	0.0	38.2	0.0	34.5
savannah sparrow	211	56	12.8	0.9	14.2	14.2	10.4	0.0	44.1	0.0	3.3
western meadowlark	206	88	14.6	2.4	14.6	0.5	14.1	4.9	36.4	9.2	3.4
mourning dove	176	54	5.7	0.0	19.9	9.1	16.5	12.5	28.4	1.1	6.8
house sparrow	167	10	3.0	0.6	3.6	89.8	1.8	0.0	0.0	0.0	1.2
western kingbird	126	48	19.0	0.0	9.5	4.8	4.8	0.0	15.9	7.1	38.9
eastern kingbird	95	52	2.1	1.1	18.9	5.3	5.3	0.0	7.4	11.6	48.4
red-tailed hawk	93	85	3.2	8.6	8.6	16.1	10.8	17.2	19.4	12.9	3.2
barn swallow	86	31	5.8	1.2	4.7	2.3	23.3	38.4	8.1	4.7	11.6
American robin	84	20	19.0	0.0	14.3	3.6	27.4	0.0	35.7	0.0	0.0
sharp-tailed grouse	82	7	80.5	0.0	19.5	0.0	0.0	0.0	0.0	0.0	0.0
gray partridge	82	7	12.2	0.0	51.2	14.6	0.0	9.8	12.2	0.0	0.0
chestnut-collared longspur	64	4	0.0	1.6	78.1	0.0	7.8	0.0	12.5	0.0	0.0
brown-headed cowbird	63	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
clay-colored sparrow	55	12	12.7	0.0	0.0	5.5	9.1	0.0	40.0	0.0	32.7
Swainson’s hawk	43	37	9.3	4.7	7.0	20.9	37.2	2.3	2.3	9.3	7.0
snow bunting	36	2	0.0	0.0	0.0	0.0	83.3	0.0	0.0	0.0	16.7
vesper sparrow	31	22	22.6	0.0	35.5	0.0	25.8	3.2	12.9	0.0	0.0

Appendix 1. Flight directions of birds observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
American tree sparrow	31	8	45.2	0.0	0.0	0.0	0.0	0.0	12.9	0.0	41.9
northern harrier	25	24	12.0	12.0	20.0	12.0	32.0	4.0	8.0	0.0	0.0
killdeer	19	7	10.5	0.0	21.1	5.3	5.3	0.0	10.5	47.4	0.0
gadwall	17	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
American kestrel	17	14	5.9	11.8	11.8	11.8	11.8	17.6	11.8	5.9	11.8
northern flicker	16	5	12.5	0.0	0.0	0.0	0.0	0.0	81.3	6.3	0.0
American crow	16	2	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
common grackle	14	6	35.7	0.0	28.6	0.0	21.4	0.0	14.3	0.0	0.0
rock pigeon	10	2	0.0	0.0	20.0	0.0	80.0	0.0	0.0	0.0	0.0
Franklin’s gull	8	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
American goldfinch	8	5	25.0	0.0	12.5	0.0	62.5	0.0	0.0	0.0	0.0
ring-necked pheasant	7	2	57.1	0.0	0.0	0.0	0.0	0.0	42.9	0.0	0.0
grasshopper sparrow	7	5	0.0	0.0	57.1	0.0	0.0	0.0	42.9	0.0	0.0
rough-legged hawk	6	6	16.7	0.0	0.0	66.7	16.7	0.0	0.0	0.0	0.0
prairie falcon	6	6	0.0	0.0	33.3	0.0	33.3	16.7	0.0	0.0	16.7
Say's phoebe	5	5	0.0	20.0	0.0	0.0	0.0	20.0	20.0	0.0	40.0
yellow-rumped warbler	4	2	0.0	0.0	0.0	0.0	0.0	25.0	75.0	0.0	0.0
great horned owl	4	4	25.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0
Cooper's hawk	4	2	0.0	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
chipping sparrow	4	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
bobolink	4	2	0.0	0.0	0.0	25.0	75.0	0.0	0.0	0.0	0.0
ferruginous hawk	3	3	0.0	0.0	0.0	66.7	0.0	0.0	0.0	33.3	0.0

Appendix 1. Flight directions of birds observed during fall point count surveys at the Oliver Expansion Wind Resource Area, 2008.

Species	Number Flying	Number of Observations	Percentage of Flights in Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
Sprague's pipit	2	2	0.0	50.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
orchard oriole	2	2	0.0	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0
northern shrike	2	2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harris' sparrow	2	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
dark-eyed junco	2	2	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
yellow warbler	1	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
white-throated sparrow	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
upland sandpiper	1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
short-eared owl	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
loggerhead shrike	1	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
least flycatcher	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
brown thrasher	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Grand Total	**4274**	**806**	**15.1**	**3.2**	**9.4**	**7.9**	**15.1**	**5.8**	**24.2**	**9.1**	**10.2**

DRAFT

NATIVE PRAIRIE SURVEY
OLIVER EXPANSION
PHASES III, IV, AND V
WIND RESOURCE AREA
MORTON & OLIVER COUNTIES
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 southwest North Dakota (Figure 1). The Oliver Expansion Wind Resource Area is located on 175,945 acres of private and state-owned land in Oliver and Morton Counties in North Dakota. Although there are no federal or state regulations explicitly protecting native prairie, the U.S. Fish and Wildlife Service highlighted the significance of native prairie in response to an inquiry letter with respect to development at this location sent during the Critical Issues Analysis and recommend avoiding areas of native prairie. 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 Dakota skipper (*Hesperia dacotae*) habitat.

To achieve these goals, a field biologist conducted ground surveys of the original 107,158 acre layout on July 29, 2009. After completion of these surveys, the Project boundary was changed to include an additional 68,787 acres not previously surveyed. The current Oliver Expansion Wind Resource Area (hereafter, Project Area) layout dated June 9, 2009 totals 175,945 acres in Oliver and Morton Counties. A field biologist conducted ground surveys on the added 68,787 acres from June 15 to July 8, 2009. The results presented in this report include the total 175,945-acre expanded Project Area, with the exception of 364 acres that was not surveyed due to no access.

The habitat types typically found within the Project Area are agricultural croplands and grasslands (including native prairie and tame grasslands). The field biologist classified 60,645 acres (34 percent of the total Project Area) as native prairie and 1,741 acres (1 percent of the total Project Area) as tame grasslands; the remaining acreage consists primarily of agricultural croplands. Large contiguous areas of native prairie are found in the central Oliver County sections, although even these areas are intermixed with tame grasslands. Grasslands (both native and tame) are more fragmented and less abundant in the remaining portion of the Project Area.

The Dakota skipper, a species of butterfly which is currently classified as a federal candidate species, may occur within the Project Area. The field biologist classified 15,162 acres of native prairie within the Project Area as excellent and 32,463 acres as good Dakota skipper habitat. This is approximately 76 percent of the total grassland habitat identified by the biologist.

At the time of report preparation, a proposed turbine layout was available for Phase III of the Oliver Expansion Wind Resource Area. The proposed turbine layout, dated September 21, 2009, proposes installation of 33 1.5-MW GE wind turbines. Under the proposed configuration, 47 percent of these turbines would be placed within native prairie (16 turbines). One of the proposed turbines falls within excellent Dakota skipper habitat. Nine of the proposed turbine locations lie within good Dakota skipper habitat.

Oliver Expansion Wind Resource Area 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 after the completion of the 2009 surveys.
- 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.
- Avoid development on CRP lands. If placement within CRP lands is unavoidable, consult with the USDA-FSA on permitting/payback requirements.
- Regularly check with the appropriate agencies (USFWS, U.S. Department of Agriculture-Farm Service Agency and North Dakota Department of Game and Fish) to determine if they have developed a formal definition to evaluate prairie quality.

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1. Introduction

NextEra Energy Resources, LLC (NextEra Energy), is planning to develop a wind energy conversion facility in southwest North Dakota (Figure 1). The Oliver Expansion Wind Resource Area (hereafter, Project Area) is located on 175,945 acres of private and state-owned land in Oliver and Morton Counties in North Dakota. At the time of the 2008 native prairie surveys, the Oliver Expansion Wind Resource Area encompassed 107,158 acres. After completion of these surveys, the Project boundary was changed to include an additional 68,787 acres not previously surveyed. The results presented in this report are inclusive of the total 175,945-acre expanded Project Area with the exception of 364 acres that was not surveyed due to no access. The Project Area currently encompasses land that consists primarily of agricultural crops and grasslands (both tame grasslands and native prairie). Of these habitats, native prairie has been noted as significant by the U.S. Fish and Wildlife Service (USFWS) in response to an inquiry letter with respect to development at this location sent during the Critical Issues Analysis. In this letter, 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 dacota*), 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 Slope Upland (also called the Missouri Plateau and River Breaks) ecoregion (Bryce et al. 1998). This semiarid rolling plain is punctuated with occasional buttes and badlands. Dryland farming and cattle grazing are the common land uses, but areas of native mixed-grass prairie remain. The mixed-grass prairie within the Missouri Slope Upland is dominated by blue grama (*Bouteloua gracilis*), western wheatgrass (*Agropyron smithii*), green needlegrass (*Stipa viridula*), little bluestem (*Andropogon scoparius*), and prairie sandreed (*Calamovilfa longifolia*, Samson et al. 1998). Tame grasslands are also found in the ecoregion.

Native prairies, which are areas of unbroken 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 (i.e., 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 (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, 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.

In addition to native habitat, human-generated habitats can provide value to wildlife and may require an additional level of permitting if developed. The U.S. Department of Agriculture – Farm Service Agency (USDA-FSA) maintains records of lands reserved under the Conservation Reserve Program (CRP) as part of the conservation programs designated by the Farm Bill of 1985 (revised in May 22, 2008). CRP is a voluntary program for agricultural landowners designed to protect millions of acres of American topsoil from erosion. Acreage enrolled in the CRP is planted to resource-conserving vegetative covers, making the program a major contributor to increased wildlife populations in many parts of the country (USDA-FSA 2007). These tracts cannot be hayed, tilled, seeded, or otherwise disturbed (including disturbance associated with powerline or other project construction) without authorization from the USDA. If wind turbines are placed on CRP lands, the enrolled private landowner will be required to withdraw the

affected acreage from the contract and may even be required to pay money back to the federal government. Also, agencies have become concerned that removing lands from the CRP will increase the loss of undisturbed habitat and result in a loss of native grassland birds.

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 June to July 2008 and from June to July 2009. These dates encompass 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, a range ecologist/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. If access was blocked due to locked gate, the area was not included in the survey.

When grasslands were encountered during field surveys, the range ecologist/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. Areas that appeared to have been tilled and were comprised of mostly non-native species were classified as tame grasslands. 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; 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 all 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, and the presence of key plant species which the Dakota skipper depends upon (e.g., bluestem (*Andropogon* species), coneflower (*Echinacea* species), and camas (*Zygadenus* species)). Excellent habitat was defined as grasslands, both tame grasslands or 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 grasslands or 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.

The North Dakota State office of the USDA-FSA was contacted regarding the location of CRP lands within and adjacent to the original Project Area prior to surveys in 2008. The USDA provided this information as digital files which could be assessed using ArcGIS 9.3. This allowed the locations of CRP lands within the original Project Area to be compared to the proposed location of the turbines. The 2008 Farm Bill prohibited the state USDA offices from releasing CRP location data in a similar format for the expanded Project Area; thus information related to CRP lands in the expanded Project Area is not available at this time. CRP lands within the original Project Area, based on boundary dated December 3, 2007, are discussed in the August 2008 Native Prairie Report (TtEC 2008).

3. Results

This report was prepared utilizing the Project boundary dated June 6, 2009 and includes the results from 2008 and 2009 native prairie surveys within the Project Area. A total of 60,645 acres (34 percent of the total Project Area) was classified as native prairie, and 1,741 acres (1 percent of the total Project Area) were classified as tame grasslands (Figure 2). Large contiguous areas of native prairie were found in the central portion of the Project Area in Oliver County. These areas were intermixed with tame grasslands. Grasslands (both native and tame) are more fragmented and less abundant in the remaining Project Area.

A total of 23 grass (22 percent non-native), 6 tree and shrub (none non-native) and 137 forb (8 percent non-native) species were identified in native prairies within the Project Area (Table 1). Fourteen grass (36 percent non-native), 2 tree and shrub (none non-native) and 43 forb (14 percent non-native) species were identified in tame grasslands within the Project Area (Table 2). Four species listed as North Dakota State Noxious Weeds were found within the Project Area: absinthe wormwood, Canada thistle, field bindweed, and leafy spurge (North Dakota Century Code 2003). An additional eight species listed as North Dakota State Invasive Species were found within the Project Area: black medic, cattail, crested wheatgrass, field sow thistle, Japanese brome, Kentucky bluegrass, smooth brome, and quackgrass. None of the plant species detected within the Project Area are listed as federally endangered or threatened.

A total of 15,162 acres of native prairie were classified as excellent habitat for the Dakota skipper (Figure 3). This is approximately 24 percent of the total grassland habitat present within Project Area. An additional 32,463 acres of native prairie were classified as good Dakota skipper habitat, or approximately 52 percent of the total grassland habitat. Over two-thirds (76 percent) of grassland habitat within the Project Area was classified as either excellent or good skipper habitat. The largest areas of habitat classified as excellent for the Dakota skipper is located in the central portion of the Project Area in Oliver County. Smaller areas of excellent habitat are distributed throughout the western and southeastern portions of the Project Area.

At the time of report preparation, a proposed turbine layout was available for Phase III of the Oliver Expansion Wind Resource Area. The proposed turbine layout, dated September 21, 2009, proposes installation of 33 1.5-MW GE wind turbines (the layout includes 33 turbines plus one alternate location). Under the proposed configuration, 47 percent of these turbines would be placed within native prairie (16 turbines). One of the proposed turbines falls within excellent Dakota skipper habitat (Figure 4. Nine of the proposed turbine locations lie within good Dakota skipper habitat (Figure 4).

4. Discussion

Prairies are an ecosystem of conservation concern and the USFWS noted the significance of native prairie in response to an inquiry letter with respect to development at this location sent during the Critical Issues Analysis (Samson et al. 2004). Native prairie comprised 34 percent of the Project Area and, and under the current configuration, 47 percent of turbines would be located within native prairie in the Phase III of the Project Area. The USFWS recommended:

- Avoidance of areas of native prairie, if possible. Where practical, turbines should be placed on lands already altered or cultivated, and away from areas of intact and healthy native habitats.
- Minimize roads, fences and other infrastructure.
- Minimize the number of turbines by using fewer, larger turbines.

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 prairie potholes within the Project Area could provide important breeding and stopover habitat for various waterfowl and shorebird species, such as those potholes present in the western and central portions of the Project Area.

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). 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). Invasive species management is left up to landowners, depending upon their management goals. 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 high availability of Dakota skipper habitat within the Project Area, any reduction of native prairie, especially to habitats classified as excellent or good, is not likely to have an impact to local Dakota skipper populations, if present. However, large amounts of unfragmented, excellent Dakota Skipper habitat exist in the central portion of the Project Area in Oliver County and these areas have the highest potential for Dakota skipper presence. 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 (Figure 3).

If wind turbines are placed on CRP lands, the enrolled private landowner will be required to withdraw the affected acreage from the contract and may be required to pay money back to the federal government; therefore, installation of wind turbines on CRP lands within the Project Area should be avoided, if possible (USDA-FSA 2007). If that is not an acceptable option, the proposed wind turbines should be sited accordingly (i.e., locate along the edges of CRP lands, where the access roads and other facilities can still be placed on non-CRP lands). Typically, development of CRP land is considered a federal action, and the USDA - FSA may conduct an environmental review through National Environmental Protection Act (NEPA) requirements and complete either a FSA-850 (similar to an Environmental Assessment [EA]) or an EA (16 U.S.C. 3801-3862); however, there is an option for developers to avoid this level of study by mitigating the loss of CRP lands by paying monies to the USDA-FSA for loss of lands due to development. The payment process goes as follows:

- Once the towers are complete and the permanent access roads are delineated, the footprint of the turbine tower and the access roadways would be measured and taken out of the CRP contract.
- The owner and the operator would have to repay the money received from the government on the acres taken out of the CRP contract, this would be the rental payments, liquidated damages and if applicable, cost shares to establish the grass cover.
- The CRP acres that are not involved with the tower or roadway would not be affected and those acres would be eligible to remain in CRP until the contract expires.

Even with the option of a payment policy, avoiding CRP lands is still the preferred option by the USDA-FSA; therefore, the turbines previously proposed for lands enrolled in the CRP should be relocated if possible.

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:

- If unsurveyed areas are planned for development, native prairie and Dakota skipper habitat surveys should be conducted.
- 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.
- Avoid development on CRP lands. If placement within CRP lands is unavoidable, consult with the USDA-FSA on permitting/payback requirements.
- Regularly check with the appropriate agencies (USFWS, USDA-FSA and North Dakota Department of Game and Fish) to determine if they have developed a formal definition to evaluate prairie quality.

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

Forbs			
Scientific name	**English name**	**Scientific name**	**English name**
Achillea millefolium L	common yarrow	*Chrysothamnus nauseosus* (Pall.) Britt.	rubber rabbit brush
Aeysimum asperum (Nutt.) DC.	western wallflower	***Cirsium arvense* (L.) Scop.**	**Canada thistle***
Agroseris glauca (Pursh) Dietr.	false dandelion	*Cirsium flodmanii* (Rydb.) Arthur	Flodman's thistle
Allium textile A. Nels & Macbr.	textile wild onion	*Cirsium undulatum* (Nutt.) Spreng.	wavy-leaf thistle
Amorpha canescens Pursh	leadplant	*Collomia linearis* Nutt.	collomia
Amorpha nana Nutt.	dwarf wild indigo	*Comandra umbellata* (L.) Nutt.	bastard toadflax
Androsace species	rock jasmine	***Convolvulus arvensis* L.**	**field bindweed***
Anemone canadensis L.	meadow anemone	***Conyza canadensis* (L.) Cronq.**	**horseweed**
Anemone cylindrica A. Gray	candle anemone	*Coryphantha vivipara* (Sweet) Britt.& Rose	pincushion cactus
Anemone patens L.	pasque flower	*Dalea purpurea* Vent.	purple prairie clover
Antennaria parviflora Nutt	pussy-toes	*Descuraninia sophia* (L.) Webb ex Prantl.	flixweed
Antennaria species	pussy-toes	*Echinacea angustifolia* DC.	purple coneflower
Apocynum androsaemifolium L.	spreading dogbane	*Erigeron caespitosus* Nutt.	fleabane
Arabis holboellii Hornem. var. *retrofacta*	rock cress	*Erigeron glabellus* Nutt	beautiful fleabane
Arabis species	rockcress species	*Erigeron* sp.	fleabane species
Arnica fulgens Pursh.	shining arnica	*Erigeron strigosis* Muhl. Ex Willd.	daisy fleabane
***Artemisia absinthium* L**	**absinthe wormwood***	*Eriogonum flavum* Nutt.	yellow wild buckwheat
Artemisia campestris L. subsp. Caudata (Michx.) Hall & Clem.	western sagewort	*Eriogonum pauciflorum* Pursh	fewflower wild buckwheat
Artemisia dracunculus L.	green sage	*Eriogonum* sp.	wild buckwheat
Artemisia frigida Willd.	fringed sage	*Erysimum asperum* (Nutt.) DC	western wallflower
Artemisia ludoviciana Dcne.	white sagewort	*Erysimum cheiranthoides* L	wormseed wallflower
Asclepias ovalifolia Dcne.	ovalleaf milkweed	*Erysimum* sp.	wallflower species
Asclepias speciosa Torr.	showy milkweed	***Euphorbia esula* L.**	**leafy spurge***
Asclepias viridiflora Raf.	green milkweed	*Gaillardia aristata* Pursh	blanket flower
Astragalus adsurgens Pall. var. robustior Hook.	standing milk-vetch	*Galium boreale* L.	northern bedstraw
Astragalus agrestis Dougl. Ex G. Don	field milkvetch	*Gaura coccinea* Pursh	scarlet gaura
Astragalus crassicarpus Nutt.	groundplum	*Glycyrrhiza lepidota* Pursh.	American licorice
Astragalus gilviflorus Sheld.	plains orophaca	*Glycyrrhiza lepidota* Pursh.	wild licorice
Astragalus missouriensis Nutt.	Missouri milkvetch	*Grindelia squarrosa* (Pursh) Dun.	curly-top gumweed
Calamagrostis stricta (Timm.) Koel.	reedgrass	*Gutierrezia sarothrae* (Pursh) Britt. & Rusby	broom snakeweed
Calamovilfa longifolia (Hook.) Scribn.	prairie sandreed	*Haplopappus spinulosus* (Pursh) DC.	cutleaf ironplant
Calylophus serrulatus (Nutt.) Raven	plains yellow primrose	*Helianthus rigidus* (Cass.) Desf.	stiff sunflower
Campanula rotundifolia L.	harebell	*Heuchera richardsonii* R. Br.	alumroot

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

Castilleja sessiliflora Pursh	downy paintbrush	*Lactuca oblongifolia* Nutt.	blue lettuce
Cerastium arvense L.	prairie chickweed	*Lactuca* sp.	wild lettuce species
Ceratoides lanata (Pursh) Howell	winterfat	*Lepidium densiflorum* Schrad.	peppergrass
Chrysopsis villosa (Pursh) Nutt.	hairy gold aster	*Lesquerella* cf. *ludoviciana* (Nutt.) S. Wats	Great Plains bladderpod

Forbs			
Scientific name	**English name**	**Scientific name**	**English name**
Lesquerella sp.	bladderpod species	*Ranunculus flammula*	
Liatris punctata Hook.	dotted blazing star	*Ratibida columnifera* (Nutt.) Woot. & Standl.	prairie coneflower
Linum rigidum Pursh.	stiffstem flax	*Rosa arkansana* Porter	prairie wildrose
Lithospermum incisum Lehm.	narrowleaf gromwel	*Rudbeckia hirta* L.	black eyed susan
Lomatium foeniculaceum (Nutt.) Coult. & Rose	desert biscuitroot	*Rumex* sp.	dock species
Lotus purshianus (Benth.) Clem. & Clem.	deer vetch	*Senecio canus* Hook.	gray ragwort
Lygodesmia juncea (Pursh) Hook.	skeleton weed	*Senecio* cf. *tridenticulatus* Rydb.	threetooth ragwort
***Medicago lupulina* L.**	**black medic†**	*Senecio plattensis* Nutt.	prairie ragwort
***Medicago sativa* L.**	**alfalfa**	*Senecio* sp.	ragwort species
***Melilotus officinalis* (L.) Pall.**	**yellow sweet clover**	*Sisyrinchium montanum* Greene	blue-eyed grass
Mertensia lanceolata (Pursh) A. DC.	bluebells	*Sisyrinchium* species	blue-eyed grass
Monarda fistulosa L.	wild bergamot	*Solidago canadensis* L.	Canada goldenrod
Musineon divaricatum (Pursh) Nutt.	wild parsley	*Solidago missouriensis* Nutt.	prairie goldenrod
Oenothera caespitosa Nutt.	gumbo lily	*Solidago mollis* Bartl.	soft goldenrod
Opuntia fragilis (Nutt.) Haw.	little prickly pear	*Solidago rigida* L.	stiff goldenrod
Opuntia polyacantha Haw.	plains prickly pear	*Solidago* sp.	goldenrod species
Orobanche fasciculata Nutt.	broomrape	*Sonchus arvensis* L.	field sow thistle†
Oxytropis lambertii Pursh	purple locoweed	*Sonchus* sp.	sow thistle species
Penstemon albidus Nutt.	white beardtongue	*Sphaeralcea coccinea* (Nutt.) Rydb.	scarlet globe mallow
Penstemon angustifolius Nutt. ex Pursh	narrow beardtongue	***Taraxacum officinale* Weber**	**common dandelion**
Penstemon eriantherus Pursh	crested beardtongue	*Thermopsis rhombifolia* Nutt. ex Richards.	prairie buck bean
Penstemon glaber Pursh.	beardtongue	***Thlaspi arvense* L.**	**pennycress**
Penstemon gracilis Nutt.	slender beardtongue	***Tragopogon dubius* Scop.**	**goat's beard**
Potentilla sp.	cinquefoil species	*Typha* sp.	cattail†
Psoralea argophylla Pursh	silver-leaf scurfpea	*Vicia americana* Muhl. ex Willd.	American vetch
Psoralea esculenta Pursh	breadroot scurf pea	*Viola pedatifida* G. Don	prairie violet
Psoralea sp.	scurf pea species	*Zigadenus venenosus* S. Wats.	death camass
Penstemon nitidus Dougl. ex Benth.	waxleaf penstemon		
Penstemon sp.	beardtongue		

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

Phlox hoodii Rich.	Hood's phlox	**Trees and Shrubs Scientific Name**	**Trees and Shrubs Scientific Name**
Plantago patagonica Jacq.	wooly plantain	*Juniperus communis* L.	*Juniperus communis* L.
Polygala alba Nutt.	white milkwort	*Prunus pumila* L. var. *besseyi* (Bailey) GI.	*Prunus pumila* L. var. *besseyi* (Bailey) GI.
Potentilla arguta Pursh	tall cinquefoil	*Rhus aromatic* Ait.	*Rhus aromatic* Ait.
Potentilla pensylvanica L.l	Pennsylvania cinquefoil	*Rosa species*	*Rosa species*
Grasses			*Juniperus communis* L.
Scientific name	**English Name**	*Prunus pumila* L. var. *besseyi* (Bailey) GI.	*Prunus pumila* L. var. *besseyi* (Bailey) GI.
***Agropyron cristatum* (L.) Gaertn**	**crested wheatgrass†**		
Agropyron dasystachyum (Hook) Scribn	thickspike wheatgrass		
***Agropyron repens* (L.) Beauv.**	**quack grass**		
Agropyron smithii Rybd	western wheatgrass		
Andropogon scoparius Michx.	little bluestem		
Bouteloua gracilis (H.B.K.) Lag. ex. Griffiths	blue grama		
***Bromus inermis* Leyss.**	**smooth brome†**		
***Bromus japonicus* Thunb. ex Murr.**	**Japanese brome†**		
Buchloe dactyloides (Nutt.)Engelm.	buffalo grass		
Carex eleocharis Bailey	needleleaf sedge		
Carex sp.	sedge species		
Carex filifolia Nutt.	threadleaf sedge		
Dichanthelium cf. *oligosanthes* (Schult.) Gould var. *scribnerianum* (Nash) Gould	Scribner's rosette grass		
Carex heliophila Mack.	sunsedge		
Hordeum jubatum L.	foxtail barley		
Koeleria pyramidata (Lam.) Beauv.	junegrass		
***Poa pratensis* L.**	**Kentucky bluegrass†**		
Puccinellia nuttalliana (Schult.) A. Hitchc.	alkali grass		
Spartina pectinata Link	prairie cordgrass		
Schizachyrium scoparium	little bluestem		
Stipa comata Trin. & Rupr.	needle-and-thread grass		
Stipa spartea Trin.	porcupine-grass		
Stipa viridula Trin.	green needle grass		

- Species in bold are non-native.
- * 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 Oliver Expansion Wind Energy Center with non-native species in bold.

Forbs			
Scientific name	**English name**	**Scientific name**	**English name**
Achillea millefolium L.	common yarrow	*Potentilla arguta* Pursh	tall cinquefoil
Allium textile A. Nels & Macbr.	textile wild onion	*Psoralea argophylla* Pursh	silver-leaf scurf pea
Anemone patens L.	pasque flower	*Psoralea esculenta* Pursh	breadroot scurf pea
Arabis holboellii Hornem. var. retrofacta	rock cress	*Ratibida columnifera* (Nutt.) Woot. & Standl.	prairie coneflower
Arnica fulgens Pursh.	shining arnica	*Rumex* sp.	dock species
***Artemisia absinthium* L.**	**absinthe wormwood***	*Senecio plattensis* Nutt.	prairie ragwort
Artemisia campestris L. subsp. *caudata* (Michx.) Hall & Clem.	western sagewort	*Solidago mollis* Bartl.	soft goldenrod
Artemisia frigida Willd.	fringed sagewort	*Sphaeralcea coccinea* (Pursh) Rydb.	red false mallow
Artemisia ludoviciana Nutt.	white sagewort	***Taraxacum officinale* Weber**	**common dandelion**
Asclepias speciosa Torr.	showy milkweed	***Thlaspi arvense* L.**	**pennycress**
Asclepias viridiflora Raf.	green milkweed	***Tragopogon dubius* Scop.**	**goat's beard**
Chrysopsis villosa (Pursh) Nutt.	hairy gold aster		
Cirsium undulatum (Nutt.) Spreng.	wavy-leaf thistle		
***Convolvulus arvensis* L.**	**field bindweed***		
Echinacea angustifolia DC.	purple coneflower		
Erysimum asperum (Nutt.) DC.	western wallflower		
Galium boreale L.	northern bedstraw		
Gaura coccinea Pursh	scarlet gaura		
Gutierrezia sarothrae (Pursh) Britt. & Rusby	broom snakeweed		
Helianthus sp.	sunflower species		
Lactuca oblongifolia Nutt.	blue lettuce		
Liatris punctata Hook.	dotted blazing star		
Lomatium foeniculaceum (Nutt.) Coult. & Rose	desert biscuitroot		
Lotus purshianus (Benth.) Clem. & Clem.	deer vetch		
***Medicago lupulina* L.**	**black medic**†		
***Medicago sativa* L.**	**alfalfa**		
Melilotus officinalis (L.) Pall.	yellow sweet clover		
Melilotus sp.	**sweet clover**		
Oxytropis lambertii Pursh	purple locoweed		
Penstemon albidus Nutt.	white beardtongue		
Penstemon gracilis Nutt.	slender beardtongue		
Plantago patagonica Jacq.	wooly plantain		

Grasses	
Scientific Name	**English Name**
***Agropyron cristatum* (L.) Gaertn**	**crested wheatgrass**†
Agropyron dasystachyum (Hook.) Scribn.	thickspike wheatgrass
***Agropyron elongatum* (Host) Beauv.**	**tall wheatgrass**
***Agropyron repens* (L.) Beauv.**	**quackgrass**†
Agropyron smithii Rydb.	western wheatgrass
Bouteloua gracilis (H.B.K.) Lag. ex. Griffiths	blue grama
***Bromus inermis* Leyss.**	**smooth brome**†
Carex eleocharis Bailey	needleleaf sedge
Hordeum jubatum L.	foxtail barley
Koeleria pyramidata (Lam.) Beauv.	Junegrass
***Poa pratensis* L.**	**Kentucky bluegrass**†
Stipa comata Trin. & Rupr.	needle-and-thread
Stipa spartea Trin.	porcupine-grass
Stipa viridula Trin.	green needlegrass

Trees and Shrubs	
Scientific name	**Common name**
Rosa arkansana Porter	prairie wildrose
Symphoricarpos occidentalis L.	western snowberry

- Species in bold are non-native.
- * 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 3: Turbines in the Oliver Phase III Expansion Wind Resource Area located in native prairie, based on layout dated September 21, 2009.

Turbine Number	Easting	Northing	Dakota Skipper Habitat Quality
4	339645	5199081	Poor
5	339567	5198787	Poor
7	338912	5200270	Poor
12	338091	5200766	Good
13	337778	5200704	Good
14	337853	5200298	Poor
15	337734	5200050	Poor
16	337574	5199827	Poor
17	337318	5201248	Good
18	337094	5201068	Good
22	338614	5203062	Good
23	338506	5202783	Good
24	338091	5202733	Good
31	336138	5203767	Excellent
32	335462	5203288	Good
33	335286	5203012	Good

Figure 1.
Wind Resource Area Vicinity Map
Oliver Expansion
(Phases III, IV, and V)

Morton and Oliver Counties
North Dakota

- Project Area 6/9/2009
- State Boundary
- County Boundary
- Lake/Reservoir
- River/Stream
- Interstate
- Federal Highway
- Major Road

NEXTera ENERGY RESOURCES

0 2.5 5 10 15 20
Miles

September 30, 2009
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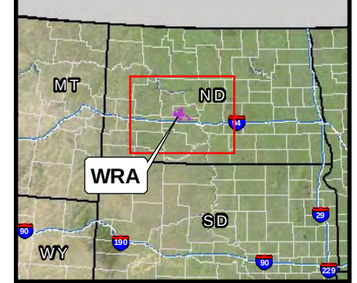
NAD83 Zone 14

Canada



TETRA TECH EC,INC

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Figure 2.
Native Prairie and Tame Grasslands
Oliver Expansion
(Phases III, IV, and V)

Morton, and Oliver Counties
North Dakota

OLIVER CO

MORTON CO

- Project Area 6/9/2009
- Survey Area
- Oliver Expansion Phase III Proposed GE Turbine 9/21/09
- County Boundary
- Perennial Stream
- Intermittent Stream
- Water Body

Cover Type

- Native
- Tame
- Hay
- Not Surveyed
- Other

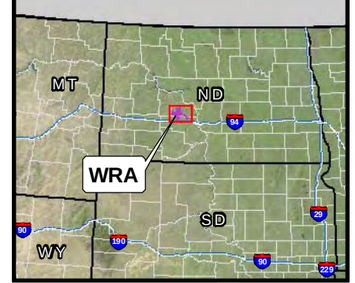
Note: Areas outside survey area were not surveyed

NEXTera ENERGY RESOURCES

0 0.5 1 2 3 4
Miles

September 30, 2009
1:155,000
NAD83 Zone 14

Canada



TETRA TECH EC,INC

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OLIVER CO

MORTON CO

Figure 3.
Potential Dakota Skipper Native Prairie Habitat Oliver Expansion (Phases III, IV, and V)

Morton and Oliver Counties North Dakota

- Project Area 6/9/2009
- Survey Area
- Oliver Expansion Phase III Proposed GE Turbine 9/21/09
- County Boundary
- Perennial Stream
- Intermittent Stream
- Water Body

Cover Rank of Native Prairie

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

Note: Areas outside survey area were not surveyed

NEXTera ENERGY RESOURCES

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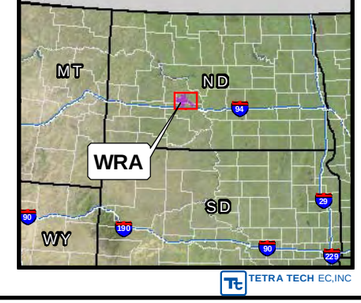
Miles

September 30, 2009
1:155,000
NAD83 Zone 14

Canada



TETRA TECH EC,INC

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OLIVER CO

MORTON CO

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Figure 4.
Potential Dakota Skipper Native Prairie Habitat Oliver Expansion (Phase III)

Morton County, North Dakota

- Project Area 6/9/2009
- Survey Area
- Oliver Expansion Phase III Proposed GE Turbine 9/21/09
- County Boundary
- Perennial Stream
- Intermittent Stream
- Water Body

Cover Rank of Native Prairie

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

Note: Areas outside survey area were not surveyed.

NEXTera ENERGY RESOURCES

0 0.5 1
Miles

N W E S

September 30, 2009
1:36,000
NAD83 Zone 14

Phase III

Canada

MT ND SD WY WRA

94 90 29 190 80 229

TETRA TECH EC,INC

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Whooping Crane Likelihood of Occurrence Summary

Oliver Expansion Wind Energy Generation Facility

(Phases III, IV, and V)

Oliver and Morton Counties, 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

August 2009

Executive Summary

The likelihood of whooping cranes occurring in Phases III, IV, and V of the Oliver Wind Energy Generation Facility (Oliver Expansion) is low to moderate. The major factor that contributed to these assessments was the lower proportion of suitable wetland habitat within the Project Areas than the surrounding area. There were no recorded observations of whooping cranes within Oliver Expansion. A total of 89 observations occurred within the 35-mile buffer area around Oliver Expansion. Three observations occurred within 10 miles of Phase III. Of these three observations, the oldest record occurred in 1964 in Burleigh County during the fall migration (October 25 - flock of two adults and one juvenile). The other two that occurred in Oliver County were in 2000 fall migration (November 3 - flock of eight adults and one juvenile) and 2006 spring migration (April 13 - flock of three adults). Both of the Oliver County observations were noted to be with a flock of sandhill cranes. 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-moderate likelihood of occurrence based on historic recorded occurrences of whooping cranes within and in proximity to the project areas and the high proportion of suitable whooping crane stopover habitat, Tetra Tech EC, Inc. recommends the following avoidance and minimization options:

- Mark new transmission and power lines related to the Oliver Expansion with bird diverters and recommend that transmission owners mark the same amount of nearby non-Project transmission lines in the area of the Oliver Expansion with bird diverters. Bird diverters reduce collisions by 70 percent; therefore, marking only the new lines does not fully offset the potential impacts. However, marking additional lines will result in a net benefit to the species as collision is risk is proportional to the length of unmarked lines.
- If wind turbines are not already engineered to prevent perching by avian predators, anti-perching devices should be installed on each turbine. Eliminate all structures on turbines and towers 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 project 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 Project 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.

Bat Likelihood of Occurrence Summary
Oliver Expansion
Wind Energy Generation Facility
(Phases III, IV, and V)
Oliver and Morton Counties, 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

August 2009

SUMMARY

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

Of the 46 bat species in the United States, 10 occur in North Dakota. Of these 10 species, 6 potentially occur within the Oliver Expansion Project Area based on current known distribution ranges. None of these species are federally listed as threatened or endangered or listed as a state species of conservation concern. Limited suitable roosting and foraging habitat exists within the project area that may provide a marginal attractiveness for migrating bats. Overall, Tetra Tech calculates a low likelihood of occurrence for bat species for the entire Oliver Expansion Project Area and a moderate likelihood of occurrence for the Phase III Project Area. When viewed as one large project, the Oliver Expansion Project Area contains less suitable bat habitat than the surrounding landscape. In contrast, the Phase III Project Area contains more suitable habitat than the surrounding landscape, much of which is located within the two transmission corridors. Although bats are not known to be a risk of collision with transmission lines, construction of the transmission lines could result in the direct loss of bat foraging and roosting habitat.

Recommendation

The precise mechanisms that determine risk of bat mortality at wind farms remain unclear. However, several guidance documents outlining bat-specific recommendations discuss the importance of preserving existing roosting and foraging habitats, minimizing the use of pesticides, maintaining interagency and stakeholder coordination, and continuing public education programs. These guidance documents vary in content but share common themes. Two of these themes are relevant to Oliver Expansion and Phase III.

- **Preserve Forest-Aquatic Matrix Habitat**

  Locating turbines, access roads, substations, and interconnects within forest-aquatic matrix (FAM) habitats may constitute a direct loss of bat foraging and roost habitat. Minimize, to the extent practical, direct impacts to FAM habitat to retain roost and foraging habitats for bats.

- **Preserve Roost Habitat/Snag Retention**

  Agricultural practices and development activities pose a risk to the remaining forested areas in prairie habitats that bats may use for summer roosting. Minimize, to the extent practical, direct impacts to these forested areas by avoiding tree removal during construction. Snags – dead trees in the early to middle stages of decay – provide suitable habitat for tree-roosting bats and should also be retained to maximum extent possible.

Executive Summary – Wind Power GeoPlanner™

Licensed Microwave Search & Worst Case Fresnel Zone

Comsearch performed an analysis to evaluate the potential effects of the planned Oliver III IV V project in Oliver County and Morton County, North Dakota on existing non-Federal Government microwave telecom systems.

Microwave Search Results: Comsearch's Wind Power GeoPlanner™ provides a graphical representation of affected microwave paths and provides supporting technical parameters. The microwave path data is overlaid on topographic basemaps. Comsearch identified 37 microwave paths that intersect the project area (see Figure 1 and Table 1 below).

Comsearch then calculated a Worst Case Fresnel Zone (WCFZ) for each microwave path in the project area. The mid-point of a full microwave path is the location where the widest (or worst case) Fresnel zone occurs. Fresnel zones are calculated for each path using the following formula.

$$Rn \cong 17.3\sqrt{\frac{n}{F_{GHz}}\left(\frac{d1d2}{d1+d2}\right)}$$

Where,
R_n = First Fresnel Zone Radius, meters
n = The Number 1
F_{GHz} = Frequency of Microwave Link, GHz
d1 = Distance to Wind Turbine from Microwave Station 1, km
d2 = Distance to Wind Turbine from Microwave Station 2, km

note: For WCFZ calculation d1 = d2

The calculated WCFZ radius, giving the linear path an area or swath, buffers each microwave path in the project area. The distance unit is in meters and can be found in the column attribute "WCFZ." In general, this is the XY area where the planned wind turbines should be avoided, if possible. These areas are shown in Figure 2 through 5.

Please note that because the turbine locations were not provided, we could not determine if any potential obstruction cases exist between the planned wind turbines and the microwave systems. If the latitude and longitude values for turbine locations are provided, Comsearch can identify specific microwave telecom paths and turbines where a potential XY conflict exists. Additionally, when wind turbines need to be located inside a WCFZ, Comsearch can provide a detailed clearance study, which considers the vertical Z-height clearance objectives.

Map Projection: The ESRI® Shapefiles contained in the enclosed GeoPlanner CD are in NAD 83 UTM Zone 14 projected coordinate system.

Comsearch Contact:
Denise Finney, Account Manager
Phone: (703) 726-5650 Fax: (703) 726-5595
Email: dfinney@comsearch.com

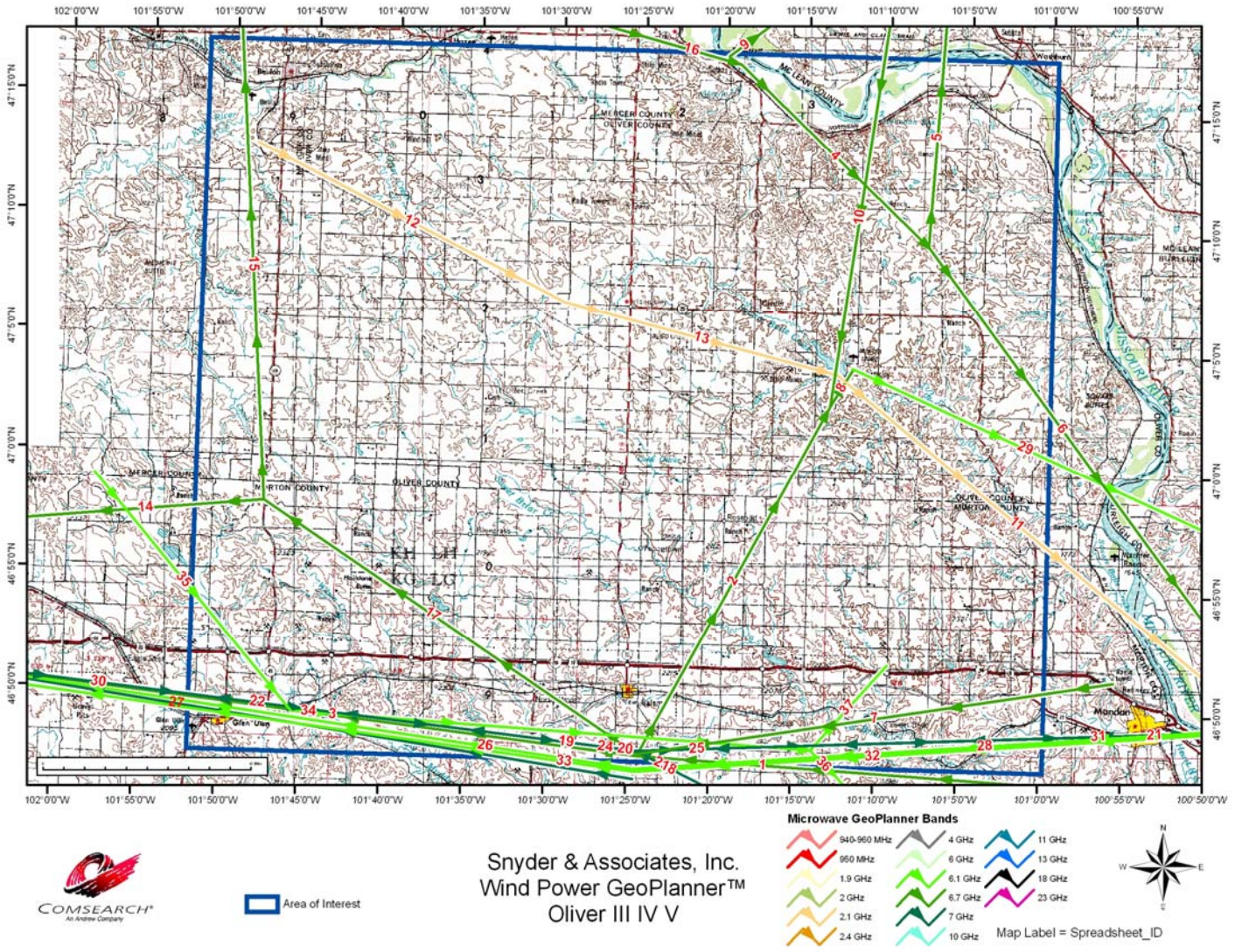


Figure 1 – Wind Power GeoPlanner™

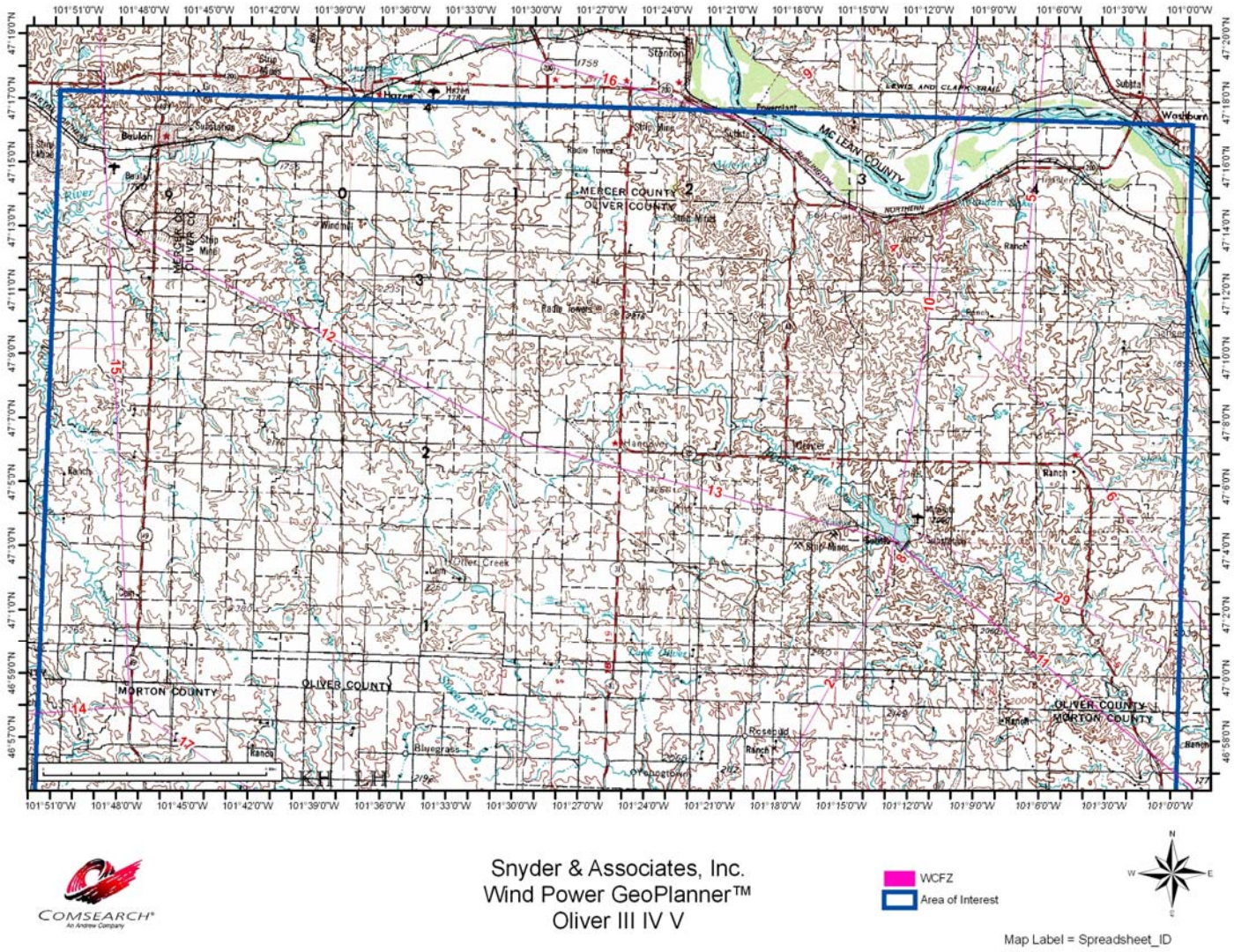


Figure 2 – Wind Power GeoPlanner™ & WCFZ (North)

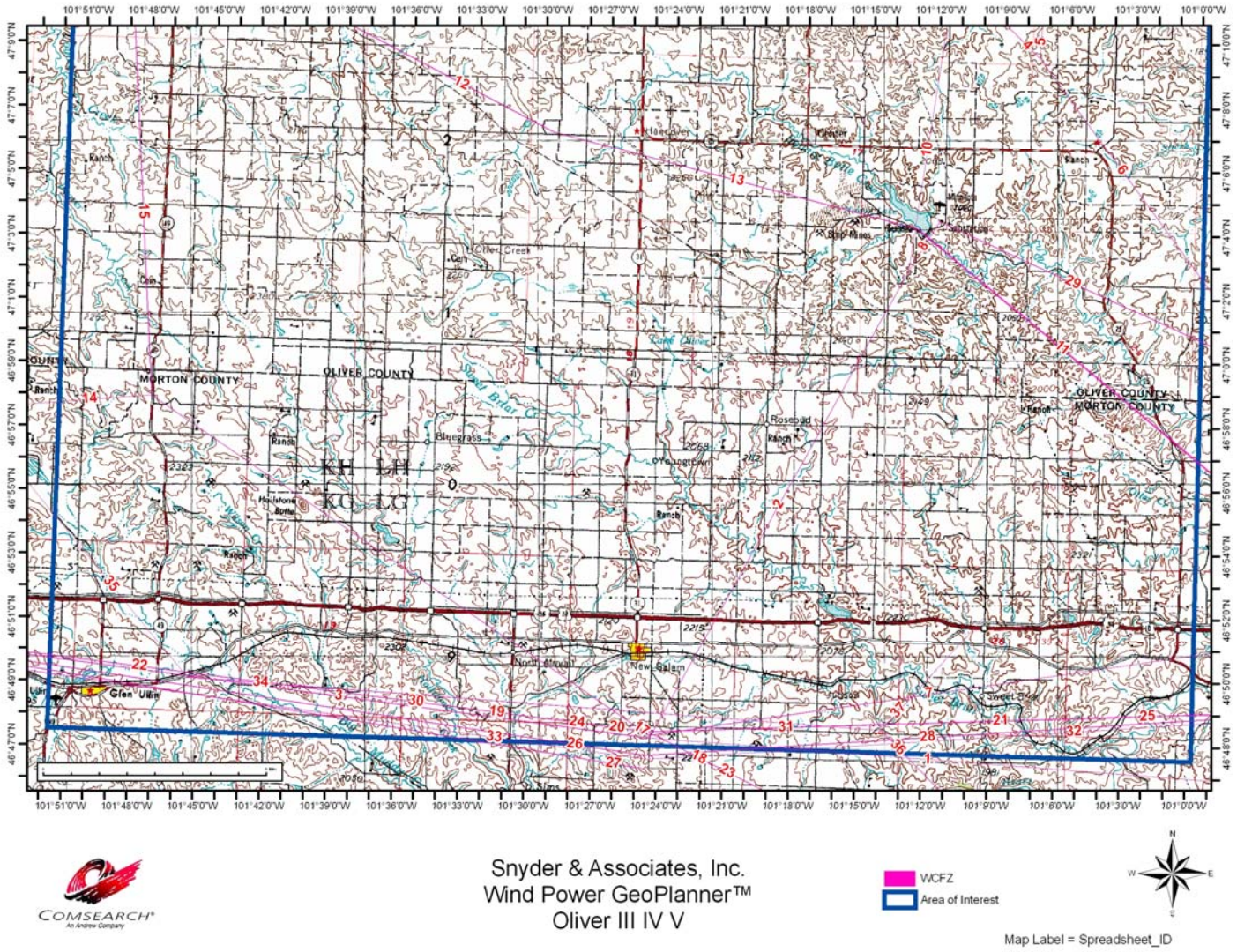


Figure 3 – Wind Power GeoPlanner™ & WCFZ (South)

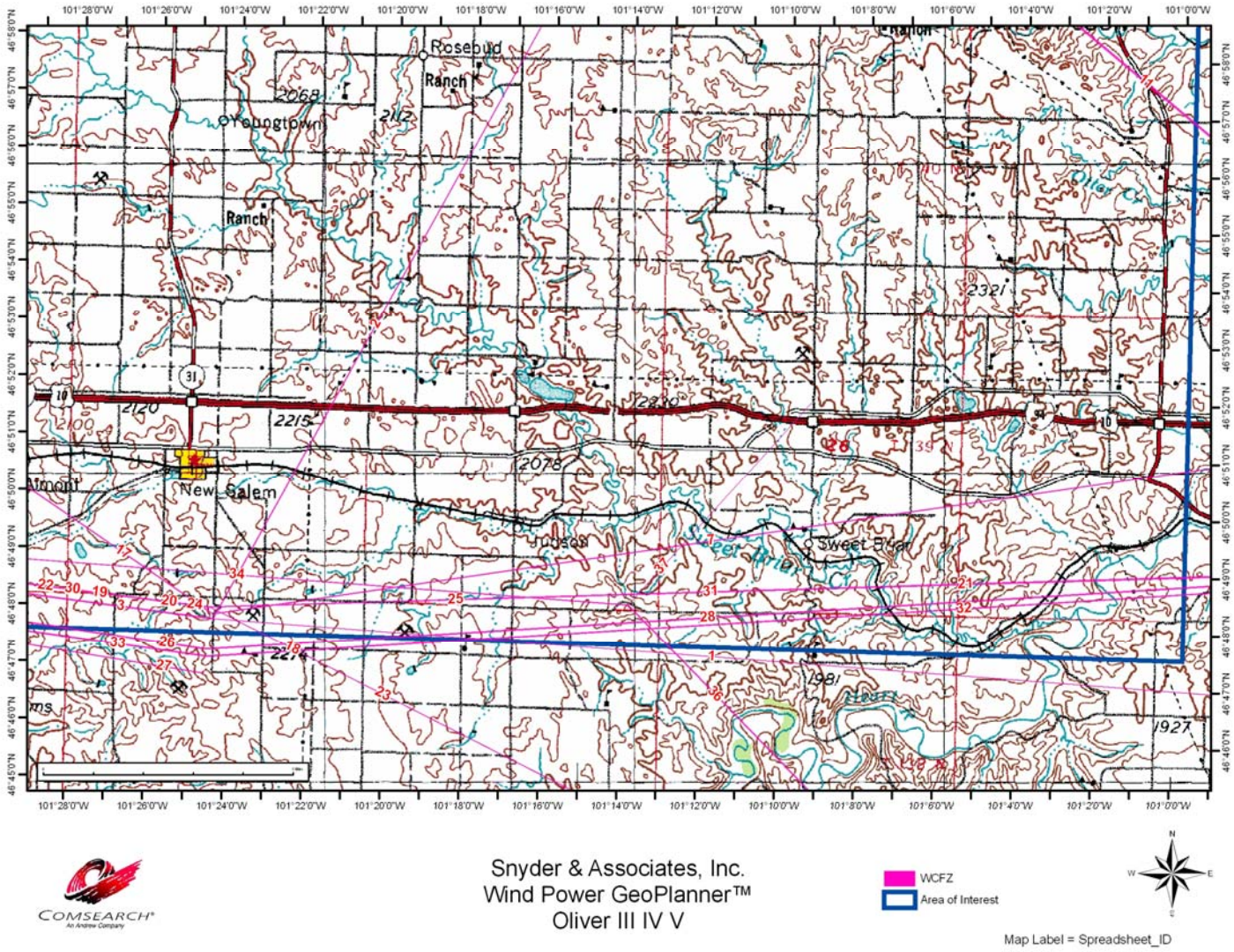


Figure 4 – Wind Power GeoPlanner™ & WCFZ (Southeast)

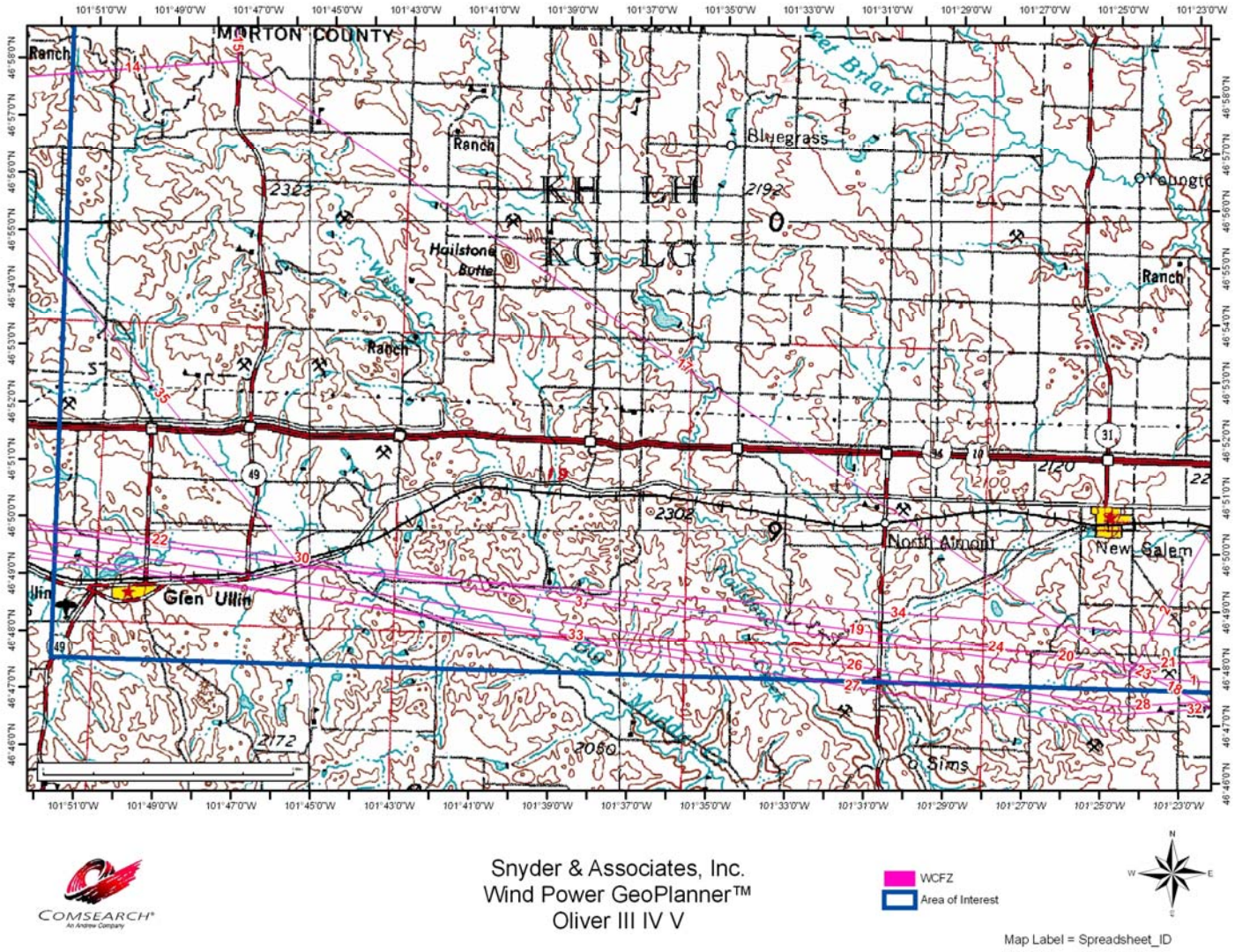


Figure 5 – Wind Power GeoPlanner™ & WCFZ (Southwest)

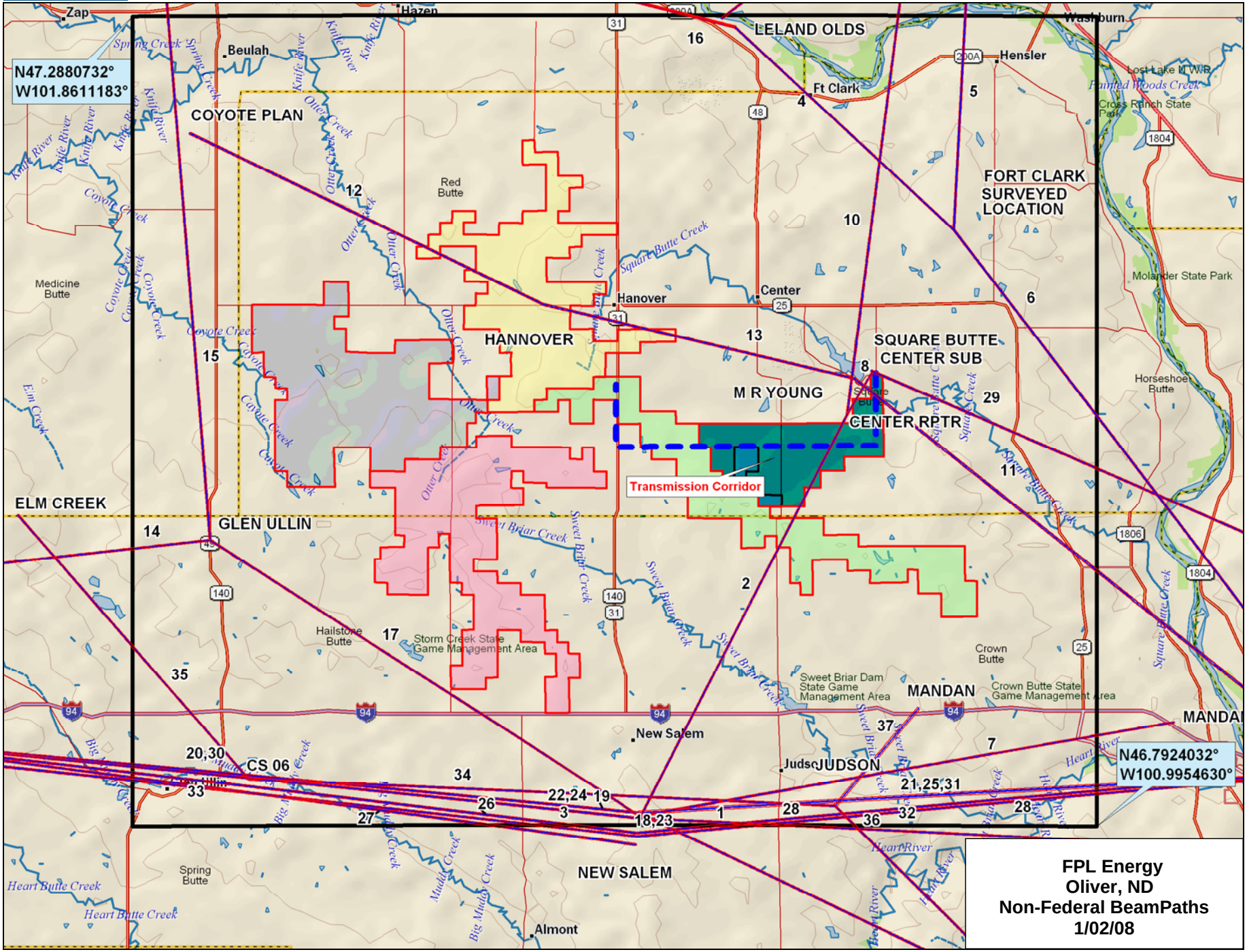
ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	BAND NAME	Licensee	WCFZ (m)
1	LINCOLN	NEW SALEM	KVY56	KVY57	Upper 6 GHz	BNSF Railway Company	20.10
2	NEW SALEM	CENTER RPTR	KVY57	WEE879	Upper 6 GHz	BNSF Railway Company	18.59
3	NEW SALEM	ANTELOPE	KVY57	KVY59	Upper 6 GHz	BNSF Railway Company	25.61
4	LELAND OLDS	FORT CLARK	WBD217	WBD218	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	15.04
5	FORT CLARK	UNDERWOOD	WBD218	WHC469	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	19.82
6	FORT CLARK	CAPITAL HILL	WBD218	WNTP685	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	21.91
7	MANDAN	NEW SALEM	WBD219	WEH428	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	20.38
8	CENTER RPTR	CENTER SUB	WEE879	WEH973	Upper 6 GHz	Great River Energy	6.10
9	STANTON	COAL CRK PR	WEE880	WEE881P	Upper 6 GHz	Great River Energy	13.64
10	COAL CRK PR	CENTER RPTR	WEE881P	WEE879	Upper 6 GHz	Great River Energy	20.44
11	M R YOUNG	BISMARCK TW	WEH267	WEH270	2.1 GHz	MINNKOTA POWER COOPERATIVE INC	38.80
12	COYOTE PLAN	HANNOVER	WEH272	WEH273	2.1 GHz	OTTER TAIL POWER COMPANY	30.53
13	HANNOVER	M R YOUNG	WEH273	WEH267	2.1 GHz	MONTANA DAKOTA UTILITIES CO	27.58
14	GLEN ULLIN	TAYLOR	WEH426	WHJ617	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	22.86
15	GLEN ULLIN	AVS PASSIVE	WEH426	WEH427P	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	22.38
16	AVS PASSIVE	LELAND OLDS	WEH427P	WBD217	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	21.25
17	NEW SALEM	GLEN ULLIN	WEH428	WEH426	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	19.74
18	ST ANTHONY	NEW SALEM	WGH992	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	23.27
19	NEW SALEM	CUSTER LOOKO	WGH993	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	25.03
20	NEW SALEM	ANTELOPE	WHB888	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	25.03
21	BISMARCK	NEW SALEM	WHF256	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	22.81
22	RICHARDTON	NEW SALEM	WHQ214	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	25.03
23	NEW SALEM	ST ANTHONY	WHQ217	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	23.27

ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	BAND NAME	Licensee	WCFZ (m)
24	NEW SALEM	RICHARDTON	WPJC457	RXONLY	7 GHz	REITEN TELEVISION INCORPORATION	25.03
25	BISMARCK	NEW SALEM	WPJC458	RXONLY	7 GHz	REITEN TELEVISION INCORPORATION	22.81
26	NEW SALEM	CUSTERS LOOK	WPON242	WPON243	Lower 6 GHz	WWC Holding Co., Inc	26.67
27	NEW SALEM	ANTELOPE	WPON897	RXONLY	7 GHz	PRIME CITIES BROADCASTING, INC.	25.04
28	MTSO BISMARC	NEW SALEM	WPOP550	WPON242	Lower 6 GHz	WWC Holding Co., Inc	24.25
29	SQUARE BUTTE	BALDWIN	WPQS329	WPQS331	Lower 6 GHz	MINNKOTA POWER COOPERATIVE INC	22.22
30	ANTELOPE	NEW SALEM	WPSI987	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	25.03
31	NEW SALEM	BISMARCK	WPSJ708	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	22.81
32	BISMARCK	NEW SALEM	WPYN764	WPYN765	Lower 6 GHz	PRAIRIE PUBLIC BROADCASTING INC	24.34
33	NEW SALEM	HEBRON	WPYN766	WPYN767	Lower 6 GHz	PRAIRIE PUBLIC BROADCASTING INC	24.22
34	CS 06	JUDSON	WQDT313	WQDT315	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	22.08
35	ELM CREEK	CS 06	WQDT314	WQDT313	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	17.04
36	JUDSON	CS 07	WQDT315	WQDT317	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	23.60
37	JUDSON	MANDAN	WQDT315	WQDT316	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	10.34

Table 1 – Microwave GeoPlanner Links Considered in Analysis (See enclosed mw_geopl.xls for more detailed information and GP_dict_matrix_description.xls for field description)

DeLORME

XMap® 5.0 Professional



FPL Energy
Oliver, ND
Non-Federal BeamPaths
1/02/08

TN
MN (7.6°E)

Scale 1 : 350,000

1" = 5.52 mi

Data Zoom 9-2

Oliver III Wind Energy Center
Acoustic Assessment
Morton County, North Dakota

October 2011

Prepared for

Prepared by

TETRA TECH EC, INC.
160 Federal Street
Boston, MA 02110
617-443-7500

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
MISO	Midwest ISO
MVA	megavolt ampere
MW	megawatt
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
PEIS	Programmatic Environmental Impact Statement
Project	Oliver III 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 an acoustic assessment for the proposed Oliver III Wind Energy Center (Project) located in Morton County, North Dakota. A screening-level analysis was completed to evaluate expected sound levels resulting from wind turbine generator (WTG) operations as well sound from the electrical substation. The overall objectives of this study were to: (1) determine Project sound sources and site-specific sound propagation characteristics incorporating terrain effects; (2) Simulate sound levels using internationally accepted calculation standards; and (3) determine the feasibility of the Project to operate in compliance with applicable noise guidelines. The study also included assessment of noise generated during Project construction and maintenance activities and reviewed the potential for cumulative sound impacts with other existing or reasonably foreseeable future development.

Wind turbine sound source data was obtained from General Electric (GE), the manufacturer of the GE xle 1.6 megawatt (MW) wind turbine model. Sound propagation modeling was conducted using the Computer-Aided Noise Abatement (CadnaA) program (version 4.1.137), 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. The results of the acoustic modeling were compared to relevant standards including the U.S. Environmental Protection Agency (EPA) environmental noise guidelines and Occupational Safety and Health Administration (OSHA) regulatory limits for worker exposure and public safety.

Acoustic modeling results demonstrate that the Project has been adequately designed to operate in compliance with levels recommended by the EPA guidelines at all existing inhabited structures considered to be noise sensitive receptors with the exception of a potential exceedance at receptor ID 6006, which occurred under anomalous meteorological conditions. Receptor ID 6006 has been identified as an occupied residence but is also a participating landowner. The acoustic modeling incorporated a number of conservative model input assumptions to ensure that the project impacts were not underestimated. The Project will also be constructed and operated in adherence with all applicable OSHA Regulation noise safety standards. Operation of the Project may result in periodically audible sound at noise sensitive receptors under certain operational and meteorological conditions. Specifically, the Project will be audible at the closest receivers relative to the Project, when background sound levels are low, and wind speeds high enough for WTG operation. Residents outside their houses with a direct line of sight to an operating WTG may hear a gentle swooshing sound characteristic of wind energy projects. During meteorological conditions favorable to sound propagation and very quiet background ambient sound conditions, WTGs may be periodically audible at more distant locations. Conversely, at times the Project may be partially or fully masked by elevated ambient sound levels generated by the increased wind speed.

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 proposed Project and wind energy in general, individual and community economic incentives, existing background sound levels, and/or the proximity of the listener to a single or grouping of WTGs. However, sound from the Project when audible will likely not be deemed excessive or unusually loud at the proposed setback distances and will be consistent with sound generated at similar wind energy projects successfully sited throughout the state of North Dakota employing similar noise criteria and WTG setback distances.

1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra; the Applicant) proposes to construct and operate the Oliver III Wind Energy Center located in Morton County, North Dakota. The Project consists of 30 GE xle wind turbine generators (WTGs), individually rated at 1.6 megawatt (MW), plus 4 alternatives (for a total of 34 WTGs). Each WTG will have a rotor diameter of 270 feet (82.5 meters) and an effective hub height of 262.5 feet (80 meters) above grade. The total potential power output capacity of the Project is approximately 48 MW. The Project will interconnect and deliver power into the Midwest ISO (MISO) system. The Project infrastructure also includes a collection electric substation, which has one 60 megavolt-ampere (MVA) transformer onsite, enabling the interconnection to the Oliver III transmission line. The substation collection system was permitted as a separate action with a decision rendered on April 20, 2011 (PU-09-724).

Tetra Tech EC, Inc. (Tetra Tech) was retained to perform the acoustic assessment including analysis of expected future sound levels resulting from operation of all Project components at existing noise sensitive receptors (i.e., residences). The operational acoustic analysis was used to determine the feasibility of the Project to operate in compliance with the applicable noise standards and guidelines. This document presents the findings of the Oliver III Wind Energy Center acoustic assessment.

1.1 Project Area

The proposed Project Area is located in Morton County, North Dakota, a primarily rural agricultural area located north of Interstate 94 and east of State Highway 31, approximately 15 miles northwest of Bismarck, North Dakota. There are a few small communities near the Project Area. The city of New Salem is located approximately 10 miles to the southwest; the city of Center is located approximately nine miles north of the Project. The land within the Project Area boundary is privately owned and primarily agricultural with scattered farmstead residences. Current land use is predominantly dryland farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

The Project Area is located within the Northwestern Great Plains ecoregion. Landscape components within this ecoregion include western mixed-grass/short-grass prairie, planted or tame grassland, upland deciduous forest, and associated wetlands. This semiarid, unglaciated region of North Dakota has a topography characterized by level to rolling plains 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. The Project Area is characteristic of the upland portion of the Missouri Slope and River Breaks regions, with the majority of the land surface currently covered by rangelands with some areas identified as native prairie. Patches of trees and shrubs exist throughout the Project Area, located primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

A total of 31 potential receptor locations were identified within the designated acoustic study area, based on the Farmstead report dated February 11, 2010 provided by NextEra. Of these 31 receptors identified, 23 are existing occupied residences. Figure 1 presents the Project Layout, including the Morton County acoustic study area, the locations of the proposed WTGs, and receptor locations, that were incorporated in the Acoustic Assessment.

OLIVER WIND III, LLC

OLIVER III WIND ENERGY CENTER

MORTON COUNTY, NORTH DAKOTA

FIGURE 1

PROJECT LAYOUT

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Receptor
- Substation
- Project Boundary

N

W E

S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3173 and 3664 - Oliver County Wind\Contract 3664 Oliver III, IV and V\GIS\Spatial\MXD\noise\Fig1_ProjectLayout.mxd 10/7/2011

1.2 Existing Acoustic Environment

Morton County is generally characterized as a rural agricultural land use area. 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 vary both spatially and temporally depending on proximity to area sound sources, roadways and natural sounds. Principal contributors to the existing acoustic environment include motor vehicle traffic, mobile farming equipment, farming activities such as plowing and irrigation, all-terrain vehicles, local roadways, 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 may dominate the soundscape, predominantly in the warmer seasons.

Following review of the applicable noise limits, it was concluded that a baseline sound survey to further document the existing acoustic conditions was not requisite to provide a regulatory compliance determination, mainly due to the proposed setback distances to noise sensitive receptors (i.e. residential uses) and the largely rural surroundings.

1.3 Acoustic Terminology

Airborne sound is described as the rapid fluctuation or oscillation of air pressure above and below atmospheric pressure, creating a sound wave. Sound is characterized by properties of the sound waves, which are frequency, wavelength, period, amplitude, and velocity. Noise is further defined as unwanted sound and is measured in the same way. A sound source is defined by a sound power level (L_w), which is independent of any external factors. The acoustic 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 and can be directly determined with a microphone or calculated from information about the source sound power level and the surrounding environment through predictive acoustic modeling. While the sound power of a source is strictly a function of the total amount of acoustic energy being radiated by the source, the sound pressure levels produced by a source are a function of the distance from the source and the effective radiating area or physical size of the source. In general, the magnitude of a source's sound power level is always considerably higher than the observed sound pressure level near a source due to the fact that the acoustic energy is being radiated in various directions from the source.

Sound levels are presented on a logarithmic scale to account for the large pressure response range of the human ear, and are 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 commonly referenced to 1 picowatt (pW), which is one trillionth of a watt. Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), which corresponds to the rate in cycles per second that sound pressure waves are generated. Typically, a sound frequency analysis examines 11 octave (or 33 1/3 octave) bands ranging from 16 Hz (low) to 16,000 Hz (high). This range encompasses the entire human audible frequency range. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency

response of the human auditory system. Sound exposure in acoustic assessments are commonly measured and calculated as A-weighted decibels (dBA). Unweighted sound levels are referred to as linear. 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. Sound levels that are linear are presented as dBL.

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 to 100 dBA. With respect to how the human ear perceives changes in sound pressure level relative to changes in "loudness", scientific research demonstrates that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- 1 dBA is the practical limit of accuracy for sound measurement systems and corresponds to an approximate 10 percent variation in the sound pressure level. 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 pressure level and it corresponds to the threshold of change in loudness perceptible 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 discernible change in an outdoor environment.

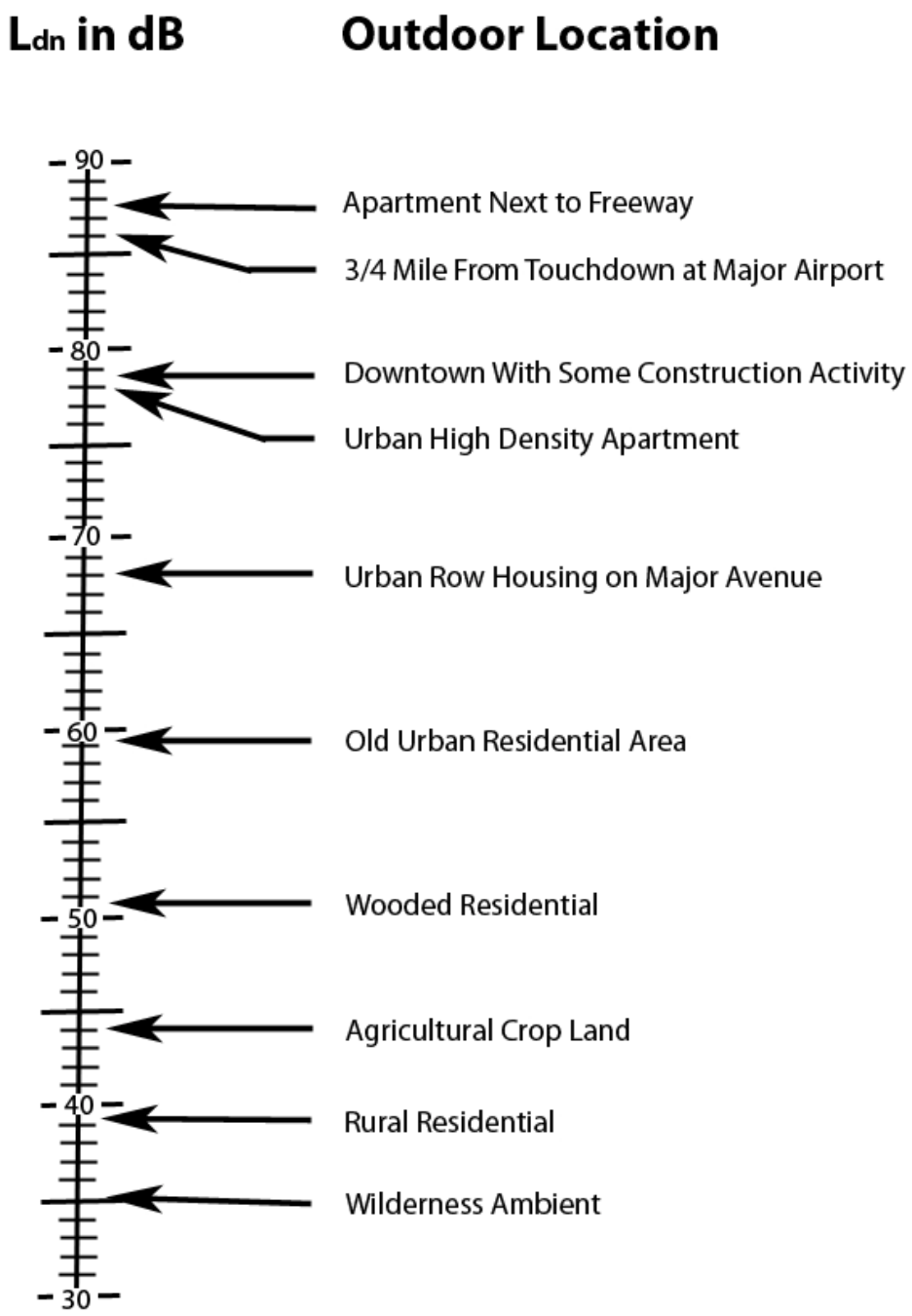
- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic pressure level but is perceived as a doubling or halving in loudness (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

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 startling or hearing loss. According to the United States Department of the Interior Bureau of Land Management (BLM), "Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States," the sound levels associated with environmental noise (to the extent that any adverse impacts are produced) have been found to generally produce effects limited to the first two categories, only. At typical wind turbine setback distances, the comparatively low level sound generated by wind farms is expected to cause no discernible impact or fall principally within the subjective response category.

Sound can be measured, calculated, and presented in various formats, with a 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 environmental acoustic assessments. The L_{eq} is often further defined by the time period (T) it is measured over $L_{eq(T)}$, for instance $L_{eq,24}$ would indicate the equivalent sound level over a 24-hour period. 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. Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Table 1. Table 2 provides additional reference information on acoustic terminology.

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 dependent on level, character, frequency or pitch, time of day, and sensitivity and perception of the listener. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in decibels referenced to 20 micropascals, the approximate threshold of human perception to sound at 1000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to picowatts (one trillionth of a watt). Equipment specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kilohertz (kHz). One hundred Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies (Hz). To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity and atmospheric conditions.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hertz and is typically divided into octave band center frequencies (Hz) ranging from 31 to 8,000 Hz.
Broadband Sound	The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz.
Masking	Interference in the perception of one sound by the presence of another sound. At elevated wind speeds, leaf rustle and noise made by the wind itself can mask wind turbine sound levels, which remain relatively constant.
Low Frequency Noise (LFN)	The frequency range of 20 to 200 Hz is typically defined as low frequency noise. Studies have shown that low frequency sound from modern wind turbines is generally below the threshold of human perception at standard setback distances.
Infrasound	The frequency range of infrasound is normally defined as below 20 Hz. Infrasound from wind turbines are significantly below recognized thresholds for both human perceptibility and standardized health.

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 state, county, or federal noise requirements specific to this Project or wind energy facilities in the state of North Dakota. Morton County does not have an ordinance with numerical decibel limits.

2.1 Environmental Protection Agency Environmental Noise Guidelines

In 1974, the U.S. Environmental Protection Agency (EPA) published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA 1974). This report represents the only published study that includes a large database of community reaction to noise to which a proposed project can be readily compared. The EPA has developed widely accepted recommendations for long term exposure to environmental noise with the goal of protecting public health and safety. The publication evaluates the effects of environmental noise with respect to health and safety, and provides information for state and local governments to use in developing their own ambient noise standards. For outdoor residential areas and other locations in which quiet is a basis for use, the recommended EPA guideline is an L_{dn} of 55 dBA. The EPA also suggests an $L_{eq(24)}$ of 70 dBA (24-hour) limit to avoid adverse effects on public health and safety at publicly accessible property lines or extents of work areas where extended periods public exposure is possible. The EPA cause-and-effect 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
Outdoor at residential structure and other noise sensitive receptors where a large amount of time is spent	55 dBA L_{dn}	
Outdoor areas where limited amounts of time are spent, e.g., park areas, school yards, golf courses, etc.	55 dBA $L_{eq(24)}$	Protection against annoyance and activity interference
Indoor residential	45 dBA L_{dn}	
Indoor non-residential	55 dBA $L_{eq(24)}$	

USEPA (U.S. Environmental Protection Agency). 1974

The application of the EPA noise guidelines is a common assessment tool to help ensure adequate protection of human health and welfare. The EPA sound level guidelines state that the levels identified are sufficiently stringent to be protective of public health and welfare with an adequate margin of safety. The EPA sound level guidelines do not impose federal requirements on the appropriateness of noise environments, nor are they a source of instructions for solving local noise problems. They are best viewed as a technical aid for local decision makers who seek to consider scientific information about effects of noise on people, and to reconcile local economic and political realities with cost and technical feasibility. While the EPA criteria limits cannot be used to infer audibility thresholds, designing to meet EPA guidelines will result in adequately minimizing potential impacts on noise sensitive receptors. When projected sound impacts meet the EPA guidelines there is no evidence that the general population will be at risk to any identified health effects. In addition, designing to meet EPA guidelines will ensure that annoyance and activity interference will also be minimized. The EPA guidelines are not regulatory

limits but are intentionally conservative to protect sensitive populations with an adequate margin of safety.

2.2 Occupational Safety and Health Administration Noise Safety Standards

The Occupational Safety and Health Administration (OSHA) provides regulatory limits for worker and public safety exposure to high noise levels. The federal government has long recognized the potential hazards caused by noise to work health and safety. Onsite noise levels are regulated by the Occupational Safety and Health Act of 1970 (29 Code of Federal Regulations [CFR] 1910.95). This regulation establishes standards for permissible noise exposure in the workplace to guard against the risk of hearing loss.

Table 4 presents a sliding scale of permissible noise levels by duration of exposure. The exposure level is raised 5 dB for every halving of exposure duration. OSHA permits noise levels up to 90 dBA, over a time-weighted average eight-hour shift ($TWA_{8\text{-}hr}$), measured on the A-scale of a sound level meter set at slow response. If there are workers exposed to a $TWA_{8\text{-}hr}$ above 85 dBA, then the regulations call for a worker hearing protection program that includes baseline and periodic hearing testing, availability of hearing protection devices, and training in hearing damage protection.

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

When employees are subjected to noise exposures exceeding those shown in Table 4, feasible administrative or engineering controls must be identified and implemented to lower employee noise exposure. If administrative controls fail to reduce sound to these acceptable levels, personal protective equipment must be provided and used to reduce noise exposure. In compliance with OSHA, Project contractors will be required to provide construction workers with readily available OSHA-approved hearing protection devices and to identify high noise areas and activities where hearing protection is needed. Operational sound generated from the Project during normal operation will be below 85 dBA and the OSHA noise exposure limits, even immediately at the base of the tower structure.

2.3 Summary of Acoustic Criteria

A summary of the pertinent acoustic criteria used to assess sound levels at existing receptors 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 the protection of worker exposure and public safety.
- Morton County does not have a noise regulation or standard. However, the County has adopted a wind energy condition use permit regulation, which requires turbines to be sited at least 1.25 times the turbine height or 1,320 feet from nearby occupied residences, commercial buildings, or public structures.

These noise limits identified are absolute and independent of the existing acoustic environment; therefore, a baseline sound survey is not required to assess conformity.

Designing the Project to meet EPA guidelines will result in adequately minimizing potential impacts on noise sensitive receptors. When projected sound impacts meet the EPA guidelines, there is no evidence that the general population will be at risk to any identified health effects. In addition, designing to meet EPA guidelines will ensure that annoyance and activity interference will also be adequately minimized. OSHA noise safety standards are mandatory requirements at all times.

3.0 ACOUSTIC MODELING METHODOLOGY

Sound generated by an operating WTG is comprised of both aerodynamic and mechanical sound with the dominant sound component from utility scale WTGs being largely aerodynamic. Aerodynamic sound refers to the sound produced from air flow and the interaction with the WTG tower structure and moving rotor blades . 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. Due to the improved design of WTG mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, mechanical noise emissions have been minimized. The WTGs being considered for the Project are upwind variable speed-type WTG with an active yaw and pitch regulated with power/torque control capability. Sound reduction elements designed into the GE 1.6 xle include impact noise insulation of the gearbox and generator, sound reduced gearbox, sound reduced nacelle, and rotor blades designed to minimize noise generation.

Wind farms, in comparison to conventional energy projects, are somewhat unique in that the sound generated by each individual WTG will increase as the wind speed across the site increases. Wind turbine 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 maximum rotational speed are achieved. Under maximum rotational wind speed the assumed maximum sound power level will be reached, generally occurring at approximately 7 to 9 meters per second [m/s] depending on WTG type and according to manufacturer specifications. It is important to recognize, as wind speeds increase, the background ambient sound level will likely increase as well, resulting in acoustic masking effects. The net result is that during periods of elevated wind when higher WTG sound emissions occur, the sound produced from a WTG operating at maximum rotational speed may well be largely or fully masked due to wind generated sound in foliage or vegetation. In practical terms, this means a nearby receptor would tend to hear leaves or vegetation rustling rather than wind turbine noise. This relationship is expected to further minimize the potential for any adverse noise effects of the Project. Conversely, acoustic masking effects may be limited during periods of unusually high wind shear or at receiver locations that are particularly sheltered from prevailing winds.

3.1 Acoustic Modeling Software and Calculation Methods

The operational acoustic assessment was performed using the planned Project turbine layout dated September 6, 2011, which consisted of the 30 planned WTGs and 4 alternative WTG locations. The acoustic modeling analysis employed the most recent version of DataKustic GmbH's CadnaA, the computer-aided noise abatement program (v 4.1.137). 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 full (1/1) octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of both sources and receptors, seasonal foliage effects, and meteorological conditions.

Topographical information was imported into the acoustic model using the official 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 G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in 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. A mixed (semi-reflective) ground factor of G=0.5 was used in the acoustic modeling. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. Sound attenuation through foliage and diffraction around and over existing anthropogenic structures such as buildings were ignored under all acoustic modeling scenarios.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, the temperature of 10°C (50°F) and 70 percent relative humidity parameters were selected as reasonably representative of conditions favorable to sound propagation. Atmospheric absorption depends on temperature and humidity and is most important at higher frequencies. Over short distances, the effects of atmospheric absorption are minimal. The ISO 9613-2 standard calculates attenuation for meteorological conditions favorable to propagation, i.e., downwind sound propagation or what might occur typically during a moderate atmospheric ground level inversion, which is assumed to be regulatory worst case. Though a physical impracticality, the ISO 9613-2 standard simulates omnidirectional downwind propagation and worst-case WTG source directivity factors. For receivers located between discrete WTG locations or WTG groupings, the acoustic model may result in over-prediction. The acoustic modeling algorithms essentially assume laminar atmospheric conditions, in which neighboring layers of air do not mix. This conservative assumption does not take into consideration turbulent eddies and micrometeorological inhomogeneities that may form when winds change speed or direction, which can interfere with the sound wave propagation path and increase attenuation effects.

Conversely, there may be meteorological conditions from time to time that will aid in the long range propagation of sound. These anomalous meteorological conditions may include well-developed moderate ground-based temperature inversions, such as commonly occurs at nighttime and during early morning hours, and wind gradients which can bend sound downwards, which may occur at any time depending on weather conditions. Per ISO 9613-2, the effects of meteorological conditions on sound propagation are small for short distances, and also small for longer distances at greater source and receptor heights. Over extended distances when the influences of wind or temperature gradients are most prevalent, atmospheric effects may cause fluctuations in received sound levels, but will typically attenuate noise to levels below those predicted. Levels significantly above those predicted are defined as exceptional events under the ISO 9613-2 standard. Propagation for anomalous meteorological conditions are presented to show, that for comparatively short periods of time, received sound levels may be higher than the mean.

3.2 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 the effective hub height, ranging from cut-in to full rated power per International Standard IEC 61400-11:2006 Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques. This internationally accepted International Electrotechnical Commission (IEC) standard was developed to ensure consistent and comparable sound emission data of utility-scale WTGs between manufacturers. Table 5 presents a summary of sound power data during

normal mode as opposed to noise restricted operation. Sound data is correlated by integer wind speeds, referenced at WTG hub height with a stated roughness length of 0.03 to 0.05 meters which is representative of level, grass covered terrain. The roughness length describes the vertical wind profile per IEC specification with a neutral atmosphere with the wind profile following a logarithmic curve. (Wind profile refers to the increase in wind speed that normally occurs with height above the ground.) Sound power data presented are inclusive of both mechanical and aerodynamic source components.

The GE specification presents an expected warranty confidence interval of k=2 dB, which added to the nominal sound power level. This confidence interval incorporates the uncertainty in independent sound power level measurements conducted, the applied probability level and standard deviation for test measurement reproducibility, and product variability. It is expected that the WTG version installed will be similar to the sound data that was used in the acoustic modeling. However, it is possible that the warranty sound data could vary slightly.

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 1.6 MW xle	<96	<96	<99	<102	<104	≤106	≤106

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 it is assumed that WTG directivity and sound generating efficiencies are inherently incorporated in the sound source data and used in the acoustic model development. A summary of sound power data for the GE 1.6 MW xle by octave band center frequency is presented in Table 6 (spectral frequency data provided with stated intended use limited for informational purposes only).

Table 6 GE 1.6 MW xle Sound Power Level by Octave Band Center Frequency

	Octave Band Sound Power Level (dB)								Broadband (dBA)
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	
GE 1.6 MW xle	84.8	93.6	99.2	100.8	100.1	97.3	89.1	86.2	106.0

4.0 PROJECT OPERATING NOISE LEVELS

Operational broadband (dBA) sound pressure levels were calculated assuming that all wind turbines are operating continuously and concurrently at the maximum manufacturer-rated sound level at the given operational condition. The sound energy was then summed to determine the equivalent continuous A-weighted downwind sound pressure level at each model receptor.

4.1 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. Table 7 presents the results of the Oliver III Wind Energy Center acoustic modeling analysis and includes the ID, status, Universal Transverse Mercator (UTM) coordinates, receptor status and the received sound levels. The receptor status is based on a farmstead report provided by NextEra dated February 11, 2010. Sound energy contribution from the Project substation was also included in the acoustic calculations. Results are presented to tenths of decibels for comparison with the EPA criterion level, which is given to one decimal place; however, the generally accepted level of accuracy for this calculation procedure is typically to the nearest whole decibel.

Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 2 through 4. Figure 2 shows the broadband (dBA) operational sound levels under low-level wind speeds sufficient for the WTGs to operate at initial cut-in rotational speeds. Figure 3 shows the broadband (dBA) operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds for moderate downwind propagation. Figure 4 shows the broadband (dBA) operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds under anomalous meteorological conditions. Acoustic modeling was completed for all WTGs operating concurrently. The tabulated results and contour plots are independent of the existing acoustic environment, i.e. are representative of expected Project-generated sound levels only. Table 7 presents a summary of the WTG acoustic modeling output, which indicates that the received sound levels are all below the most stringent EPA guideline, except for at two receptors (noted in bold), which may potentially exceed the most stringent EPA guideline during anomalous meteorological conditions. The two exceedances include receptor ID 6003, which has been identified as an abandoned structure, and receptor ID 6006, which is occupied and a participating landowner.

Table 7 Summary of Acoustic Modeling Results

Receptor ID	Property Owner	Receptor Status	UTM Coordinates (m)		Received Sound Levels (dBA)		
			Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
6003	**Abandoned**	**Calvin Schmidt**	**335434**	**5204641**	**35.4**	**45.4**	**49.3**
6006*	**Occupied**	**Arden Hagerott**	**335875**	**5202206**	**35.3**	**45.3**	**48.9**
6005	Occupied	Chad Olson	335894	5202102	34.9	44.9	48.5
300008	Abandoned	Arden Hagerott	337179	5202968	37.1	47.1	48.0
30008	Abandoned	(Relay Tower)	337240	5201768	36.5	46.5	47.5
7007	Occupied	Ben Kopp	338286	5203461	35.0	45.0	45.8
7002	Occupied	Walter Vogel	339472	5200083	33.8	43.8	44.6
6008	Occupied	Audrey Spence Etal	338714	5201739	32.1	42.1	44.5
6009	Abandoned	Audrey Spence Etal	338753	5201759	32.0	42.0	44.4
7004	Abandoned	Nels & Darlene	339106	5200837	33.5	43.5	44.4
6014	Abandoned	Kasper & Caroline	337857	5198463	32.9	42.9	44.2
6011	Occupied	Val Schlosser	336821	5199125	32.5	42.5	44.1
6004	Occupied	Tom Zander	334582	5203847	30.5	40.5	43.6
7010	Occupied	Lawrence & Frances	338391	5204385	28.2	38.2	41.2
7016	Occupied	Lawrence & Frances	337949	5204464	28.3	38.3	41.2
6002	Abandoned	Alan Schwalbe	335368	5206778	26.0	36.0	40.6
6010	Occupied	Marcus Zander	335722	5198836	25.6	35.6	38.7
7020	Occupied	Ronald & Virginia	341032	5200597	24.8	34.8	38.2
6012	Abandoned	Zander Family Trust	335789	5197882	23.4	33.4	37.0
6013	Occupied	Bruce Engelhardt	336785	5196966	22.2	32.2	35.9
7029	Occupied	Vernon Bahm Etal	341907	5197106	22.7	32.7	35.6
7027	Occupied	Vernon Bahm Etal	342143	5197130	21.9	31.9	35.0
7023	Occupied	Vernon Bahm Etal	342191	5197153	21.7	31.7	34.8
5020	Occupied	Simon Schmidt	334149	5206673	19.5	29.5	33.8
5021	Occupied	Simon Schmidt	334144	5206664	19.5	29.5	33.7
5013	Occupied	Douglas Doll etal	331662	5210195	<20	<20	<20
5015	Occupied	Dale & Gail Hilton	335015	5210254	<20	<20	<20
5016	Occupied	Dale & Gail Hilton	335270	5210159	<20	<20	<20
5017	Occupied	Dale Barnhardt	335141	5210664	<20	<20	<20
5018	Occupied	Delmar Hagerott etal	334958	5209903	<20	<20	<20
5026	Occupied	Mark & Lynette Dagley	331919	5207710	<20	<20	<20

*Participating landowner with two turbines.

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, 365 days a year), which was used as a Project acoustic design goal. The EPA guideline limits presented in Section 2.1 are based on the yearly L_{dn}. To calculate the yearly L_{dn}, consideration of the variation in atmospheric conditions is necessary over an extended time period to determine the long term sound exposure. The approach employed in this Project acoustic assessment assumed a sustained wind speed at WTG hub height sufficient to result in full rotation wind turbine operation 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:

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

To calculate yearly L_{dn}, the $L_{eq\ (1\text{-}hour)}$ in the above equation was assigned the value of the Project-generated sound level for the WTG operating condition under analysis (cut-in or at full rotational speed). Under real world meteorological conditions wind speed and direction will be variable. Over the course of a 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 sound levels generated during maximum rotational is a worst case assessment approach and will ensure compliance during all other WTG operational conditions. Though this long term operational operating scenario is not a realistic condition, the intention of employing this calculation methodology is to provide a further level of conservatism in the calculation sound impacts.

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FIGURE 2
RECEIVED SOUND LEVELS:
WIND TURBINES AT CUT-IN WIND SPEED

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Receptor
- Substation
- Project Boundary

Isopleth Ranges (dBA)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- > 55
- 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 3173 and 3664 - Oliver County Wind\Contract 3664 Oliver III, IV and V\GIS\Spatial\MXD\noise\Fig2_WTG_Cut-In.mxd 10/7/2011

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FIGURE 3

RECEIVED SOUND LEVELS:
WIND TURBINES AT MAXIMUM
ROTATIONAL WIND SPEED

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Receptor
- Substation
- Project Boundary

Isopleth Ranges (dBA)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- > 55
- 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 3173 and 3664 - Oliver County Wind\Contract 3664 Oliver III, IV and V\GIS\Spatial\MXD\noise\Fig2_WTG_Cut-In.mxd 10/7/2011

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FIGURE 4
RECEIVED SOUND LEVELS:
WIND TURBINES AT MAXIMUM ROTATIONAL WIND SPEED, ANOMALOUS METEOROLOGICAL CONDITIONS

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Receptor
- Substation
- Project Boundary

Isopleth Ranges (dBA)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- > 55
- 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 3173 and 3664 - Oliver County Wind\Contract 3664 Oliver III, IV and VI\GIS\Spatial\MXD\noise\Fig4_WTG_AnomMet.mxd 10/7/2011

5.0 OTHER SOUND CONSIDERATIONS

5.1 Cumulative Effects

An assessment of cumulative environmental impacts considers the potential impact of a proposed Project in the context of existing developments to ensure that any potential environmental impacts are not considered in isolation. The cumulative effects can result from individually minor, but collectively more significant actions over a given period of time. Cumulative impacts are impacts that result from the incremental consequences of a project when added to other existing wind energy developments. A wind energy development would need to be located within approximately 2 to 3 km of the proposed wind farm in order to present a possible cumulative influence on sound. The nearest existing wind energy project is located approximately 10 miles away and, therefore, the Project was not considered with respect to cumulative effects.

5.2 Electrical Substation

Substations have switching, protection and control equipment and typically 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 vibrational noise is the principal noise source and does not vary significantly with electrical load. Transformers are designed and catalogued by megavolt ampere (MVA) ratings. Just as horsepower ratings designate the power capacity of an electric motor, a transformer's MVA rating indicates its maximum power output capacity. The National Electrical Manufacturers Association (NEMA) published NEMA Standards TR1-1993 (R2000), which establish the maximum noise level allowed for transformers, voltage regulators, and shunt reactors based on the equipment's method of cooling its dielectric fluid (air-cooled vs. oil-cooled) and the electric power rating.

Transformer noise is generated and will attenuate with distance at different rates depending on the transformer dimensions, voltage rating, and design. The noise produced by substation transformers 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. The characteristic humming sound consists of tonal components generated at harmonics of 120 Hz. Most of the acoustical energy resides in the fundamental tone (120 Hz) and the first 3 or 4 harmonics (240, 360, 480, 600 Hz). In addition to core vibration noise, transformer cooling fans may generate broadband noise, limited to periods when high heat loads require additional cooling capacity. The resulting audible sound is a combination of core noise and the broadband fan noise. Circuit-breaker operations may also cause audible noise, particularly the operation of air-blast breakers which is characterized as an impulsive sound event of very short duration. This is expected to occur only a few times throughout the year, and was therefore not considered in this analysis.

The American National Standards Institute (ANSI) and the International Electrotechnical Commission (IEC) have established methodologies for measurement of noise from transformers and other electrical devices. Measurements involve taking reference sound level measurements using microphones positioned 0.3 m (1 ft) from a tautly drawn string that encircles the device at a height above grade set at one-half the overall height of the device. The transformer noise output is the average of all measurements taken around the perimeter, incorporating contributions from both cooling fans and auxiliary equipment. The sound power radiated is calculated from the NEMA rating with total sound energy integrated over the total surface area of the transformer's four sides.

The proposed Oliver III substation will be located in the southeast corner of section 4 with the Project area. The closest occupied receptor (ID 6004) is approximately 1,300 meters (4,265 feet) west of the electrical substation. To assess potential impacts of 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. Currently, the Project substation design is only at a schematic level. Transformer sound source levels for the planned 60 MVA transformer were estimated for a NEMA sound rating of 76 dBA and are presented in Table 8. The octave band center frequencies were calculated linearly based on the estimate transformer NEMA rating using standard engineering technical guidelines.

Table 8 Transformer Sound Power Level (NEMA 76 dBA)

	Adjusted weighted Octave Band Sound Power Data (dBA)								
	31.5	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
NEMA Rating 76 dBA	99	105	107	102	102	96	91	86	79

Substations with transformer sizes of 10 to 150 MVA can present a noise concern if the separation distance is less than a few hundred feet between the transformer and noise sensitive receptors. The distance from the Project substation and transformer to the nearest noise sensitive receptor is over 4500 feet. Therefore, no adverse transformer noise impacts are expected. 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. Therefore, the transformer may be periodically audible at the nearest residences on infrequent occasions when background sound levels are very low.

5.3 Construction Noise

The development of the Oliver III Wind Energy Center will involve construction to establish access roads, excavate and form WTG foundations, prepare the site for crane-lifting and assemble and commission the WTGs. Work on large-scale wind projects such as the Oliver III Wind Energy Center 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 line.

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 9.

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 normally notifies the community via public notice or alternative method of the 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 noise sensitive receptors as is practical. Candidate construction noise mitigation measures include scheduling louder construction activities during daytime hours and equipping internal combustion engines with appropriate sized muffler systems to minimize noise excessive emissions.

Table 9 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 CONCLUSIONS

Project operational sound has been calculated and compared to relevant environmental noise guidelines as established by the EPA and OSHA. Acoustic modeling analysis per ISO 9613-2 only indicated two potential exceedances of the EPA noise guideline under anomalous meteorological conditions. The two exceedances occurred at receptor IDs 6003 and 6006. Receptor ID 6003 has been identified as unoccupied and abandoned for residential purposes. Receptor ID 6006 has been identified as occupied and slightly exceeds the EPA 48.6 dBA guideline by 0.3 dBA as shown in Table 7 but is a participating landowner.

The EPA guideline levels 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 a Project-generated sound level is below ambient conditions, the spectral and temporal characteristics of the new sound may result in perceptibility. 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 and wind energy in general, individual and community economic incentives, existing background sound levels, the proximity of the listener to a single or grouping of WTGs, among other factors. Due to their support of Project development, Project participants have been found to be less likely to become annoyed by low-level WTG sound than non-participants. Non-participants that consider the development of renewable energy sources, and wind energy projects 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 standards or limits relative to existing ambient conditions are proposed and met. 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.

In conclusion, the acoustic modeling analysis, inclusive of a number of conservative assumptions, demonstrates the Project is adequately designed to meet EPA guidelines at all noise sensitive occupied residences with the exception of receptor ID 6006. Sound from the Project when audible will likely not be deemed excessive or unusually loud at the setback distances and will be consistent with sound generated at similar wind energy projects successfully sited throughout the state of North Dakota employing similar criteria and WTG setback distances. The Oliver III Wind Energy Center is expected to generate sound levels that will be below EPA guideline limits and is therefore not expected to present an adverse noise impact with respect to public welfare, health and safety.

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Shadow Flicker Impact Analysis for the Oliver III Wind Energy Center

Prepared for

NextEra Energy Resources, LLC

Prepared by

TETRA TECH EC, INC.

160 Federal Street
Boston, MA 02110

October 2011

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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. In addition, when the turbine blades mask (cover) less than 20% of the solar disk, relative to the position of the observer, the shadow is 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 (4,921 feet) 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 30 wind turbines as part of the Oliver III Wind Energy Center (Project) in Morton County, North Dakota (the layout includes 4 alternate locations). Since the Project is using a minimum turbine siting setback requirement of 1,400 feet (to any occupied residence), 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 1.6xle** – 3-blade 82.5-meter-diameter rotor, with a hub height of 80 meters. The GE 1.6xle 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. The 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.

Shadow flicker impacts are not regulated in applicable state or federal law, and there is no permitting trigger with regard to hours per year of anticipated impacts to a receptor from a wind energy project. Due to the significant growth of the wind energy industry in recent years, some states have published model bylaws for local governments to adopt or modify at their own discretion which sometimes includes guidance and recommendations for shadow flicker levels and mitigation. However, a general precedent has been established in the industry both abroad and in the United States that fewer than 30 hours per year of shadow flicker impacts is acceptable to receptors in terms of nuisance and well below health hazard thresholds. In German court case for example, a judge found 30 hours of actual shadow flicker per year at a certain neighbor's property to be tolerable (WindPower 2003).

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 6, 2011, which includes 30 turbines and 4 alternate locations, was included in the analysis. The WindPro analysis was conducted to determine shadow flicker impacts under realistic impact conditions (actual expected shadow flicker). 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 National Elevation Dataset (NED) information. 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%	64%	73%	72%	65%	58%	43%	47%

- Estimated wind turbine operations and orientation (based on nearly 2.5 years of wind data from 10/23/2008 to 4/30/2011 (wind speed / wind direction frequency distribution) measured at meteorological tower on 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
7.5%	4.6%	4.0%	4.6%	6.7%	10.9%	10.1%	5.9%	5.5%	9.5%	16.0%	14.7%

- 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, and periods where the rotor masks less than 20% of the solar disk, were excluded, for the reasons identified earlier (in Section 1).

A total of 31 sensitive receptor locations were identified in the vicinity of the Project Area. These receptors are based on the February 11, 2010 Farmstead Report data. 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 describes 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. None of the 31 receptors modeled had expected shadow flicker impacts predicted for more than 30 hours per year.

The maximum predicted shadow flicker impact at any receptor, for the range of potential wind turbine options, is 22 hours, 58 minutes per year, which is only approximately 0.5 percent of the potential available daylight hours.

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

Receptor ID	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
7002	Occupied	22:58
7007	Occupied	18:48
300008	Abandoned	13:38
6005	Occupied	8:41
6003	Abandoned	6:47
6011	Occupied	6:15
6006	Occupied	5:01
7004	Abandoned	4:23
7016	Occupied	4:15
6004	Occupied	2:44

The overwhelming majority of the receptor locations evaluated have less than 20 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	31
= 0 Hours	19
> 0 Hours < 10 hours	9
≥ 10 Hours < 20 hours	2
≥ 20 Hours < 30 hours	1
≥ 30 hours	0

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.

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FIGURE 1

RESIDENTIAL RECEPTORS MODELED WITH WINDPRO TO PREDICT EXPECTED SHADOW FLICKER IMPACTS

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Substation
- Receptor
- Project Boundary

N

W E

S

0 0.5 1 Miles

REFERENCE MAP

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FIGURE 2

WINDPRO PREDICTED EXPECTED SHADOW FLICKER IMPACT AREAS

OCTOBER 2011

Legend

- GE 1.6 xle Turbine (9/6/2011)
- Substation
- Receptor
- Project Boundary

Shadow Flicker Iso Line

- 15 hrs/yr
- 30 hrs/yr
- 50 hrs/yr
- 75 hrs/yr
- 100 hrs/yr

N

W E

S

0 0.5 1 Miles

REFERENCE MAP

TODD.GYS(ECIBOSDGYST) P:\FPL Energy\Dakotas\Contract 3173 and 3664 - Oliver County Wind\Contract 3664 Oliver III, IV and V\GIS\Spatial\MXD\shadow_flicker\Shadow_Flicker_Fig1_Receptors_20111011.mxd 10/11/2011

ATTACHMENT A

Detailed Summary of WindPro Shadow Flicker Analysis Results

Oliver III Wind Energy Center
WindPro Shadow Flicker Analysis Results Summary

WindPro Receptor ID	NextEra Oliver III Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)	Status	Owner
1	6002	335,368	5,206,778	0:00	Abandoned	Alan Schwalbe
2	6003	335,434	5,204,641	6:47	Abandoned	Calvin Schmidt
3	6004	334,582	5,203,847	2:44	Occupied	Tom Zander
4	6005	335,894	5,202,102	8:41	Occupied	Chad Olson
5	6006	335,875	5,202,206	5:01	Occupied	Arden Hagerott
6	30008	337,240	5,201,768	0:00	Abandoned	(Relay Tower)
7	6008	338,714	5,201,739	0:59	Occupied	Audrey Spence Etal
8	6009	338,753	5,201,759	0:00	Abandoned	Audrey Spence Etal
9	6010	335,722	5,198,836	0:00	Occupied	Marcus Zander
10	6011	336,821	5,199,125	6:15	Occupied	Val Schlosser
11	6012	335,789	5,197,882	0:00	Abandoned	Zander Family Trust
12	6013	336,785	5,196,966	0:00	Occupied	Bruce Engelhardt
13	6014	337,857	5,198,463	0:59	Abandoned	Kasper & Caroline
14	7002	339,472	5,200,083	22:58	Occupied	Walter Vogel
15	7004	339,106	5,200,837	4:23	Abandoned	Nels & Darlene
16	7007	338,286	5,203,461	18:48	Occupied	Ben Kopp
17	7010	338,391	5,204,385	0:00	Occupied	Lawrence & Frances
18	7016	337,949	5,204,464	4:15	Occupied	Lawrence & Frances
19	7020	341,032	5,200,597	0:00	Occupied	Ronald & Virginia
20	7023	342,191	5,197,153	0:00	Occupied	Vernon Bahm Etal
21	7027	342,143	5,197,130	0:00	Occupied	Vernon Bahm Etal
22	7029	341,907	5,197,106	0:00	Occupied	Vernon Bahm Etal
23	300008	337,179	5,202,968	13:38	Abandoned	Arden Hagerott
24	5015	335,015	5,210,254	0:00	Occupied	Dale & Gail Hilton
25	5016	335,270	5,210,159	0:00	Occupied	Dale & Gail Hilton
26	5017	335,141	5,210,664	0:00	Occupied	Dale Barnhardt
27	5013	331,662	5,210,195	0:00	Occupied	Douglas Doll etal
28	5018	334,958	5,209,903	0:00	Occupied	Delmar Hagerott etal
29	5026	331,919	5,207,710	0:00	Occupied	Mark & Lynette Dagley
30	5021	334,144	5,206,664	0:00	Occupied	Simon Schmidt
31	5020	334,149	5,206,673	0:00	Occupied	Simon Schmidt