DRAFT
NATIVE PRAIRIE SURVEY OLIVER EXPANSION PHASES III, IV, AND V WIND RESOURCE AREA MORTON & OLIVER COUNTIES NORTH DAKOTA

PREPARED FOR

NEXTera ENERGY RESOURCES

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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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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.

		Trees and Shrubs Scientific Name	**Trees and Shrubs Scientific Name**
Phlox hoodii Rich.	Hood's phlox		
Plantago patagonica Jacq.	wooly plantain		
Polygala alba Nutt.	white milkwort	*Juniperus communis* L.	*Juniperus communis* L.
Potentilla arguta Pursh	tall cinquefoil	*Prunus pumila* L. var. *besseyi* (Bailey) GI.	*Prunus pumila* L. var. *besseyi* (Bailey) GI.
Potentilla pensylvanica L.l	Pennsylvania cinquefoil	*Rhus aromatic* Ait.	*Rhus aromatic* Ait.
		Rosa species	*Rosa species*

	Juniperus communis L.
Prunus pumila L. var. *besseyi* (Bailey) GI.	*Prunus pumila* L. var. *besseyi* (Bailey) GI.

Grasses	
Scientific name	**English Name**
***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
Achillea millefolium L.	common yarrow
Allium textile A. Nels & Macbr.	textile wild onion
Anemone patens L.	pasque flower
Arabis holboellii Hornem. var. retrofacta	rock cress
Arnica fulgens Pursh.	shining arnica
***Artemisia absinthium* L.**	**absinthe wormwood***
Artemisia campestris L. subsp. *caudata* (Michx.) Hall & Clem.	western sagewort
Artemisia frigida Willd.	fringed sagewort
Artemisia ludoviciana Nutt.	white sagewort
Asclepias speciosa Torr.	showy milkweed
Asclepias viridiflora Raf.	green milkweed
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
Potentilla arguta Pursh	tall cinquefoil
Psoralea argophylla Pursh	silver-leaf scurf pea
Psoralea esculenta Pursh	breadroot scurf pea
Ratibida columnifera (Nutt.) Woot. & Standl.	prairie coneflower
Rumex sp.	dock species
Senecio plattensis Nutt.	prairie ragwort
Solidago mollis Bartl.	soft goldenrod
Sphaeralcea coccinea (Pursh) Rydb.	red false mallow
***Taraxacum officinale* Weber**	**common dandelion**
***Thlaspi arvense* L.**	**pennycress**
***Tragopogon dubius* Scop.**	**goat's beard**

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

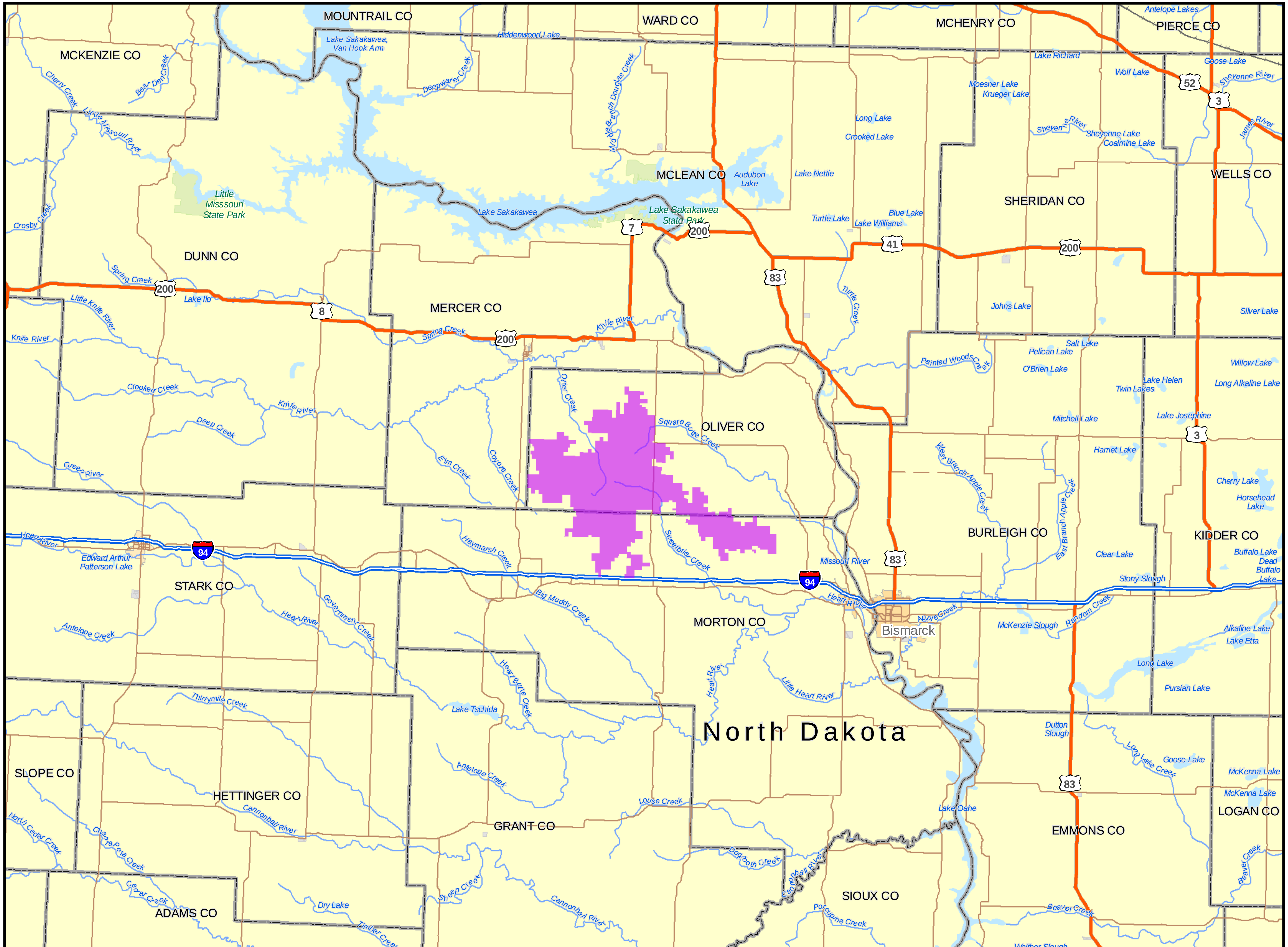


Figure 1.
Wind Resource Area Vicinity Map
Oliver Expansion
(Phases III, IV, and V)

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

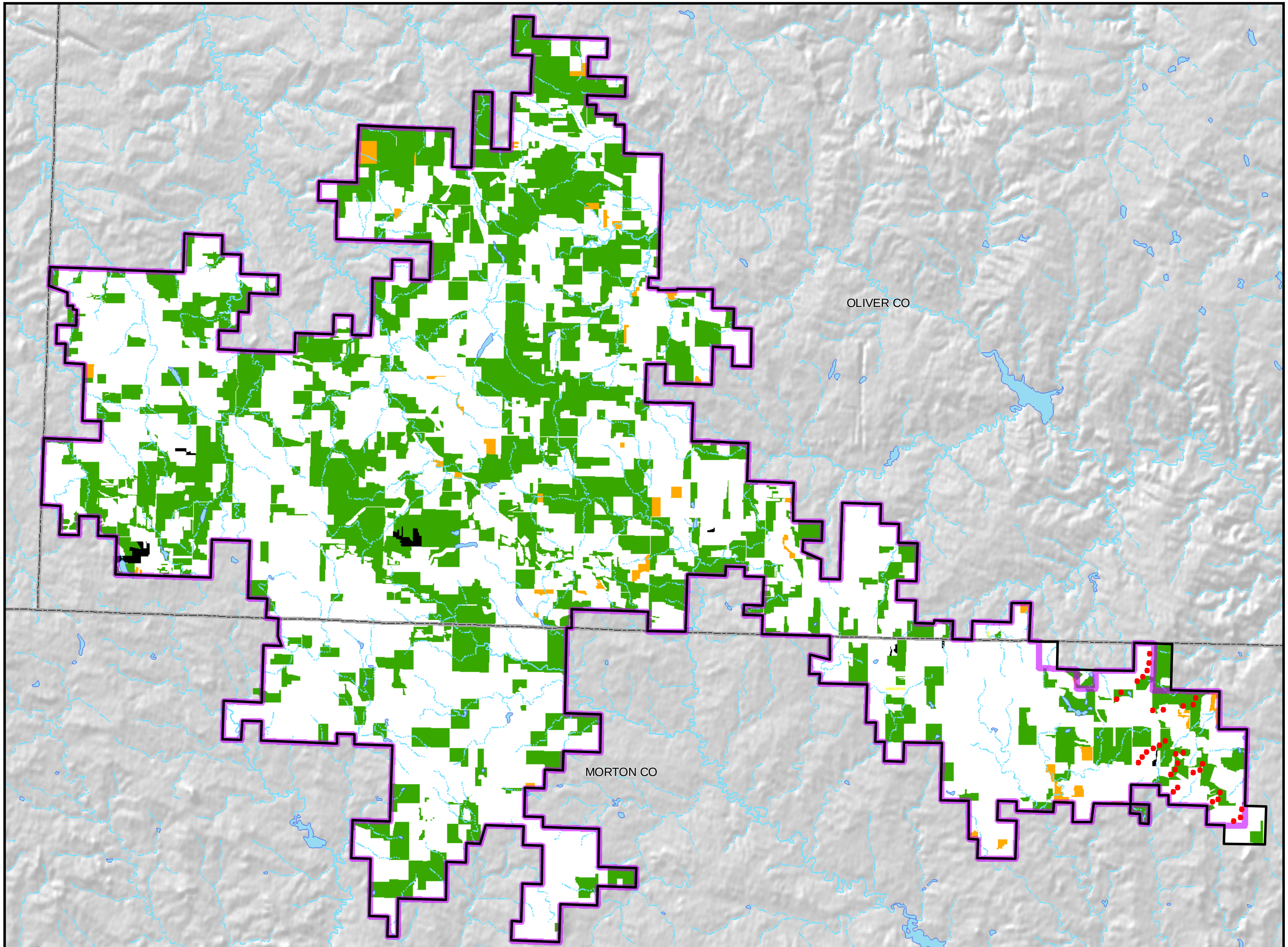
September 30, 2009
1:750,000
NAD83 Zone 14

TETRA TECH EC,INC

P:\GIS_PROJECTS\FPL\Oliver\maps\Native_Prairie_Survey\2009SpringReport_Maps\NextEra_Oliver_NPS_Figure1_WRA_Vicinity_171111_092509.mxd - Last Accessed: 9/30/2009 - Map Scale correct at: ANSI B (17" x 11")

Figure 2.
Native Prairie and Tame Grasslands 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

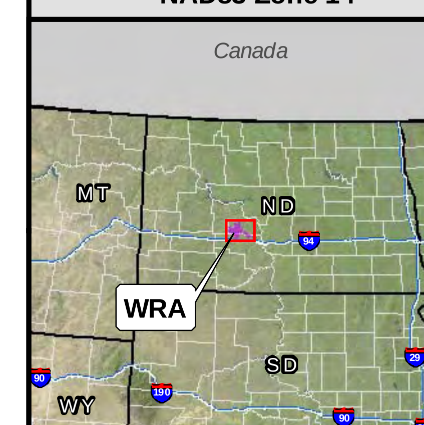
Cover Type

Native
Tame
Hay
Not Surveyed
Other

Note: Areas outside survey area were not surveyed

0 0.5 1 2 3 4
Miles

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



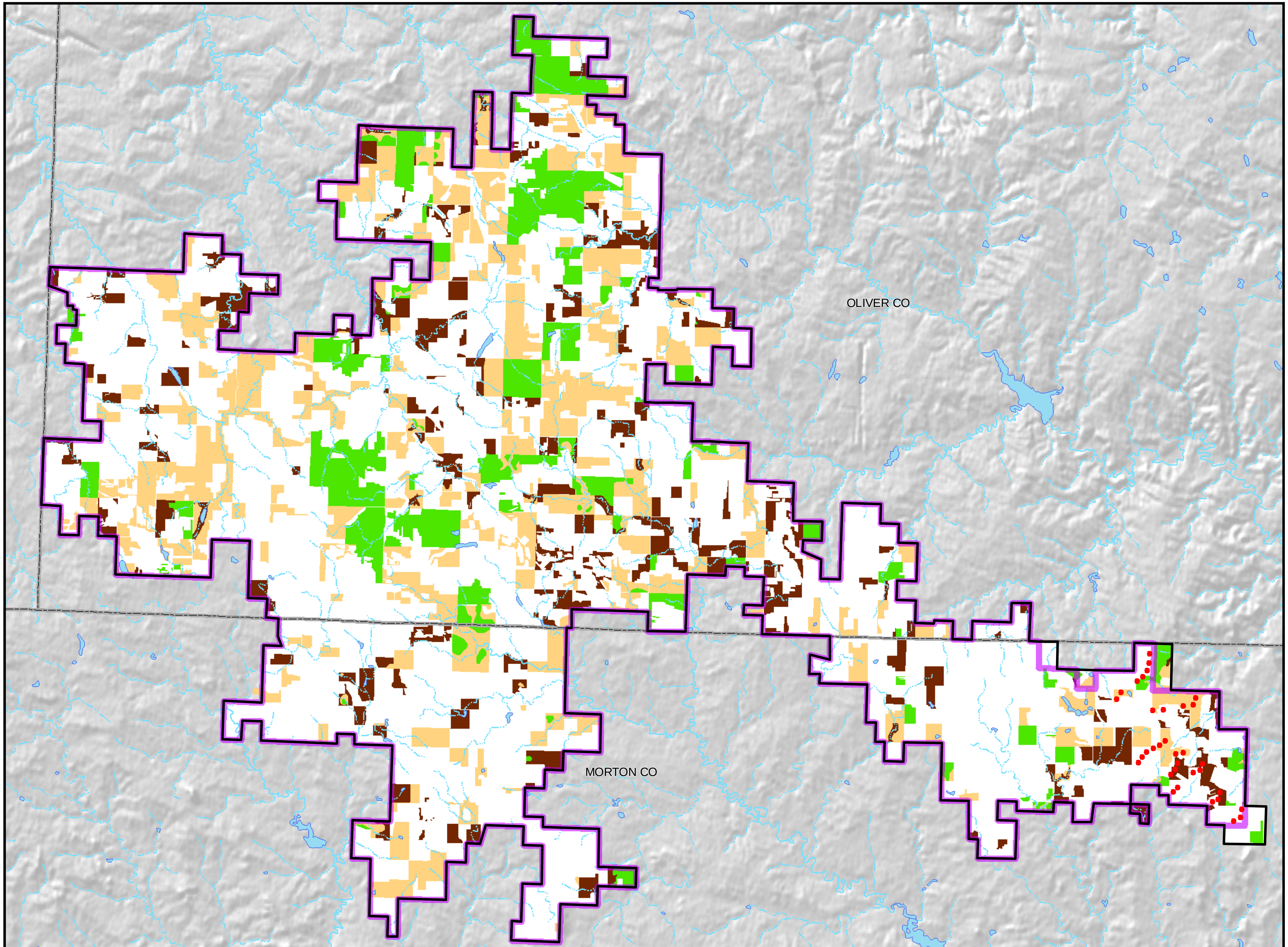


Figure 3. Potential Dakota Skipper Native Prairie Habitat Oliver Expansion (Phases III, IV, and V)

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

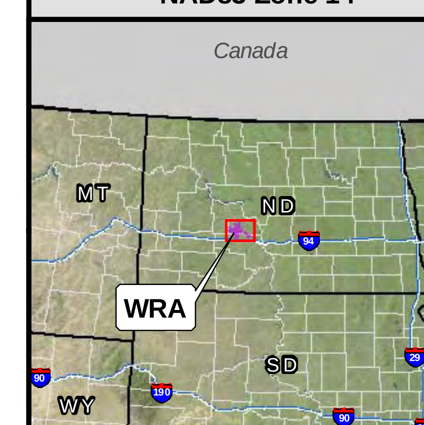
Excellent/Likely
Good/Possible
Poor/Unlikely
Other

Note: Areas outside survey area were not surveyed

NEXTera ENERGY RESOURCES

0 0.5 1 2 3 4
Miles

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



TETRA TECH EC,INC

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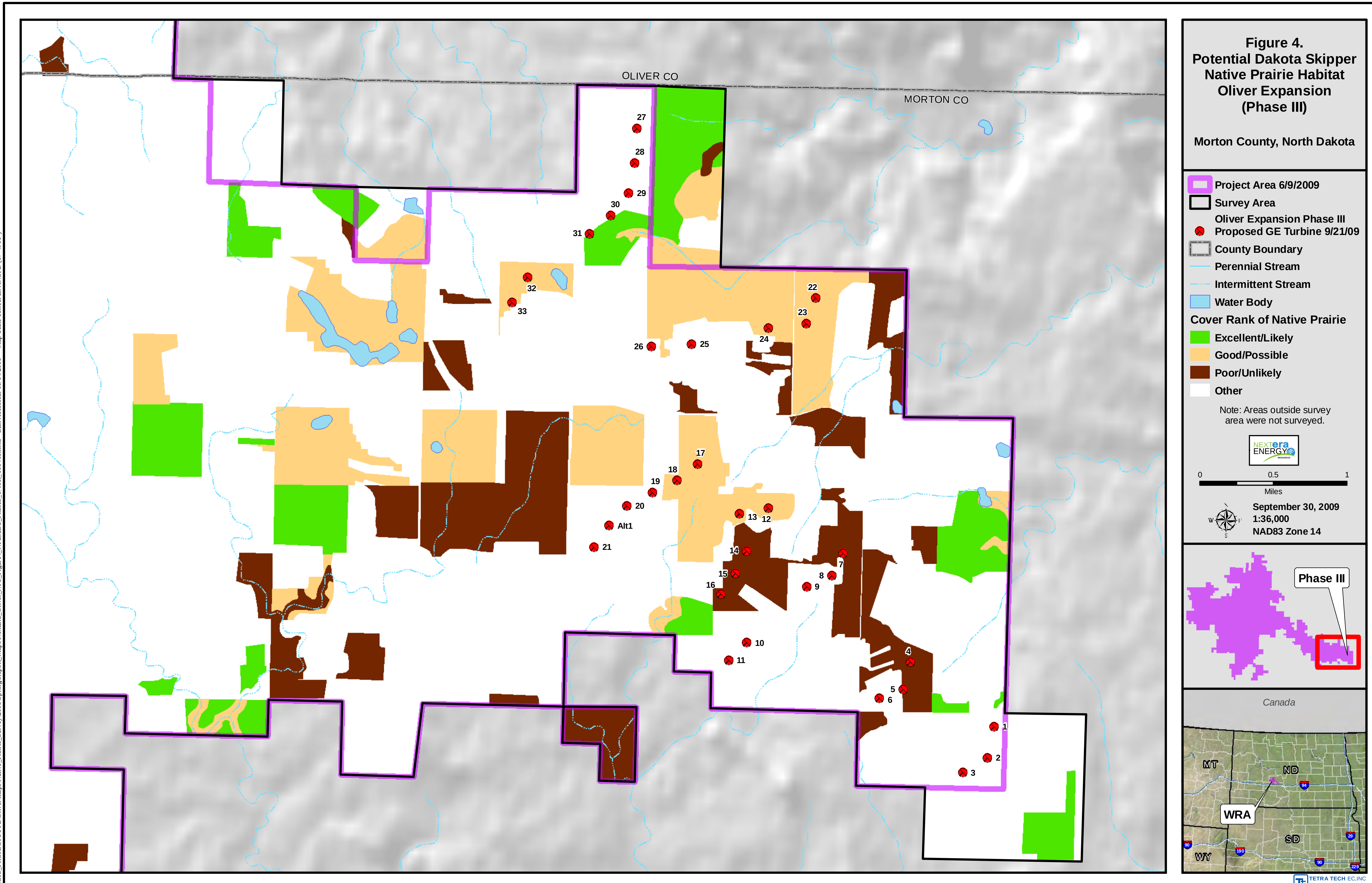

Figure 4.
Potential Dakota Skipper Native Prairie Habitat Oliver Expansion (Phase III)

Morton County, North Dakota

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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Appendices

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).

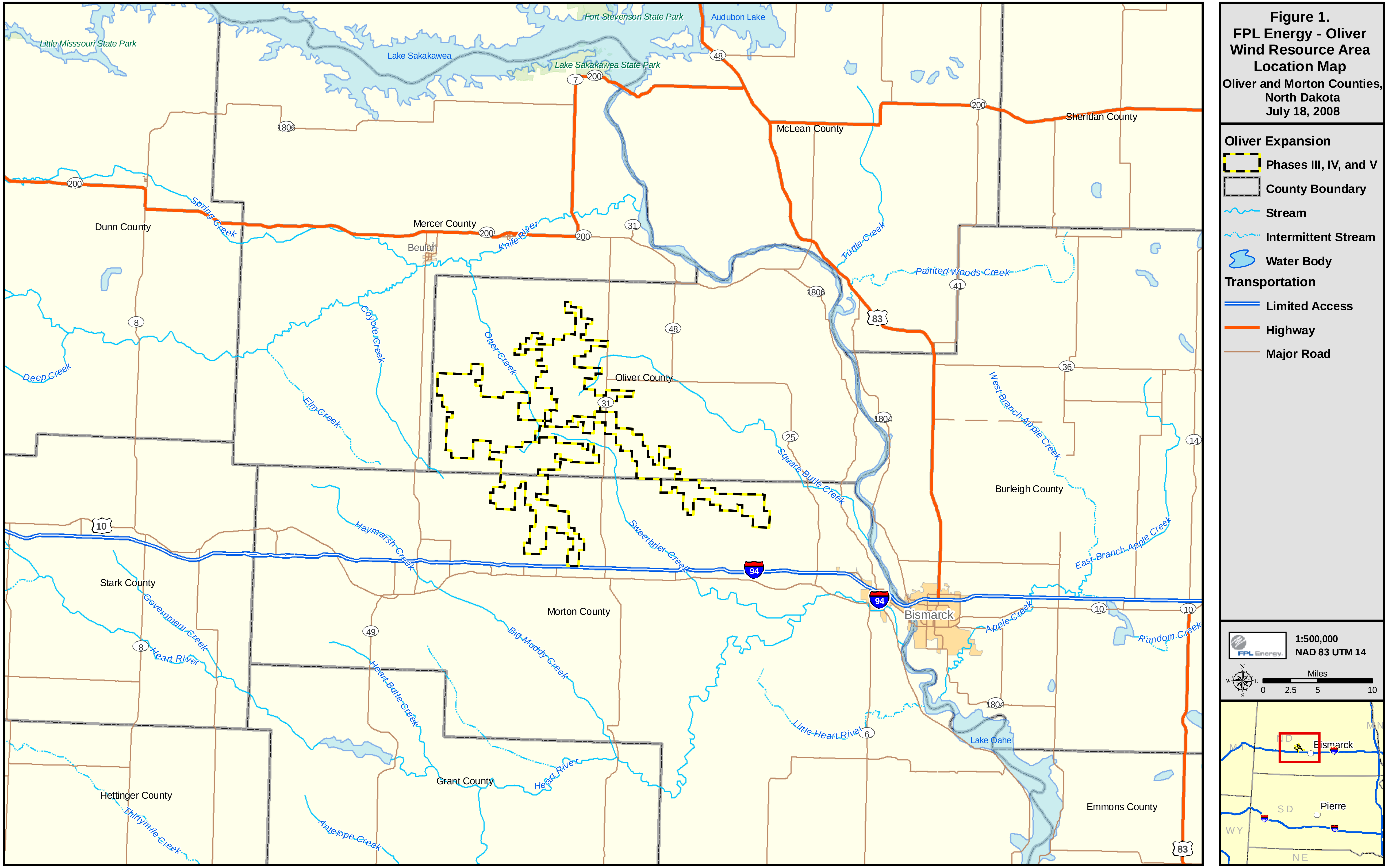

Figure 1.
FPL Energy - Oliver Wind Resource Area Location Map
Oliver and Morton Counties, North Dakota
July 18, 2008

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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.

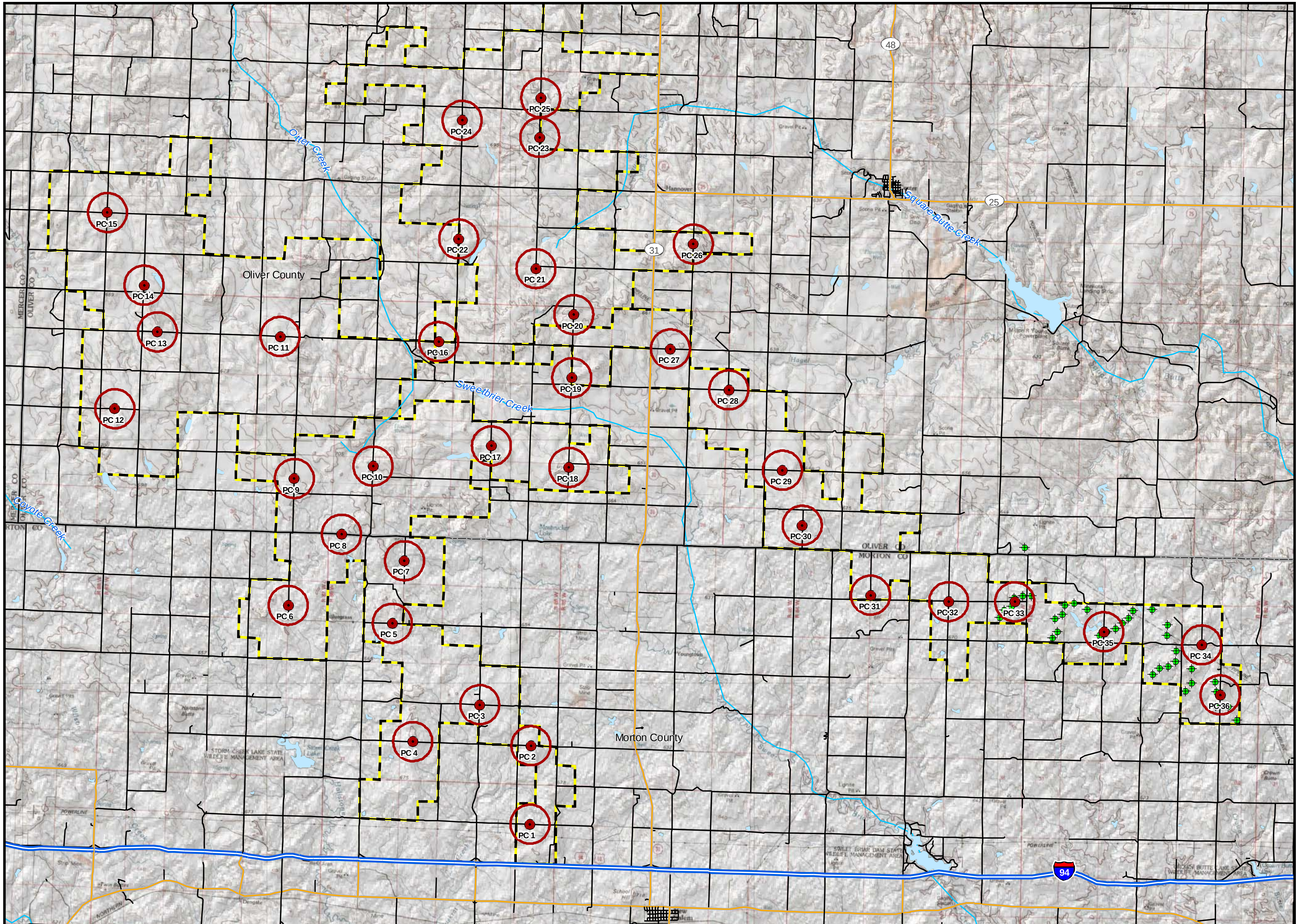


Figure 2.
FPL Energy - Oliver Point Count Location Map

Oliver and Morton Counties, North Dakota
July 18, 2008

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

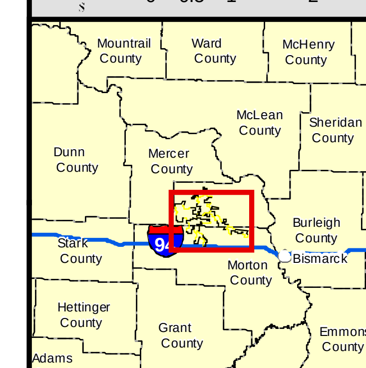
Oliver Expansion
Phases III, IV, and V
County Boundary
Stream
Intermittent Stream
Water Body

Transportation
Limited Access
Highway
Major Road
Other Road

* only a portion of turbines shown

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

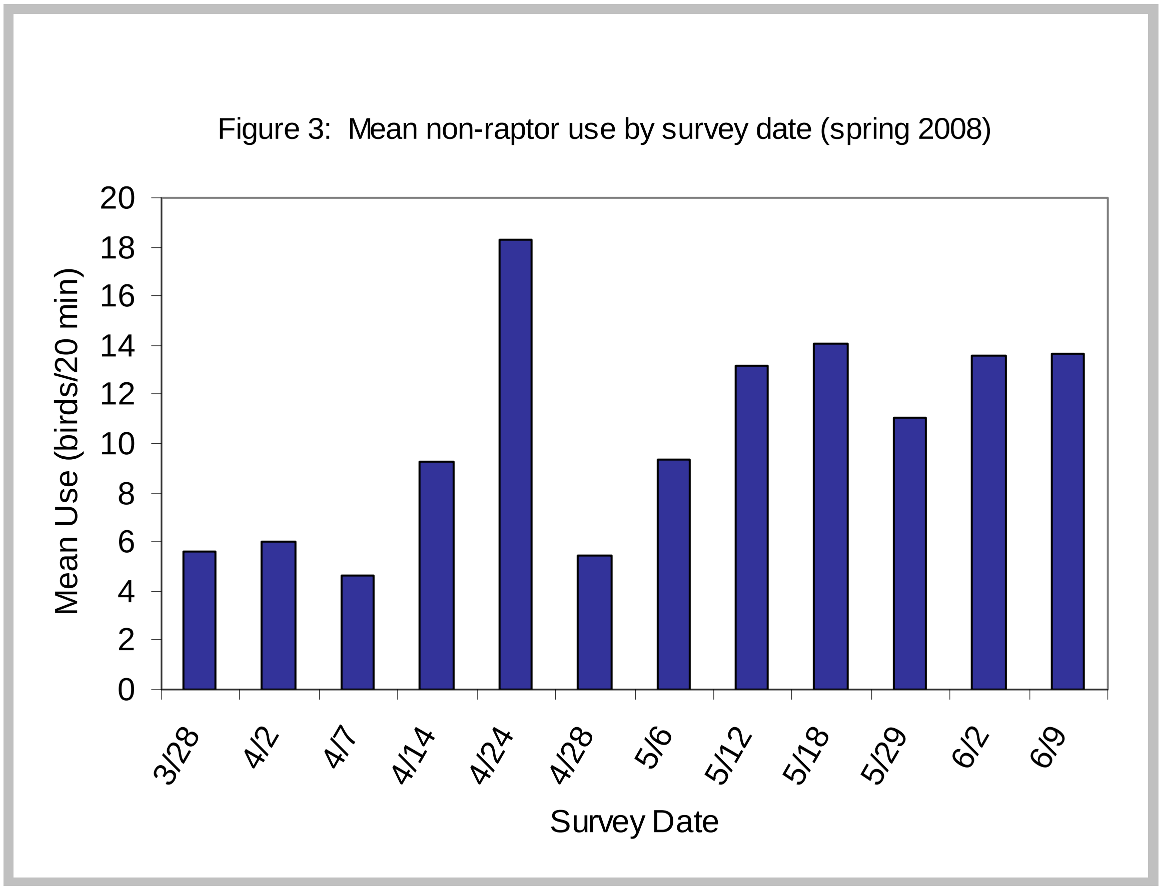
Biologists recorded a total of 4,581 birds of 68 identified species and 1 unidentified species group during the 432 fixed-point count surveys (**Table 2**). The most frequently observed birds seen were the western meadowlark (16.8 percent of all birds observed), red-winged blackbird (12.3 percent), and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



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**).

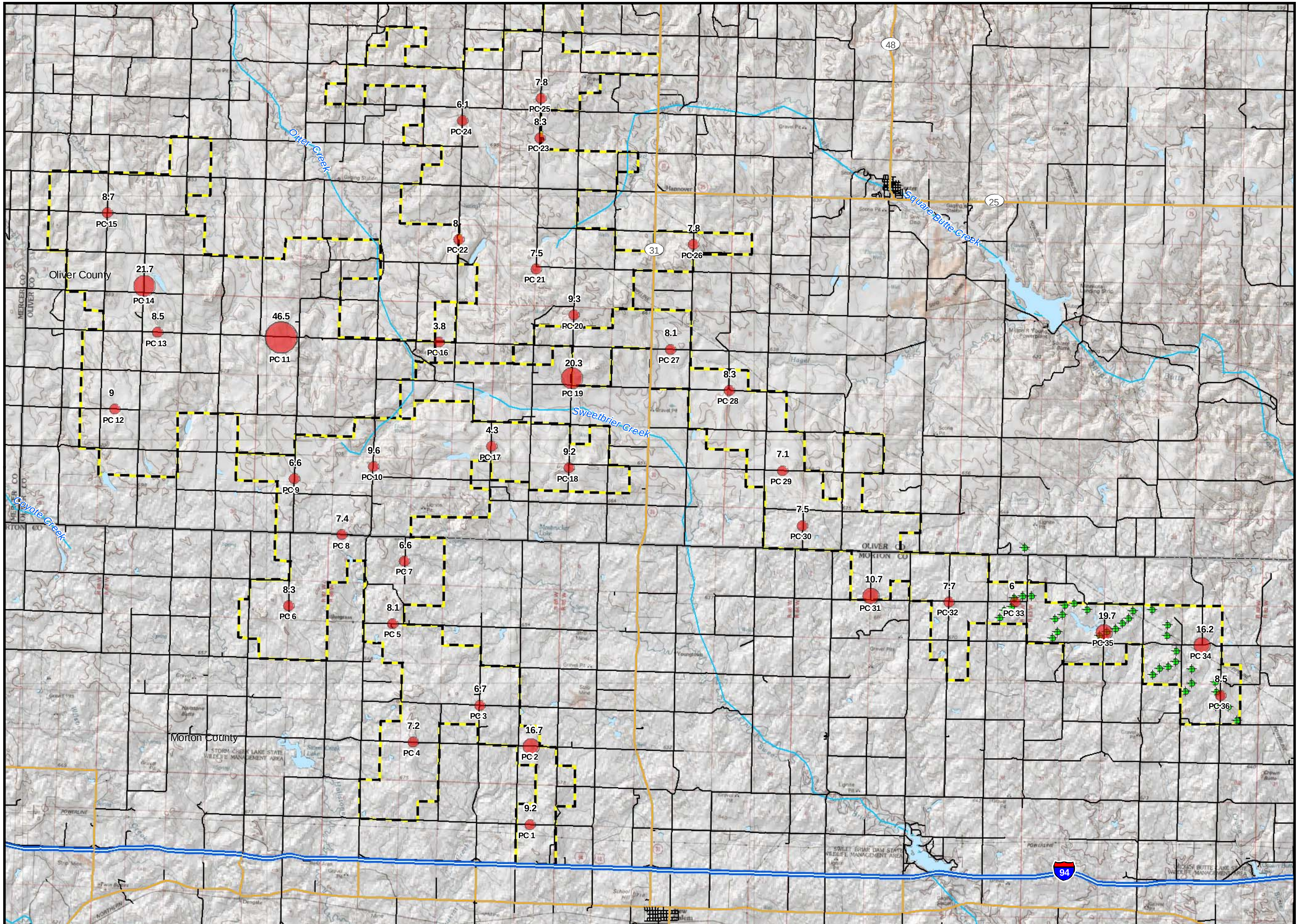


Figure 4.
FPL Energy - Oliver Mean Non-Raptor Use by Point Count Location (spring 2008)
Oliver and Morton Counties, North Dakota
July 18, 2008

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

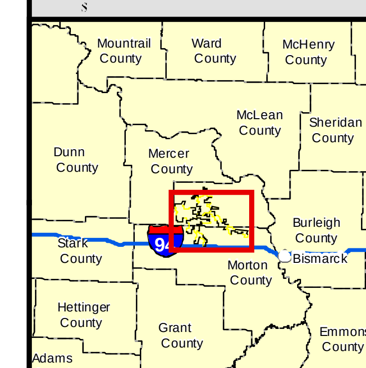
- Limited Access
- Highway
- Major Road
- Other Road

* 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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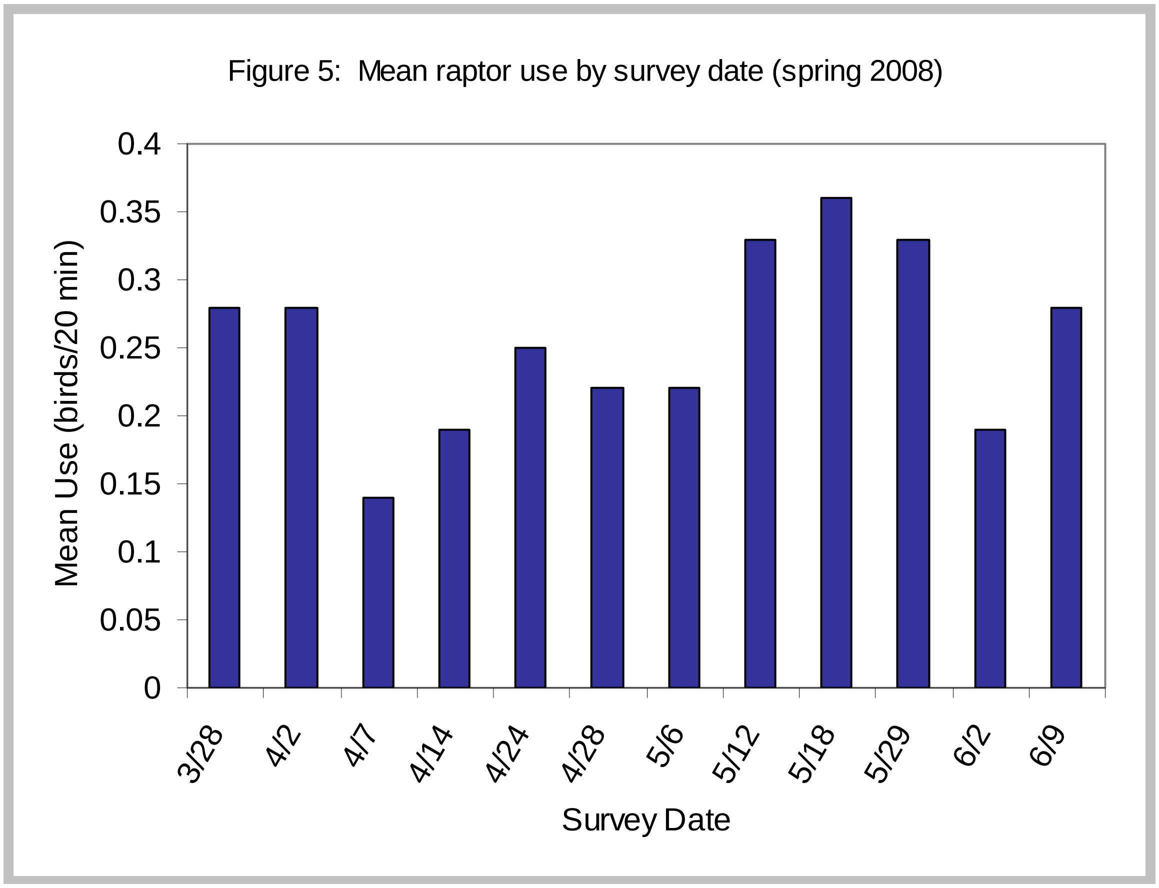
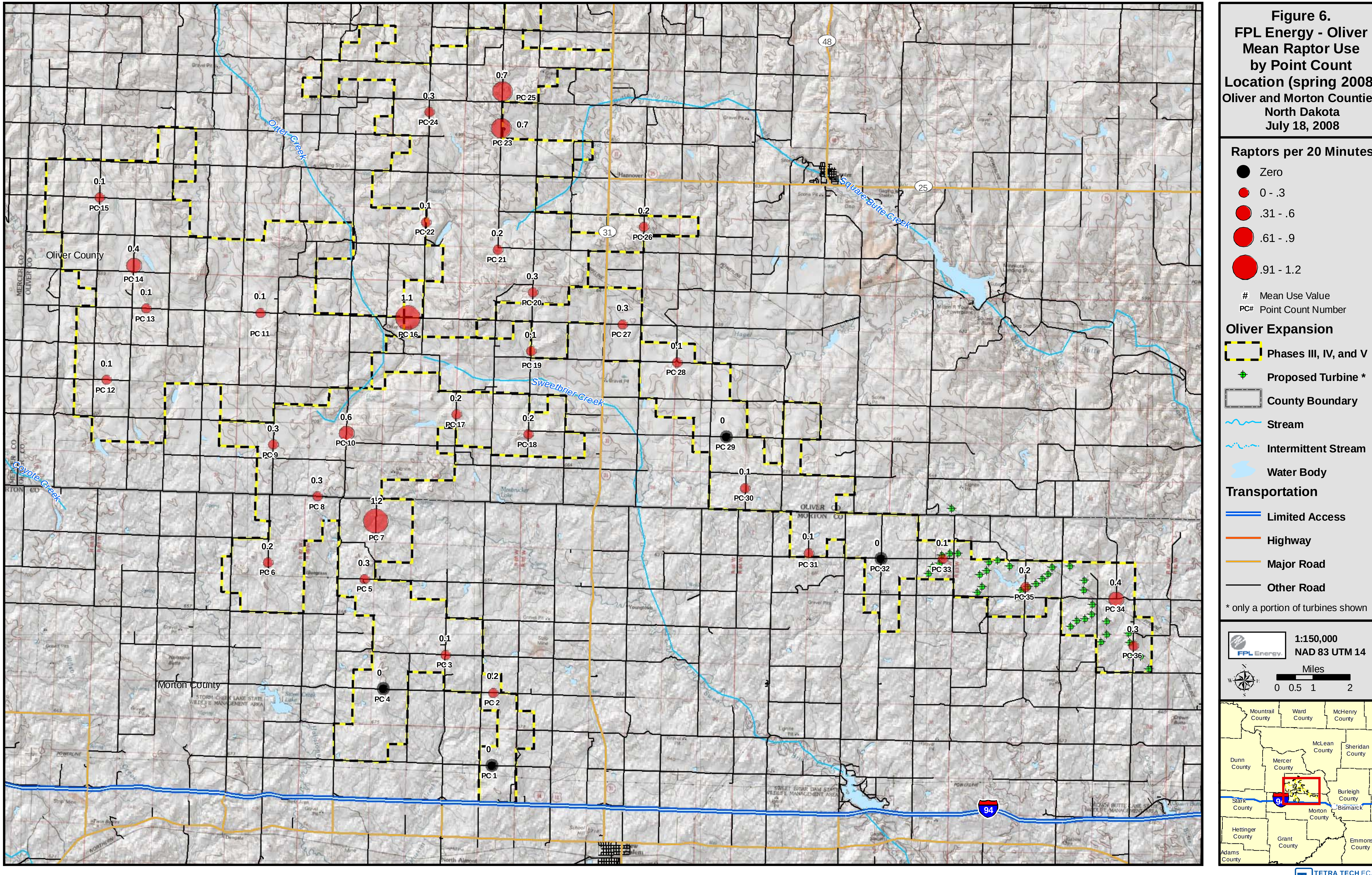


3.4 Frequency of Occurrence

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.



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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.

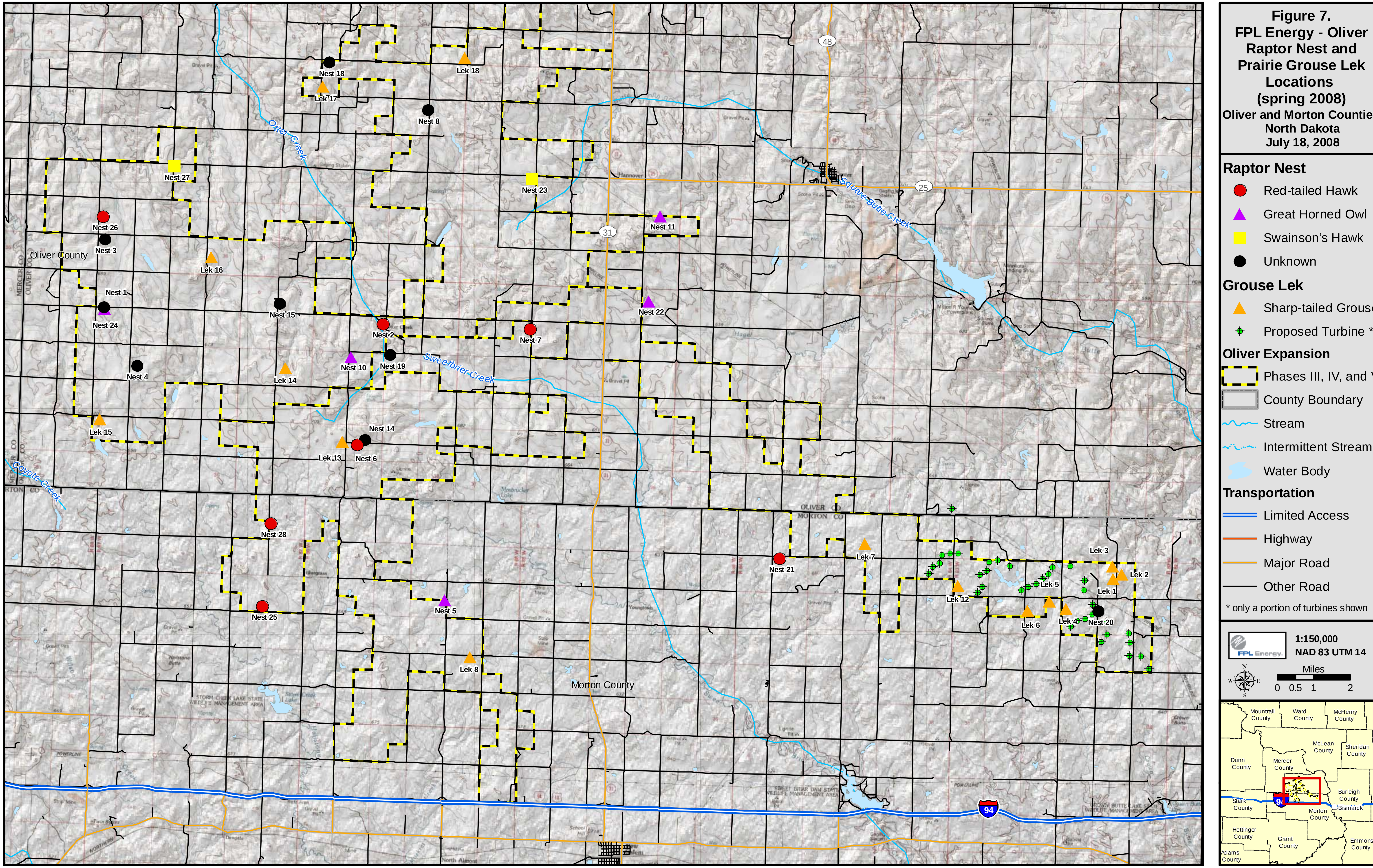

Figure 7. FPL Energy - Oliver Raptor Nest and Prairie Grouse Lek Locations (spring 2008)
Oliver and Morton Counties, North Dakota
July 18, 2008

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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).

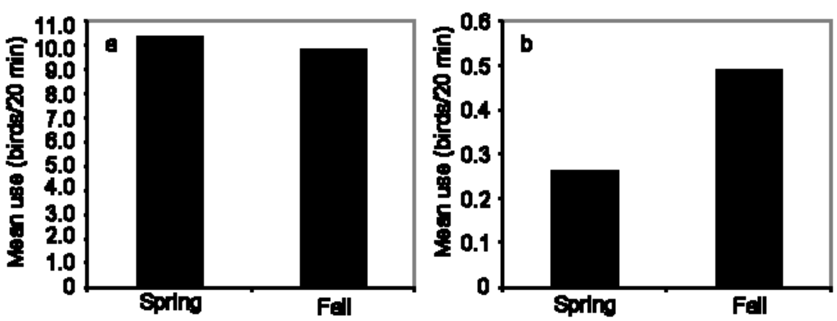

Figure ES-1. Mean raptor and non-raptor use by season.

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).

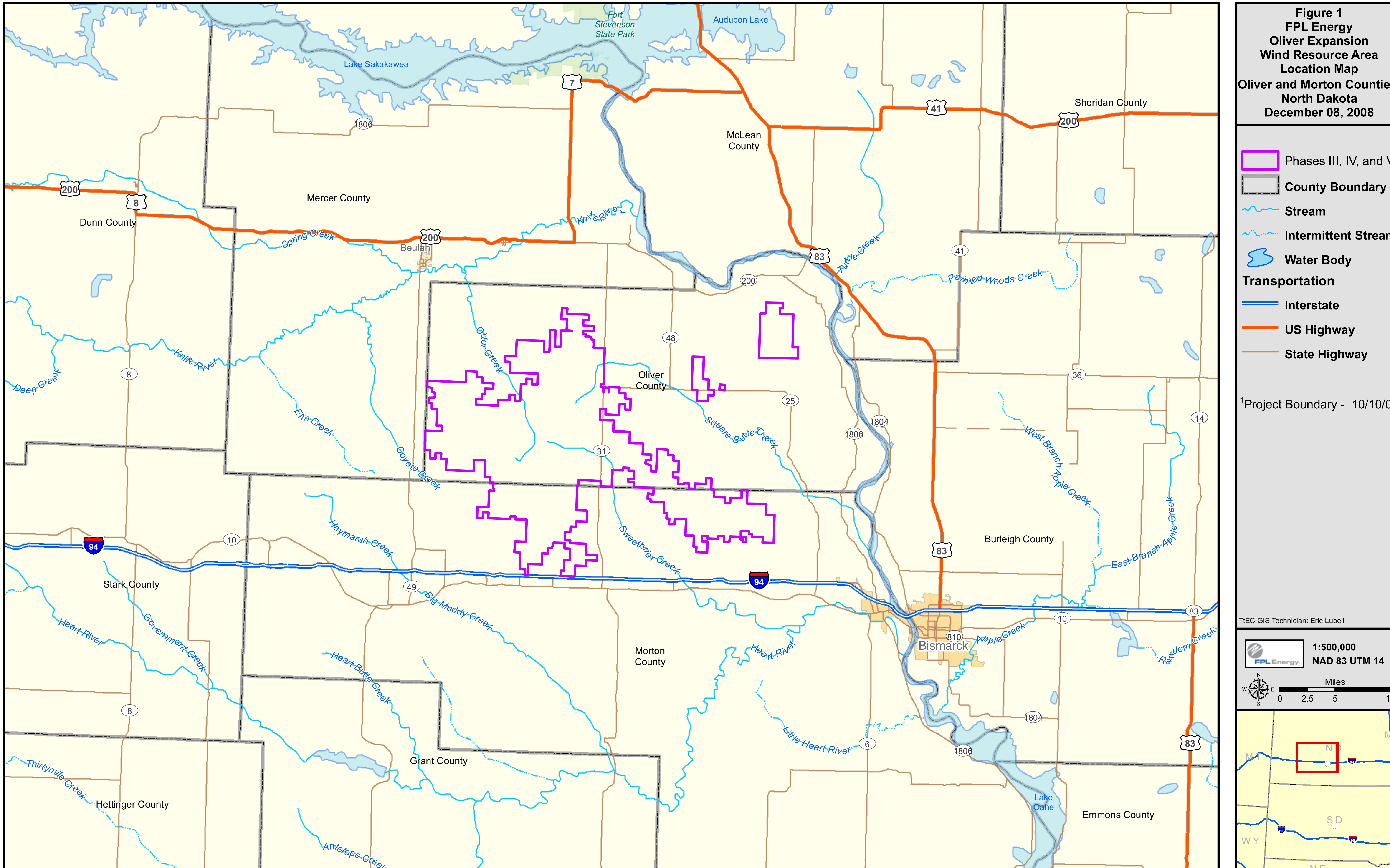

Figure 1
FPL Energy
Oliver Expansion
Wind Resource Area
Location Map
Oliver and Morton Counties, North Dakota
December 08, 2008

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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 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.

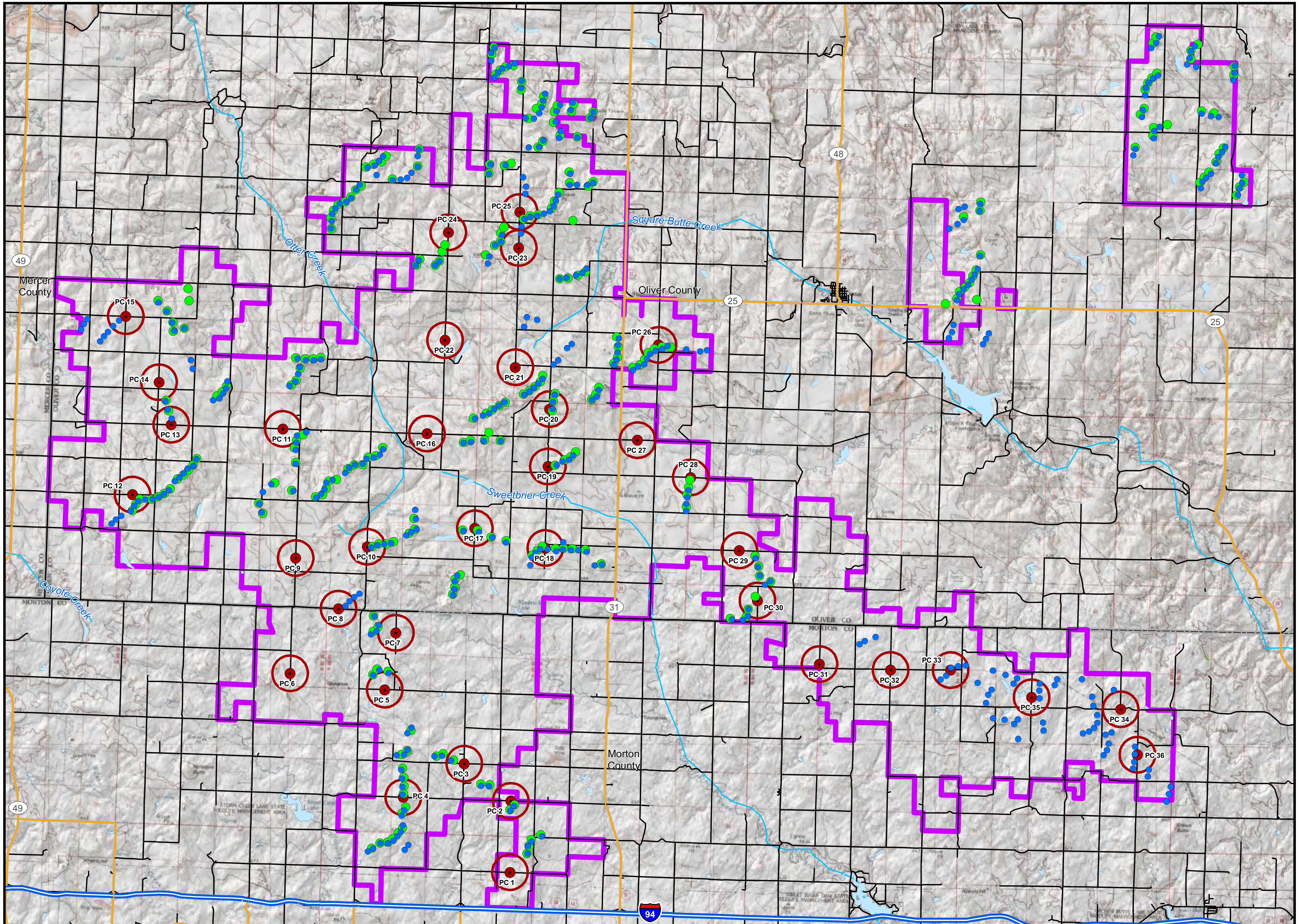


Figure 2
FPL Energy
Oliver Expansion
Point Count Location Map

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).

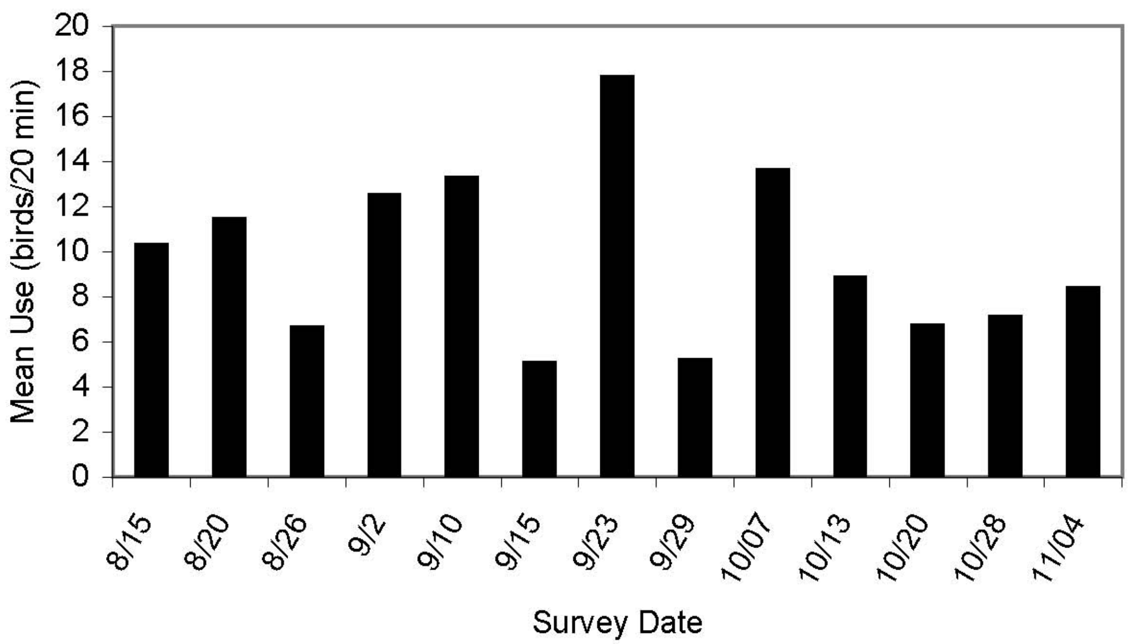
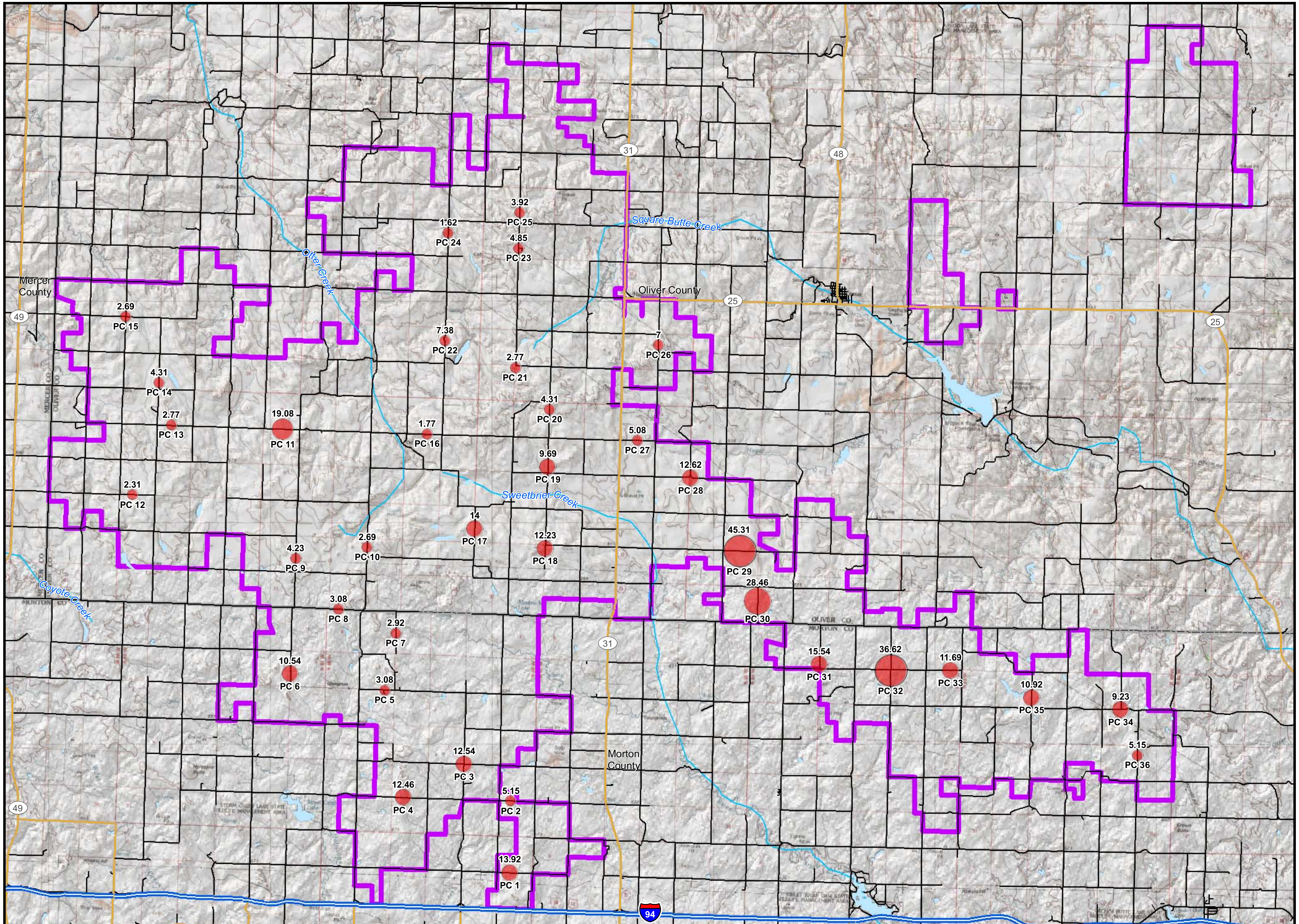


Figure 3. Mean non-raptor use by survey date (fall 2008)

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

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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).

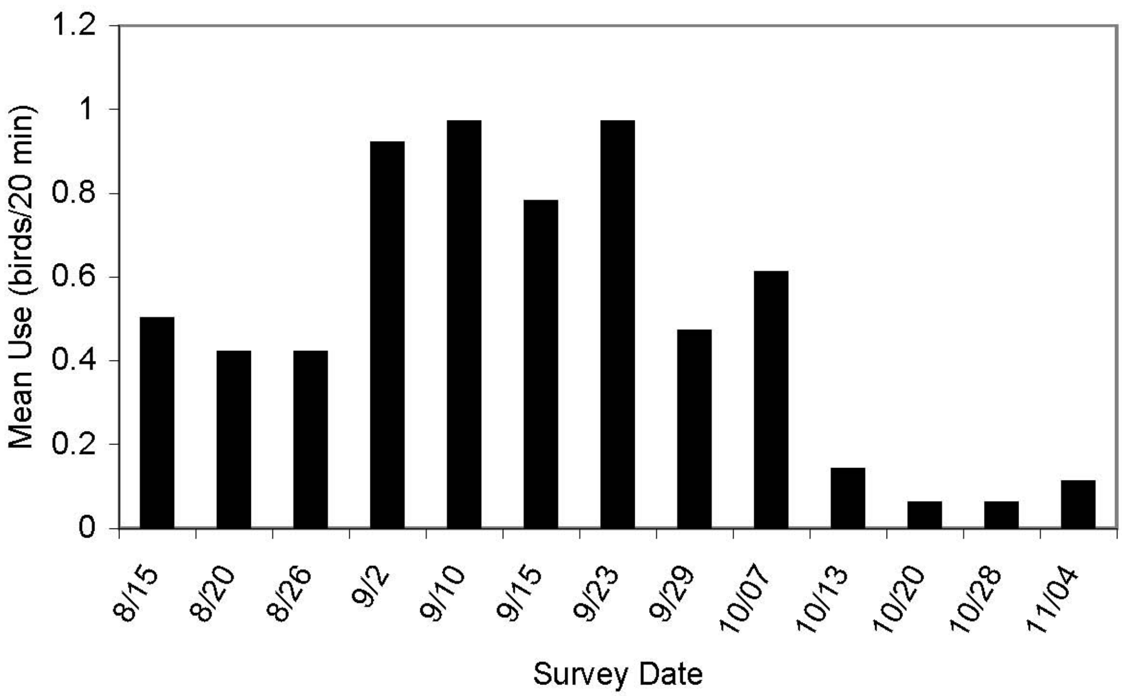

Figure 5. Mean raptor use by survey date (fall 2008)

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.

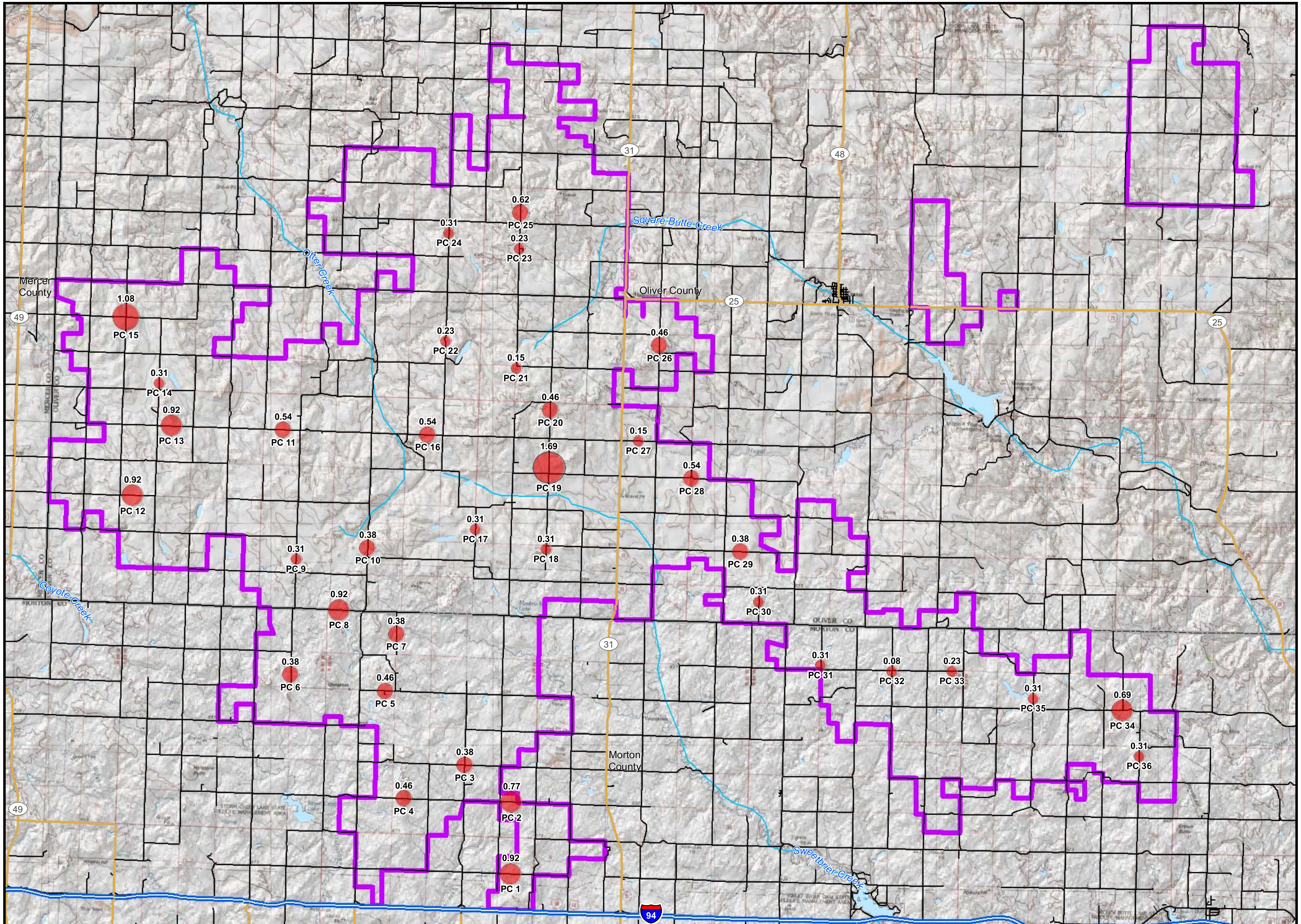

Figure 6
FPL Energy
Oliver Expansion
Mean Raptor Use
by Point Count
Location (fall 2008)
Oliver and Morton Counties,
North Dakota
December 08, 2008

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

Mountrail County, Ward County, McHenry County, McLean County, Sheridan County, Dunn County, Mercer County, Oliver County, Burleigh County, Stark County, Morton County, Bismarck, Hettinger County, Grant County, Emmons County, Adams County

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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.

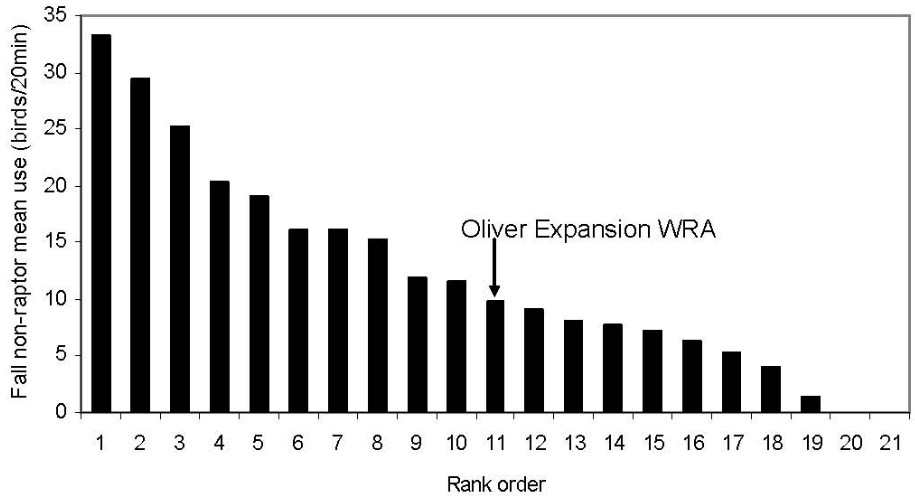

Figure 7. Comparison of non-raptor mean use at Oliver Expansion WRA to other mean use studies at wind projects.

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.

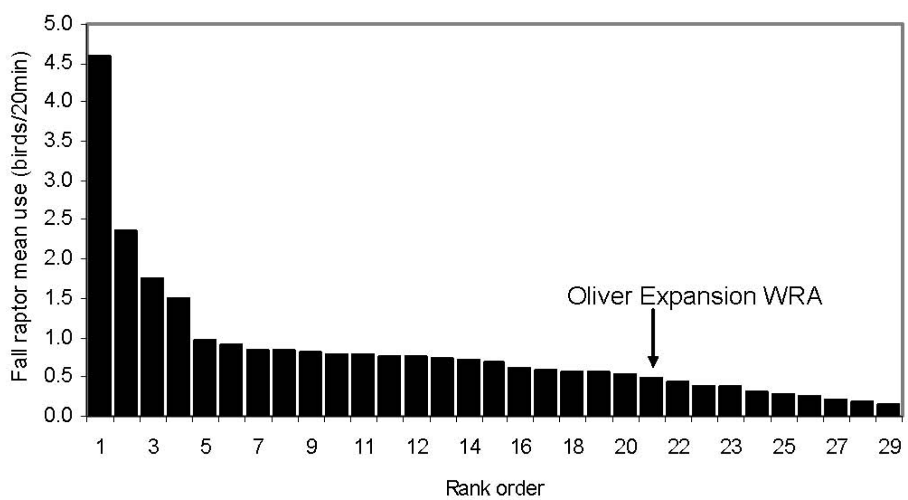

Figure 8. Comparison of raptor mean use at Oliver Expansion WRA to other mean use studies at wind projects.

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

Whooping Crane Likelihood of Occurrence Report

Oliver Expansion Wind Energy Generation Facility

(Phases III, IV, and V)

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(Updated November 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. 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.

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1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra Energy) is currently developing plans to expand a wind energy facility in Oliver and Morton Counties, North Dakota (Figure 1). One concern when developing wind energy facilities in parts of the Great Plains is the federally endangered whooping crane (*Grus americana*). The whooping crane migrates through portions of North Dakota during spring and fall. Whooping cranes have been killed by collisions with power lines, and the whooping crane recovery plan lists construction of power lines, fences, and other structures in the migration corridor as a threat to the species (Canadian Wildlife Service [CWS] and United States Fish and Wildlife Service [USFWS] 2007). Thus, the construction of wind turbines may pose a risk to whooping cranes through direct mortality or avoidance of areas where turbines are located.

To continue their efforts to identify areas where they can minimize impacts, NextEra contracted Tetra Tech EC, Inc (Tetra Tech) to conduct a landscape-scale analysis to assess the potential occurrence of whooping cranes within Phases III, IV, and V of the Oliver Wind Energy Generation Facility (Oliver Expansion). As requested, results for Phase III are called out separately since that will be the first phase of development. The objective of this likelihood of occurrence analysis is to evaluate the biological and landscape features within the Oliver Expansion to determine the potential for whooping cranes to occur. Despite the small population size of whooping cranes, certain landscape features may increase the likelihood of whooping crane occurrence during migration. Thus, Tetra Tech developed a likelihood index to evaluate the Oliver Expansion Project Area based on its location in the migration corridor, the locations of historical observations of whooping cranes, the presence of feeding and roosting sites, and the availability of habitat within the Project Area compared to the surrounding landscape. The likelihood index does not predict how many whooping cranes will occur in the Oliver Expansion Project Area; rather it scores the site based on a suite of variables that are related to whooping crane occurrence. Higher scores denote higher potential likelihood of occurrence.

2.0 LEGAL STATUS OF THE WHOOPING CRANE IN THE UNITED STATES

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

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

Gulf Coast of Texas. This flock is referred to as the Aransas-Wood Buffalo National Park Population. Due to intensive management, this population has increased from 15 birds in 1941 to 247 as of the start of spring migration in 2009 (USFWS 2009).

3.0 ENVIRONMENTAL SETTING AND PROJECT AREA DESCRIPTION

3.1 Environmental Setting

The Oliver Expansion Project is located within the Northwestern Great Plains (Bryce et al. 1998). This landscape includes the western mixed-grass prairie, short-grass prairie, and associated wetlands of the Missouri Slope and River Breaks regions. This semiarid, unglaciated region of North Dakota includes level to rolling plains topography with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Land use is predominantly dry-land farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

3.2 Project Area Description

The Oliver Expansion is located on privately owned lands in south-central North Dakota, consists of 184,665 acres, and is located approximately 30 miles northwest of Bismarck in Oliver and Morton Counties (Figure 1); Phase III consists of 22,368 acres. The Oliver Expansion Project Area is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture and rangelands with patches of native prairie. The area contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Residences and abandoned farmsteads are scattered throughout the Project Area. Patches of trees and shrubs exist throughout the Project Area, and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields. Further details on the geographic features and land use can be found in the Critical Issues Analysis (Tetra Tech 2008).

4.0 WHOOPING CRANE BIOLOGY

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

4.1 Reasons for the Population Decline

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

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

4.2 Threats to Whooping Cranes

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

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

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

5.0 WHOOPING CRANE MIGRATION

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

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

5.1 Fall Migration

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

5.2 Spring Migration

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

5.3 Migration Flight Behavior

Whooping cranes are diurnal migrants and primarily fly by using static soaring, but low-level flapping flight may be used when conditions dictate. Migration is initiated after the air has warmed and thermal updrafts are present. Individuals spiral upwards on thermals of warm air to heights of 1,000 to 6,000 feet (Kyut 1992), then enter into long, descending glides. This process is repeated throughout the day until suitable habitat is reached. Static soaring is energy efficient as birds seldom flap after they are airborne. Whooping cranes may travel up to 500 miles per day in ideal conditions; during average conditions they may travel 250 miles per day (Stehn and Wassenich 2006). During the end of the migration flight, individuals will enter long descending glides and use flapping flight at lower altitudes until they reach suitable roosting and feeding habitat. Whooping cranes do not regularly migrate during unfavorable weather conditions such as a strong headwind, rain or other precipitation, or overcast conditions. When visibility is poor, individuals use flapping flight at lower altitudes until they reach suitable roosting or feeding habitat.

5.4 Stop-over Habitat Characteristics

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

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

6.0 ASSESSMENT OF WHOOPING CRANES LIKELIHOOD OF OCCURENCE

The primary threats of wind energy development to whooping cranes are mortality due to collision with transmission lines and associated structures and loss of habitat. Because of the high levels of concern regarding whooping cranes, the ability to evaluate the risk to whooping cranes at individual project areas is a critical component to understanding the environmental impacts of a proposed wind facility. Here, Tetra Tech presents a method used to evaluate the likelihood of whooping cranes to occur at a project located in southwest North Dakota. This evaluation method incorporates the location of the project in the migration corridor, the locations of historical observations of whooping cranes, the presences of feeding and roosting sites, and the availability of habitat within the Project Area compared to the surrounding landscape (Table 1). Tetra Tech expects whooping cranes to be more likely to occur over the life of a project at projects with high scores. For the purposes of this report, the scores calculated for each parameter were totaled and the likelihood of occurrence for whooping cranes in the project was ranked accordingly: Low (0-4); Moderate (5-10); High (10+).

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

Biological Justification

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

Scoring

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

Assumptions

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

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

6.2 Attractiveness on the Landscape (A)

Biological Justification

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

Scoring

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

Assumptions

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

6.3 Historical Whooping Cranes Observations (H)

Biological Justification

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

Scoring

Tetra Tech developed scores for the historical observations of whooping cranes in relation to the location of the project. As the occurrence of 1 whooping crane at a project is significant and because of the bias associated with the observations, Tetra Tech did not place weight on the number of observations, only on the general distance of the nearest observation to a given project. If at least 1 observation occurred on or within the project boundary, it was scored 3; if at least 1 observation occurred within 10 miles of the boundary, it was scored 2; if at least 1 observation occurred within 25 miles of the boundary, it was scored 1.

Assumptions

- Whooping crane locations represent the best approximate location of the observation.
- The locations in the report and the map provided by the USFWS represent the full extent of whooping crane locations known to the USGS and USFWS.
- Each observation is at least one whooping crane, although some observations may represent groups of whooping cranes.
- Because spatial data were not available, whooping crane locations were digitized from maps and therefore the actual location may not be depicted exactly on the maps presented.

6.4 Presence of Foraging and Roosting Sites (W)

Biological Justification

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

Scoring

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

Assumptions

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

Field verification

Tetra Tech verified the presence of suitable roosting locations during a site visit in October 2009 timed to coincide with the fall migratory period for whooping cranes in North Dakota. Any desktop-identified wetlands that were found to (a) either not exist or (b) exist in a form that might render them unusable by cranes were removed from the analysis. Sixty-four (64) acres of wetlands and 271 acres of wetland-agricultural matrix were removed.

6.5 Likelihood Index Formula (LI)

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

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

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

7.0 OLIVER EXPANSION RISK ASSESSMENT AND SUMMARY

The likelihood index score was 4.1 for the entire Oliver Expansion and 4.3 for Phase III only (Table 2) implying a low to low-moderate likelihood of occurrence for both areas. Sixty-three percent of the Oliver Expansion consists of suitable wetland-agriculture matrix habitat, making the Presence of Feeding and Roosting Sites (W) value 0.63 (Figure 4). The Oliver Expansion is located within the 75-percent buffer; therefore, the Location (L) parameter was 7.5. The percentage of available wetlands within the Oliver Expansion is lower than the surrounding 35-mile buffer area, with a calculated Attractiveness on the Landscape (A) value of 0.20. Sixty-two percent of Phase III consists of suitable wetland-agriculture matrix habitat, making the Presence of Feeding and Roosting Sites (W) value was 0.62 (Figure 5). Phase III is located within the 75-percent buffer; therefore, the Location (L) parameter was 7.5. The percentage of available wetlands within Phase III is lower than the surrounding 35-mile buffer area, with a calculated Attractiveness on the Landscape (A) value of 0.23. The likelihood of occurrence is slightly higher for Phase III than for the entire Oliver Expansion because a higher proportion of the Phase III Project Area contains suitable stopover habitat.

There were no recorded observations of whooping cranes within the proposed Oliver Expansion (including Phase III). A total of 89 observations occurred within the 35-mile buffer around the Oliver Expansion. Details of each observation can be found in Appendix 1. The closest observations near Phase III were three observations within the 10 miles. 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) respectively. 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. Additionally, the absence of a sighting in a specific area should not be construed as a whooping crane having never occurred in that area.

8.0 REGULATORY CONSIDERATIONS

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

9.0 RECOMMENDATIONS AND MITIGATION OPTIONS

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

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

Potential 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 area and surrounding landscape as well as coordination with state and federal wildlife biologists. In the current political environment, the preferred method of avoidance and minimization may change rapidly as more information about whooping crane behavior and habitat availability becomes available.

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Jim Kowalsky Field Reconnaissance	October 13, 2009 Date
Anne-Marie Griger/Tracey Martorano Peer Review	November 4, 2009 Date
Jason Jones Technical Review	November 3, 2009 Date
Bill Scales GIS Technician	August – November 2009 Date

TABLES

Table 1. Parameters used in the likelihood index calculation.

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

Table 2. Likelihood index scores for Oliver Expansion and Phase III.

	Location in the Migration Corridor (*L*)	Attractiveness on the Landscape (*A*)	Historical Whooping Crane Observations (*H*)	Presence of Foraging and Roosting Habitat (*W*)	Likelihood Index Score (*LI*)
Oliver Expansion	7.5	0.20	2	0.63	4.1
Phase III	7.5	0.23	2	0.62	4.3

FIGURES

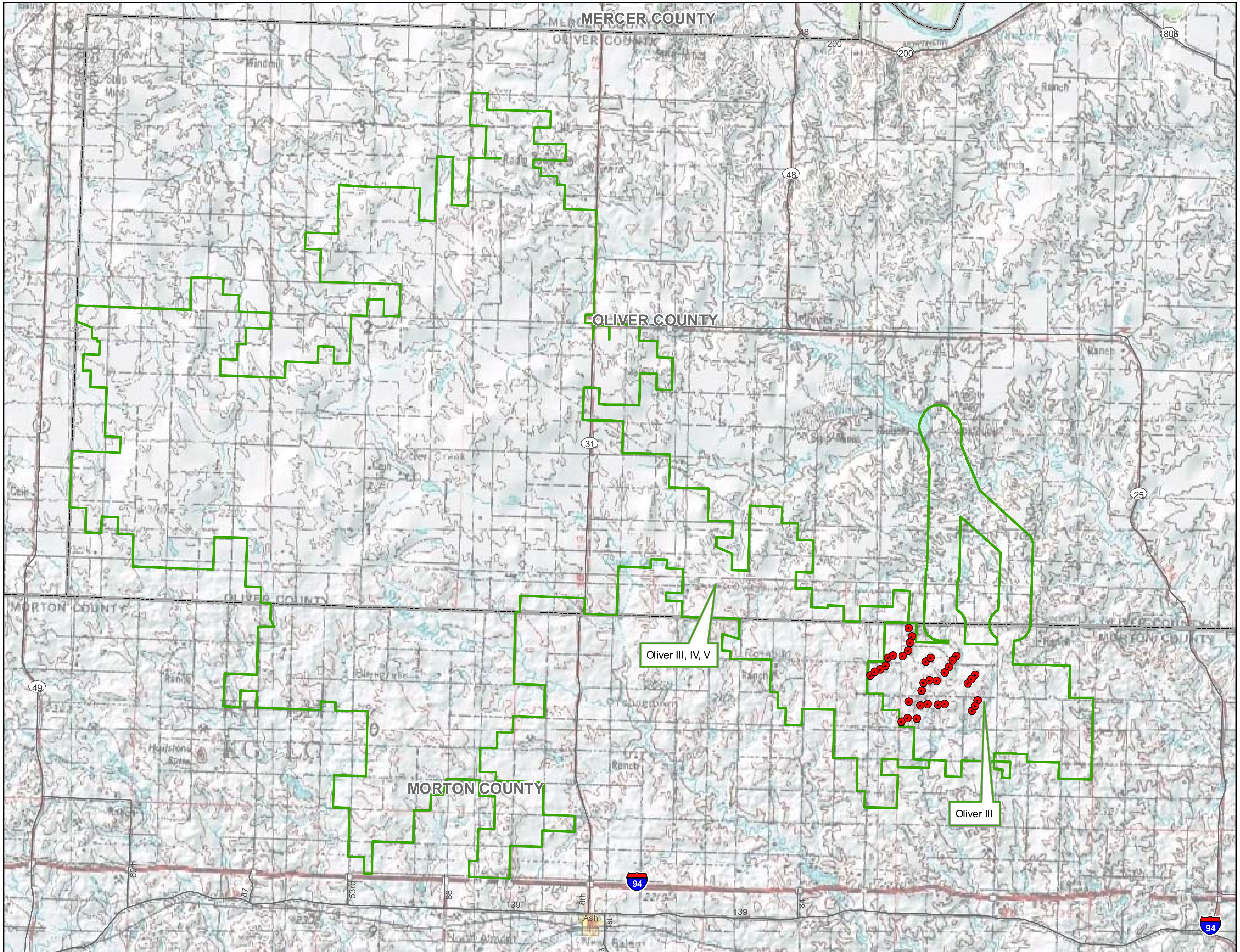

Figure 1.
Oliver Expansion Wind Energy Phases III, IV, and V Project Vicinity Map

Morton and Oliver Counties
North Dakota

November 2009

L E G E N D

- Oliver III GE XIe 33T 2 Alts (dated 8/7/09)
- Oliver III, IV, & V Boundary (8/25/09)
- County Boundary
- State Boundary
- Highway
- Major Road
- Local Road

Data Sources:
National Geographic Topo Maps
ESRI Streetmap 9.3

00.3750.75 1.5 2.25 3
Miles

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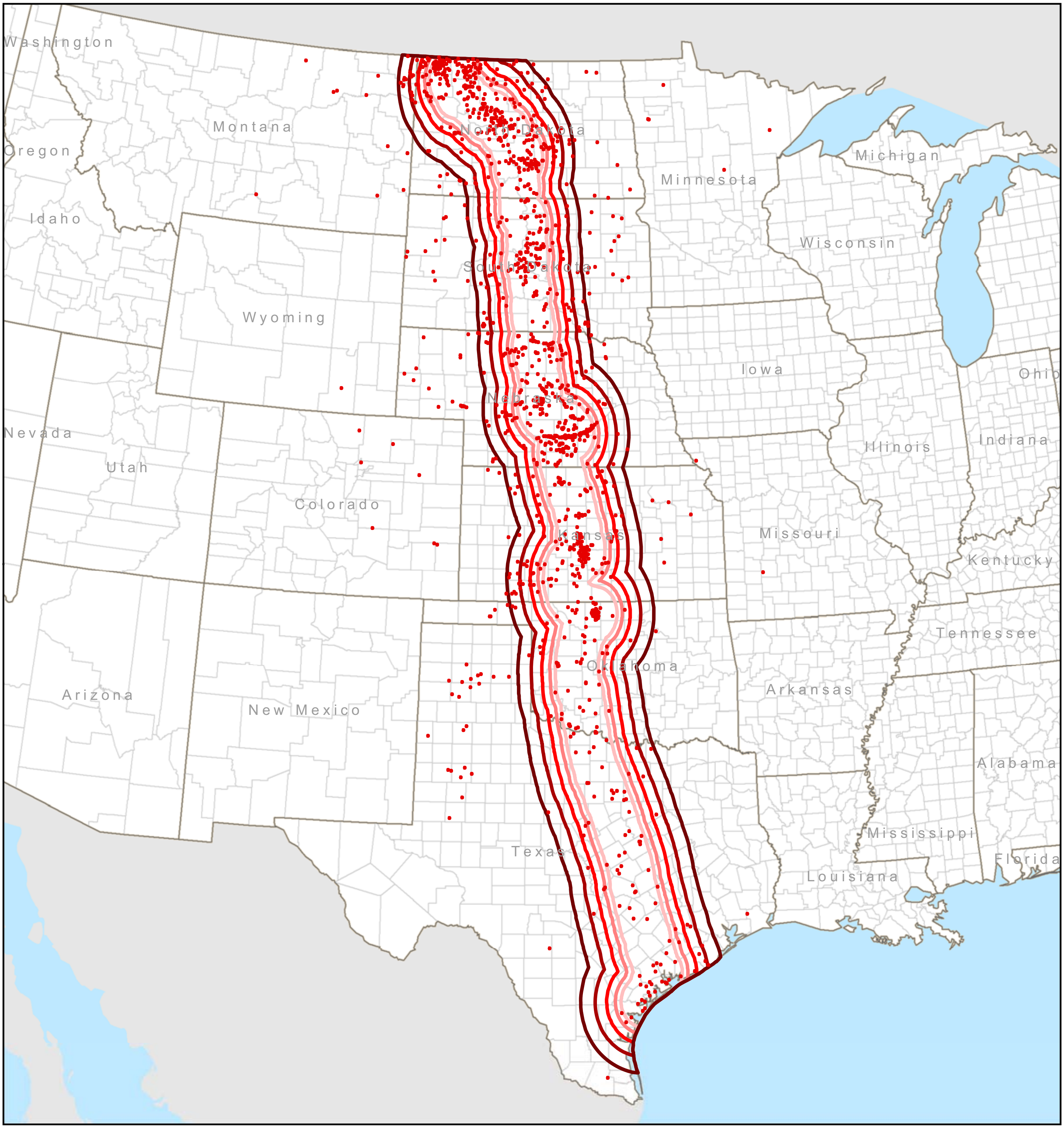
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

L O C A T I O N M A P



L E G E N D

State Boundary

County Boundary

Whooping Crane Sighting

Percentage of Sightings

75.08%

79.44%

85.04%

89.83%

94.83%

N
W
E
S

0 40 80 160 240 320

Miles

Figure 2.
Whooping Crane Migration Route in the United States

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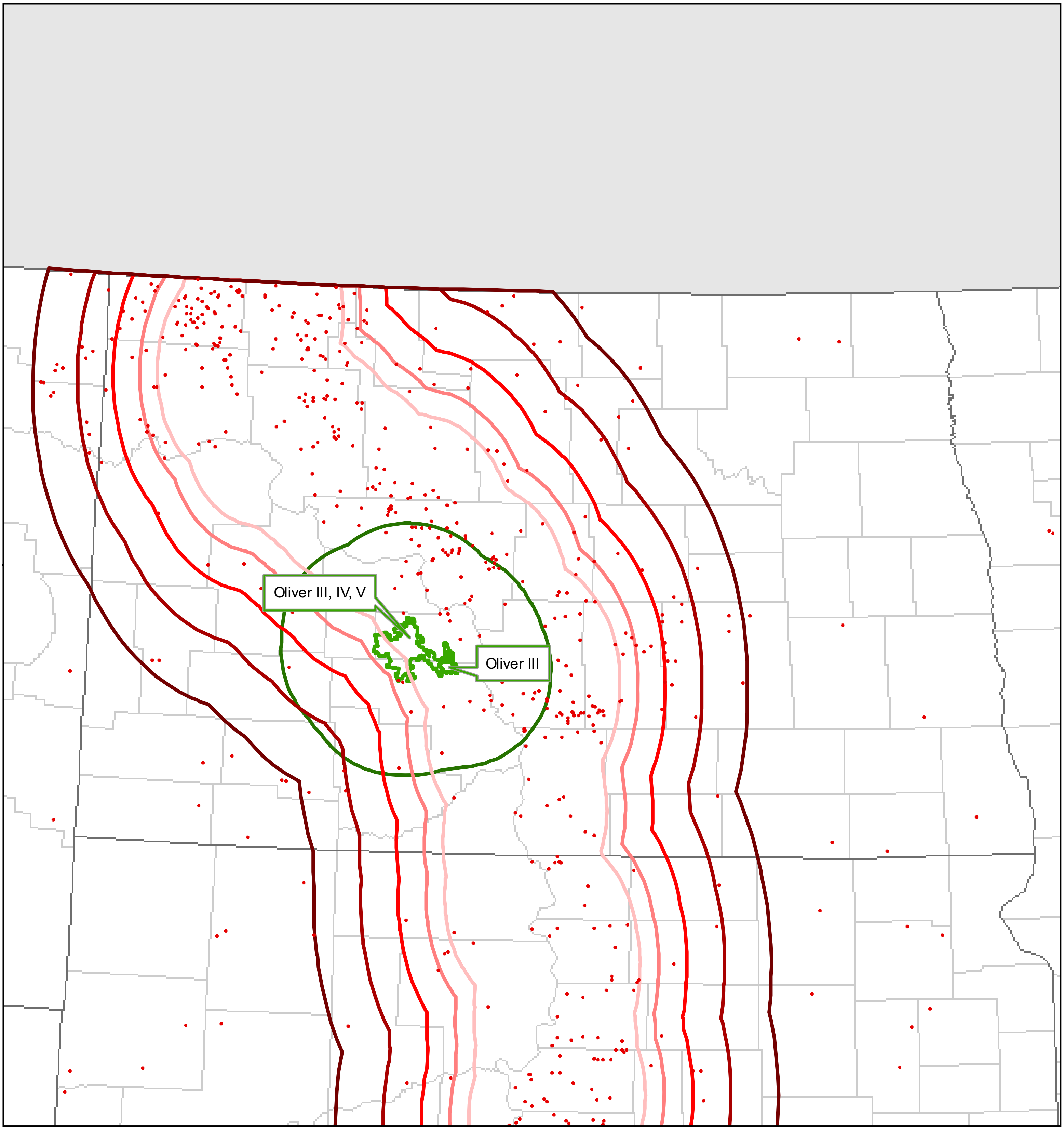
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

Data Sources:
USFWS Whooping Crane Migration Corridors & Sightings
ESRI Streetmap 9.3

NEXTera ENERGY
RESOURCES



L E G E N D

- Whooping Crane Sighting
- Project Area (8/25/09)
- 35-Mile Buffer
- State Boundary
- County Boundary

Percentage of Sightings

- 75.08%
- 79.44%
- 85.04%
- 89.83%
- 94.83%

N
W E
S

0 10 20 40 60 80
Miles

Data Sources:
USFWS Whooping Crane Data
ESRI Streetmap 9.3

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

Figure 3.
Oliver Expansion Wind Energy
Phases III, IV, and V
Whooping Crane Migration
Map: North Dakota

November 2009

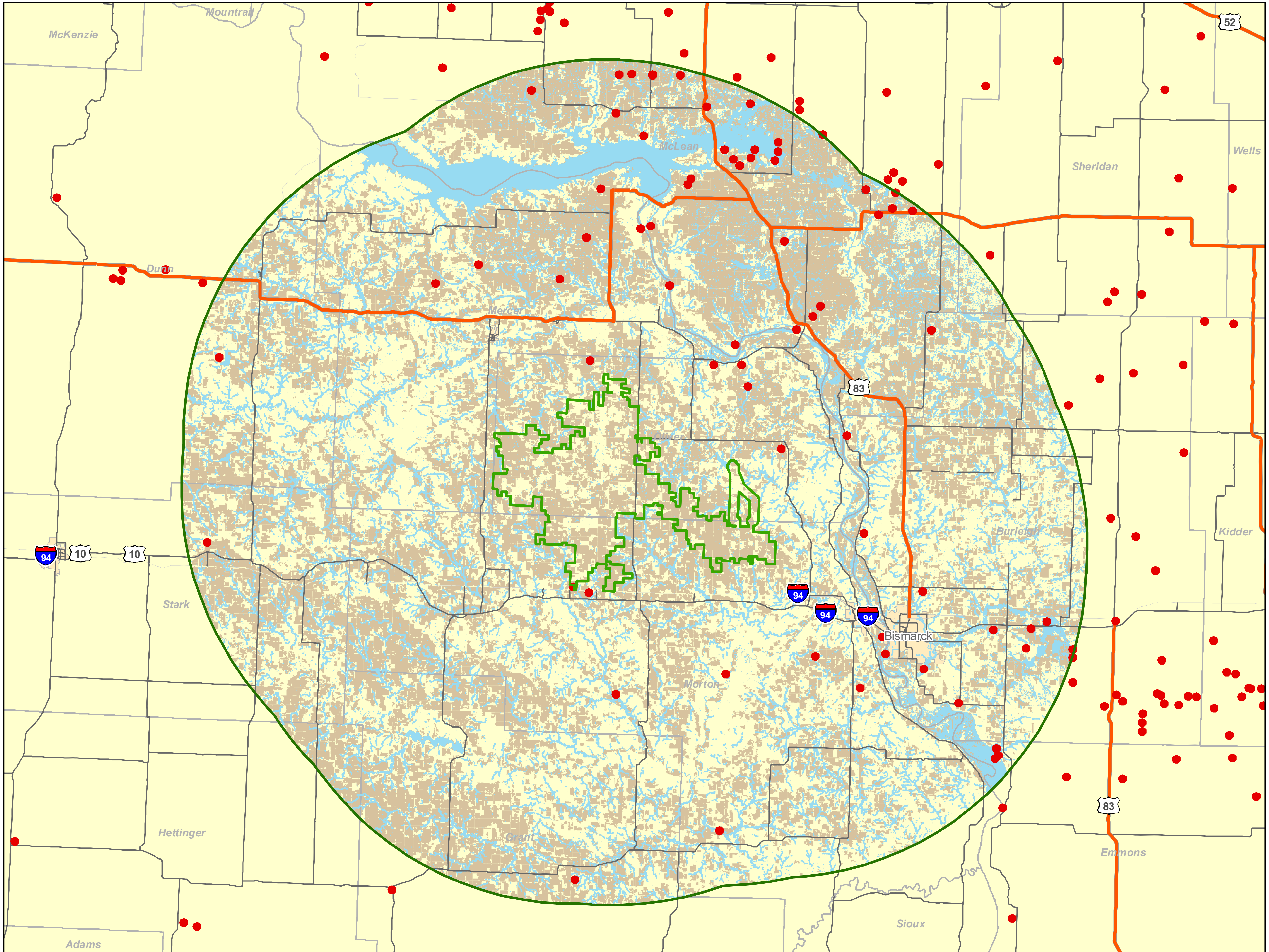

Figure 4.
Baldwin Wind Energy
Whooping Crane Habitat Map

Burleigh County
North Dakota

November 2009

L E G E N D

- Wetland
- Stream
- Wetland/Agricultural Matrix
- Baldwin Boundary (8/25/09)
- 35 Mile Buffer
- Whooping Crane Sitings
- Highway
- Major Road
- Local Road

Data Sources:
USGS 2001 NLCD Data
NWI Wetland Data
USFWS Whooping Crane Data
ESRI Streetmap 9.3

0 1.5 3 6 9 12
Miles

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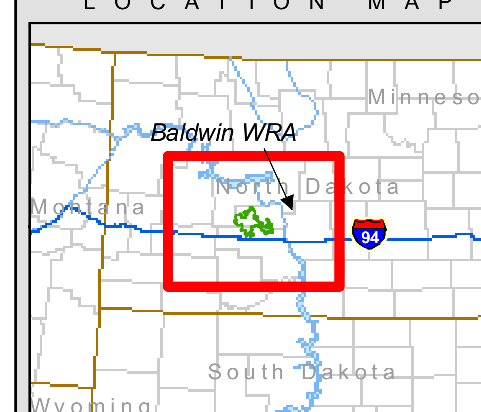
Coordinate System: NAD 1983 UTM Zone 14N

L O C A T I O N M A P



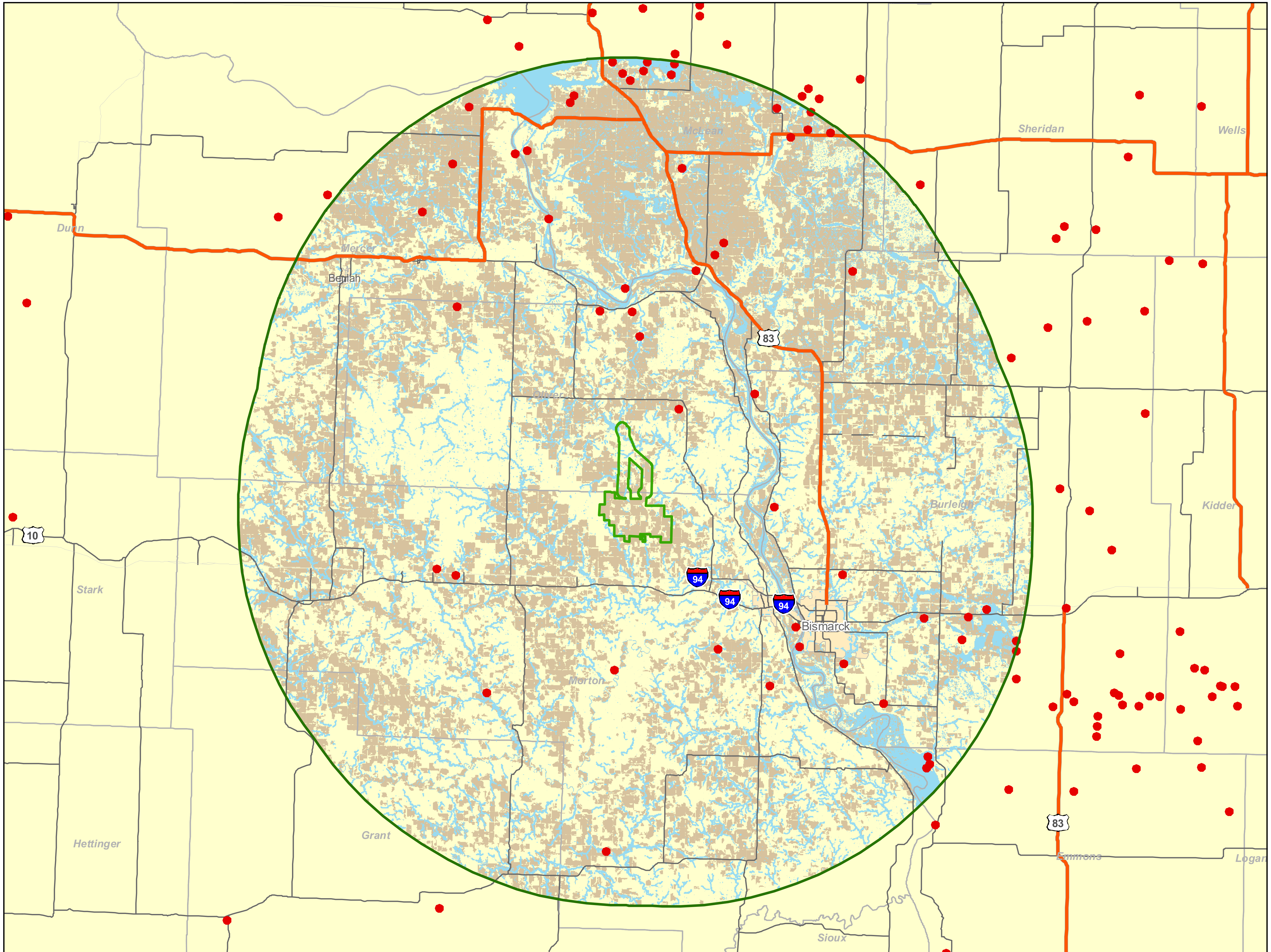


Figure 5.
Oliver Expansion Phase III
Whooping Crane Habitat Map

Morton and Oliver Counties
North Dakota

November 2009

LEGEND

- Oliver III Boundary (8/25/09)
- 35 Mile Buffer
- Stream
- Wetland
- Wetland/Agricultural Matrix
- Whooping Crane Sighting
- Highway
- Major Road
- Local Road

Data Sources:
USGS 2001 NLCD Data
NWI Wetland Data
USFWS Whooping Crane Data
ESRI Streetmap 9.3

0 1.25 2.5 5 7.5 10
Miles

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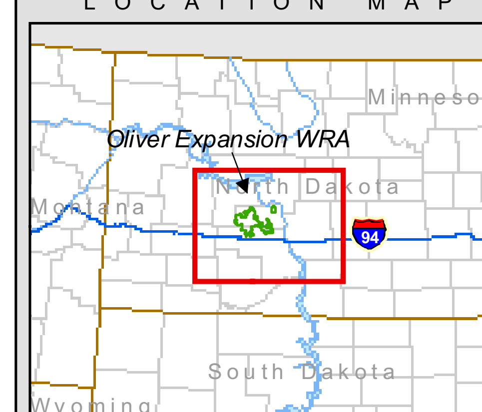
Coordinate System: NAD 1983 UTM Zone 14N

LOCATION MAP



APPENDIX

Appendix 1. Whooping Crane sightings within 35 miles of the Oliver Expansion						
Adults	**Juveniles**	**Total**	**Date**	**Year**	**County**	**Location Specifics**
1	0	1	09/24/61	1961	OLIVER	FT. CLARK
1	0	1	09/21/62	1962	MCLEAN	AUDUBON NWR
2	1	3	10/25/64	1964	BURLEIGH	10N MANDAN
6	0	6	11/1/64	1964	MCLEAN	NEAR AUDUBON NWR
3	0	3	04/21/68	1968	MORTON	6.5S,4E JUDSON
2	0	2	04/12/69	1969	MCLEAN	LAKE SAKAKAWEA
8	0	8	04/23/70	1970	MCLEAN	AUDUBON NWR
2	0	2	05/03/70	1970	BURLEIGH	3SW BISMARCK, MISSOURI RIVER
1	0	1	09/23/71	1971	MCLEAN	1NE BLUE LAKE
2	0	2	10/12/71	1971	MCLEAN	AUDUBON NWR
1	0	1	10/16/71	1971	MCLEAN	1E,2S TURTLE LAKE
1	0	1	04/25/72	1972	MCLEAN	AUDUBON NWR
1	0	1	09/20/72	1972	MCLEAN	AUDUBON NWR
6	0	6	10/00/74	1974	MCLEAN	AUDUBON NWR
2	0	2	11/02/75	1975	MERCER	11NW HAZEN
2	0	2	04/23/76	1976	MCLEAN	4N,2W, GARRISON
2	0	2	04/10/76	1976	GRANT	2SE CARSON
1	0	1	04/09/77	1977	MCLEAN	AUDUBON NWR
2	0	2	10/27/77	1977	STARK	.25N TAYLOR
1	0	1	10/21/77	1977	BURLEIGH	3S,1.5E MENOKEN
3	0	3	09/20/77	1977	MCLEAN	3S GARRISON
1	0	1	10/29/78	1978	MCLEAN	LAKE WILLIAMS
4	0	4	04/17/79	1979	MCLEAN	3SW RIVERDALE
2	0	2	09/24/79	1979	MCLEAN	2NE TURTLE LAKE
1	0	1	09/29/81	1981	MCLEAN	NEAR LAKE WILLIAMS
2	1	3	10/28/82	1982	MERCER	10NW BEULAH
2	0	2	04/16/83	1983	MCLEAN	4N,4W, GARRISON
2	1	3	04/17/97	1997	MCLEAN	4W,0.5S GARRISON
2	0	2	04/12/98	1998	MCLEAN	1S,4W COLEHARBOR
3	0	3	04/13/98	1998	MCLEAN	2N COLEHARBOR
3	0	3	04/13/98	1998	MCLEAN	4N GARRISON
2	1	3	10/27/99	1999	MCLEAN	9W WASHBURY, NEAR MISSOURI R.
2	0	2	10/15/91	1991	MCLEAN	12S,3/4E BENEDICT
6	0	6	10/21/91	1991	MERCER/MCLEAN	MISSOURI RIVER,3N,1E STANTON
2	0	2	04/14/92	1992	MCLEAN	8NE COLEHARBOR
2	1	3	04/23/92	1992	MCLEAN	10NE GARRISON
1	0	1	09/29/93	1993	MCLEAN	2S,4.5E,.25N TURTLE LAKE
1	0	1	10/13/93	1993	MCLEAN	2N,3E TURTLE LAKE
1	0	1	10/04/94	1994	MCLEAN	4N,1/4E GARRISON
1	0	1	10/25/94	1994	MCLEAN	1/2W TURTLE LAKE
3	0	3	04/28/95	1995	MCLEAN	2NE COLEHARBOR
1	0	1	10/26/95	1995	MERCER	1E,1N PICK CITY
1	0	1	10/13/96	1996	BURLEIGH	3W,8N WING
2	0	2	10/25/83	1983	MORTON	40W,1N,1E BISMARCK
1	0	1	10/13/83	1983	MCLEAN	5W MERCER

Appendix 1. Whooping Crane sightings within 35 miles of the Oliver Expansion						
Adults	**Juveniles**	**Total**	**Date**	**Year**	**County**	**Location Specifics**
1	0	1	05/11/84	1984	MCLEAN	.5E AUDUBON NWR
2	0	2	09/29/84	1984	BURLEIGH	NEAR MCKENZIE SLOUGH
6	0	6	04/02/86	1986	MCLEAN	S RIVERDALE AIRPORT
4	0	4	04/18/87	1987	MCLEAN	RIVERDALE, MISSOURI RIVER
4	0	4	04/17/87	1987	BURLEIGH	BISMARCK,MISSOURI RIVER
2	1	3	11/01/87	1987	DUNN	8S,4W HALLIDAY
6	2	8	10/28/87	1987	MERCER	1.2W,.5N JCT 200-1806
4	1	5	04/15/88	1988	MCLEAN	3SE UNDERWOOD
0	1	1	04/15/88	1988	MCLEAN	3SE UNDERWOOD
0	1	1	06/11/89	1989	MCLEAN	1W,1N EMMIT
1	0	1	09/27/90	1990	MCLEAN	4E AUDUBON NWR HQTRS
1	0	1	10/03/90	1990	MCLEAN	4E,5N,1.5W GARRISON
3	1	4	04/10/00	2000	BURLEIGH	8SE BISMARCK
6	0	6	04/10/00	2000	MORTON	2N FLASHER
2	0	2	10/12/00	2000	McLEAN	7N,6.5W TURTLE LAKE
8	1	9	11/03/00	2000	OLIVER	10E CENTER
2	0	2	04/11/01	2001	MCLEAN	11N,2E TURTLE LAKE
4	0	4	04/17/01	2001	MCLEAN	11E,1N GARRISON
2	0	2	10/22/01	2001	EMMONS	5S,12W MOFFIT
2	1	3	10/23/01	2001	EMMONS	5S,12W MOFFIT
7	0	7	04/17/02	2002	BURLEIGH	0.25W MCKENZIE,MCKENZIE SLOUGH
2	0	2	10/19/02	2002	MCLEAN	5.5N AUDUBON NWR
5	0	5	10/25/02	2002	BURLEIGH	BISMARCK, SERTOMA PARK
2	0	2	10/25/02	2002	EMMONS	5S,12W MOFFIT
2	0	2	10/25/02	2002	BURLEIGH	BISMARCK AIRPORT
3	0	3	10/16/02	2002	MCLEAN	2N WASHBURN
6	0	6	10/16/02	2002	MCLEAN	4.5NE WASHBURN
3	0	3	04/13/03	2003	OLIVER	9SW WASHBURN
2	0	2	04/06/03/	2003	BURLEIGH	2W MENOKEN
2	0	2	11/01/04	2004	MORTON	5W NEW SALEM
2	0	2	04/30/05	2005	MORTON	5SW MANDAN
0	1	1	05/25/05	2005	OLIVER	8SE HAZEN
12	0	12	10/16/05	2005	SHERIDAN	3S, 1.5W PICKARDVILLE
4	1	5	10/22/05	2005	MERCER	10N, 3E, 0.75S HAZEN
13	4	17	10/22/05	2005	MERCER	10N, 3E, 0.75S HAZEN
3	0	3	11/13/05	2005	BURLEIGH	7W, 2S WILTON, MO RIVER BOTTOMS
3	0	3	04/22/06	2006	MCLEAN	MISSOURI RIVER, 2W WASHBURN
5	1	6	04/23/06	2006	MERCER	5N, 0.5E HAZEN
2	0	2	05/04/06	2006	BURLEIGH	9N, 2E WILTON
1	0	1	4/15/2007	2007	BURLEIGH	2E MENOKEN, ALONG HWY 10
20	0	20	4/15/2007	2007	BURLEIGH	SW BISMARCK
3	0	3	5/22/2007	2007	MERCER	4S, 7W WASHBURN
1	0	1	4/18/2007	2007	MORTON	2E, 2S ALMONT
4	1	5	11/03/2007	2007	BURLEIGH	W-NW OF WING

DRAFT

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

Prepared For:

NextEra Energy Resources, LLC
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Juno Beach, Florida 33408

Prepared By:

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

August 2009
(Updated November 2009)

EXECUTIVE 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 low-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.

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1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra Energy) is currently planning to develop Phases III, IV, and V of the Oliver Wind Energy Generation Facility (Oliver Expansion) in Oliver and Morton Counties, North Dakota (Figure 1). Recent monitoring studies indicate that utility-scale wind energy facilities have had greater bat mortality than was expected based on early monitoring studies where birds were the primary focus of attention (NRC 2007). The potential for bat collisions with turbines is highest in the forested regions of the eastern part of the United States (NWCC 2004); however, relatively high numbers of bat fatalities have been documented in the mixed-grass plains and agricultural regions of Iowa (Jain 2005), Oklahoma (Piorkowski 2006), and Minnesota (Johnson et al. 2004).

To continue their efforts to identify areas where they can minimize impacts, NextEra Energy contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct an in-depth literature review and landscape scale analysis to assess the potential occurrence and risk for bat species that may occur within the Project Area. As requested, results for Phase III are called out separately since that will be the first phase of development. Although, to date, there is no clear relationship between pre-construction occurrence and post-construction mortality, certain features of a project may make it more or less attractive to bats, thus increasing or decreasing the relative mortality risk. Tetra Tech developed a likelihood index to evaluate the Oliver Expansion Project Area based on the number of species potentially occurring in the Project Area, the amount of suitable foraging and roosting habitat within the Project Area and the surrounding landscape, and several additional factors that were likely to increase the presence of bats including the presence of perennial streams, number of human developments, and the number of natural areas. The likelihood index does not predict bat occurrence or mortality. Rather, it scores the project based on a suite of variables that are related to occurrence and potential mortality. Bat presence is more likely to occur over the life of a project at a project with a higher score, thus indicating higher likelihood of occurrence and, thus, potential for turbine-related fatalities given the patterns of bat fatalities at other wind farms in the United States.

2.0 BATS AND WIND ENERGY

Wind energy is one of the fastest growing sectors of the energy industry (NRC 2007) and has led to unexpected levels of bat mortality (Kunz et al. 2007). Several variables may contribute to the fatalities of bats at wind facilities including, but not limited to, biology of the bat species, season, region, and turbine design (Kunz et al. 2007). Species that have the highest risk of fatalities at wind facilities are tree, foliage, or cavity roosting migratory bats (Kunz et al. 2007; Arnett et al. 2008). Nearly 75 percent of all bat fatalities have been associated with migratory tree bats including the hoary bat, eastern red bat and silver-haired bat, all three of which occur within the range of the Project Area. Migratory bats travel long distances at altitudes occupied by wind turbine blades, making them susceptible to collisions. The probability of mortality events increases during periods of poor weather, such as just before or after the passing of a storm front (Arnett et al. 2008).

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

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

3.0 STATUS OF BATS IN NORTH DAKOTA

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

Bats rank among North America's least studied wildlife, yet declines in population numbers among all species have been documented since the 1960s (Tuttle 2004). Compared to bird species, there are relatively few laws that protect bats. On federal lands such as National Forests, National Wildlife Refuges, and lands administered by the Bureau of Land Management, agencies have developed habitat management guidelines and other regulations to enhance or minimize disturbance to habitats. Existing environmental laws primarily address the protection of caves and wanton destruction of wildlife. The protection and regulation of non-threatened bat species on private lands is typically left at the state wildlife agencies' discretion.

4.0 ENVIRONMENTAL SETTING AND PROJECT AREA DESCRIPTION

4.1 Environmental Setting

The Oliver Expansion Project Area is located within the Northwestern Great Plains (Bryce et al. 1998). This landscape includes the western mixed-grass prairie, short-grass prairie, and associated wetlands of the Missouri Slope and River Breaks regions. This semiarid, unglaciated region of North Dakota includes level to rolling plains topography with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Land use is predominantly dry-land farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

4.2 Project Area Description

The Oliver Expansion Project Area is located on privately owned lands in south-central North Dakota. The Project Area consists of 184,665 acres and is located approximately 30 miles northwest of Bismarck in Oliver and Morton Counties (Figure 1); Phase III consists of 22,368 acres. The landscape within the Project boundaries is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture and rangelands with patches of native prairie. The area contains numerous small wetlands that vary from shallow, vegetated depressions to deeper, open water communities. Residences and abandoned farmsteads are scattered throughout the Project Area. Patches of trees and shrubs exist throughout the Project Area, and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields. Further details on the geographic features and land use can be found in the Critical Issues Analysis (Tetra Tech 2008).

5.0 GENERAL BAT BIOLOGY

5.1 Roosting Habitat

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

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

5.2 Foraging Ecology

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

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

5.3 Migration Behavior

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

6.0 ASSESSMENT OF BAT LIKELIHOOD OF OCCURENCE

The primary threats of wind energy facilities to bats are fatalities from collisions with wind turbines and loss of roosting and foraging habitat. Because of the high levels of concern regarding bats, the ability to evaluate the risk to bats at an individual project is a critical component to understanding the environmental impacts of a proposed wind facility. There is no clear relationship between pre-construction occurrence and post-construction mortality; however, certain features of landscapes may make them more attractive to bats. Here, Tetra Tech presents a method used to evaluate the likelihood of bat occurrence at a given project. This evaluation method includes the use of both habitat- and species-based variables. Identifying the habitat-based variables essential to the species' requirements during roosting and foraging is key in determining the suitability of the habitat (Duchamp et al. 2004), whereas understanding the species' ecology and behavior is key in developing a model that leads to understanding the relative risk from wind energy development. Habitat-based variables include the amount of suitable foraging and roosting habitat, the number of natural areas, the number of perennial streams, and the number of human developments. Species-based variables included using bat species known to occur in the region and behavioral characteristics. For the purposes of this report, the scores calculated for each variable were totaled and the likelihood of occurrence for bats in the project area was ranked accordingly: Low (0-10); Moderate (11-20); High (21+). Specific details about each variable and how they were used to estimate likelihood are presented below.

6.1 Forest-Aquatic Matrix

Biological Justification

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

Scoring

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

Using these datasets, minimum thresholds for habitat sizes were generated. The minimum area for forest features was set at one acre whereas the minimum area for water features was set at 0.004 acre. All wetlands within 0.8 mile of a forested area represent a forest aquatic patch (FAP). Each habitat type (forest and wetland) included an additional 75-foot area beyond the habitat to account for foraging and flight behavior immediately adjacent to each habitat (i.e., a buffer area; Figure 2). The total area of the FAP includes the bat habitat, the buffer area around the habitats, and the area between them. The model is nonrestrictive and includes FAPs if they are within 0.8 mile of another FAP, provided an additional forested area is within the project area. When multiple FAPs are combined, they are referred to as a forest-aquatic matrix (FAM). Areas that contained 1 to 25,000 acres received a score of 1.0, areas that contained 25,001 to 50,000 acres received a score of 2.0, and more than 50,001 acres received a score of 3.0. The greater amount of FAM in a particular area, the higher the score and likelihood bats would occur.

FAM Assumptions

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

Field Verification

In October 2009, a Tetra Tech field biologist visited the Project to confirm the presence of desktop-identified forest patches within Phase III of the Project. Any areas deemed to be unfit to support roosting bats (e.g., insufficient vertical complexity) were removed from the analysis. A total of 862 acres of forest-aquatic matrix was removed.

6.2 Natural Areas

Biological Justification

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

Scoring

The total number of natural areas within and 2-miles surrounding the Project Area were counted using readily accessible landownership data. Two miles was arbitrarily chosen as a distance from the Project to account for species movement during nightly foraging activity. Lands enrolled in the CRP or state wetland reserve program may be of benefit to bats but complete information regarding the locations of these types of lands is not always publicly available and was therefore not included in the evaluation. The total number of natural areas was counted in the Project Area and assigned to a category with a corresponding score based on the total number of natural areas found. Scores were 0.5 for 1 to 10 natural areas, 1.0 for 11 to 30 natural areas, and 1.5 for 31 or more natural areas.

Natural Area Assumptions

- Each natural area provides an equal value to bat species regardless of size, current habitat and management objective.
- Easement data obtained represents the most current data available.

6.3 Perennial Streams

Biological Justification

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

Scoring

The presence of perennial streams in the Project Areas was evaluated using hydrological data from the NWI data (USFWS 2006), NLCD data (USGS 2007), and existing resource reports produced for the Project. Each area was given a score based on the presence or absence of this type of water feature. A project that contains perennial streams received a score of 0.5 whereas a project with no perennial streams received a score of 0.

Perennial Stream Assumptions

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

6.4 Human Development

Biological Justification

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

Scoring

All towns in and within 2 miles of the Project Areas were identified using the NLCD data (USGS 2007) for North Dakota. Towns with populations greater then 50 (as of the 2000 census) were tallied, and a corresponding score was assigned. An area received a score of 0.33 for 1 to 2 towns, 0.5 for 3 to 4 towns, and 1.0 for 5 or more towns.

Structure and Human Development Assumptions

- The housing/population density of developments within a town has no affect on the suitability for bats.
- Habitat availability and suitability is similar between towns regardless of surrounding habitat features.

- Smaller communities or isolated residences such as farms and structures such as bridges, overpasses and culverts are assumed to be uniformly distributed over the area.

6.5 Species Ranking Index

Biological Justification

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

Scoring

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

Species Ranking Index Assumptions

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

6.6 Species Landscape Index

Biological Justification

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

Scoring

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

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

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

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

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

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

$$SL = \sum P * HI$$

Species Landscape Index Assumptions

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

7.0 RESULTS

7.1 Forest-Aquatic Matrix

The Oliver Expansion contains 18,208 acres of FAM (Table 2: Figure 3) and the 3-mile buffer contains 41,732 acres. The total FAM within the WRA and the 3-mile buffer equals 59,940 acres which equates to a FAM score of 3.0. Phase III contains 2,738 acres of FAM (Table 2; Figure 4) and the 3-mile buffer contains 15,634 acres. The total FAM within the WRA and 3-mile buffer equals 18,372 which equates to a score of 1.0.

7.2 Natural Areas

Three natural areas occur within 2 miles of the Oliver Expansion Project Area: Wilbur Boldt Wildlife Management Area (WMA), Storm Creek WMA, and Sweetbriar Lake WMA. Only one of these (Wilbur Boldt WMA) falls within the 2 miles of Phase III. The score for the natural areas variable is 0.50 for both areas.

7.3 Perennial Streams

There are 60 perennial streams within the Oliver Expansion: Hailstone Creek, Otter Creek, Square Butte Creek, Sweet Briar Creek, and 56 others that are unnamed. The score for the perennial streams variable for the Oliver Expansion is 0.50. There are 16 perennial streams within Phase III: Square Butte Creek and 15 others that are unnamed. The score for this variable is 0.50.

7.4 Human Development

There are two towns with more than 50 people within 2 miles of the Oliver Expansion. The score for the human development variable is 0.33. There are no towns within 2 miles of Phase III. The score for this variable is 0.0.

7.5 Species Ranking Index

The Oliver Expansion and Phase III each have a species ranking index of 0.92 (5.5/6), based on the likelihood of encounter for the 6 species whose ranges overlap with both areas (Table 3).

7.6 Species Landscape Index

For Oliver Expansion, there are 18,208 acres of FAM located within the 184,665-acre project area. The 3-mile buffer (280,296 acre) has 41,732 acres of FAM. Based on these parameters the habitat index (HI) is calculated to be 0.66. There are six species of bats that could potentially occur within the WRA; therefore, the species landscape index (SL) is 3.96 (Table 4).

For Phase III, there are 2,738 acres of FAM located within 22,368-acre project area. The 3-mile buffer (183,931 acre) has 15,634 acres of FAM. Based on these parameters the habitat index (HI) is calculated to be 1.44. There are 6 species of bats potentially occurring within Phase III of the WRA; therefore, the species landscape index (SL) is 8.64 (Table 4).

7.7 Assessment Summary for the Oliver Expansion and Phase III

The likelihood index score for Oliver Expansion is 9.21 and Phase III is 11.56, indicating a low likelihood of bat occurrence for the Oliver Expansion as a whole and a low-moderate likelihood of occurrence for Phase III (Table 4). When viewed as one large project, the Oliver Expansion Project Area contains less suitable bat habitat than the surrounding landscape (Figure 3). In contrast, the Phase III Project Area contains proportionally more suitable habitat than the surrounding landscape, much of which is located within the two transmission corridors (Figure 4). 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.

8.0 RECOMMENDATIONS FOR THE OLIVER EXPANSION AND PHASE III

The precise mechanisms that determine risk of bat mortality at wind farms remain unclear (RESOLVE 2004, Kunz et al. 2007). 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 (Mitchell-Jones 2004, Tuttle 2004). These guidance documents vary but share common themes. Two of these themes are relevant to the Oliver Expansion project area in North Dakota.

- **Preserve FAM Habitat**

  Locating turbines, access roads, substations, and transmission within FAM habitats may constitute a direct loss of bat foraging and roosting 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 bat 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.

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TABLES

Table 1. Life history, behavior and habitat preferences of bat species for Oliver Expansion, North Dakota*.

English Name	Scientific Name	Listing Status	Abundance and ND Distribution	Maximum Foraging Distance	Habitat/Foraging Habits	Summer Maternity Colony Size	Bachelor Summer Roosts	Winter Hibernacula Colony Size	Winter Roosts or Hibernacula
big brown bat	*Eptesicus fuscus*	None	Common year -round resident. Statewide	1.2 square miles	A generalist, more common in deciduous forests. Adapted to human development. Forages over land and water, open areas and forests. Aerial hawking.	25–75 individuals	Roosts in hollow trees, crevices in cliffs, buildings, bridges and bat houses.	Rarely more than a few hundred individuals.	Winters in caves, mines, and man-made structures.
eastern red bat	*Lasiurus borealis*	None	Common migratory species. Statewide (except southwest corner)	3.5 square miles	Conifer and deciduous trees in floodplain preferred. Aerial hawking.	Small family groups of 2-3 individuals	Solitary. Roosts on foliage.	Solitary; groups up prior to migration	Not believed to winter in the Dakotas
hoary bat	*Lasiurus cinereus*	None	Common migratory species. Statewide	0.03 square miles	Conifer and deciduous trees in floodplain preferred. Found near water. Aerial hawking.	Small family groups of 2-3 individuals	Solitary. Roosts on foliage.	Solitary; groups up prior to migration	Not believed to winter in the Dakotas

Table 1. Life history, behavior and habitat preferences of bat species for Oliver Expansion, North Dakota*.

English Name	Scientific Name	Listing Status	Abundance and ND Distribution	Maximum Foraging Distance	Habitat/Foraging Habits	Summer Maternity Colony Size	Bachelor Summer Roosts	Winter Hibernacula Colony Size	Winter Roosts or Hibernacula
little brown bat	*Myotis lucifugus*	None	Common year -round resident. Statewide	0.11 square miles	Found commonly in cottonwood floodplains, typically near water. In arid parts of state found in riparian woodlands. Often hunts over water. Aerial hawking.	Solitary or small colonies.	Diverse range of roost substrates: buildings, caves, hollow trees, piles of stacked lumber	NA	Winters in caves, tunnels and abandoned mines. Winter roosts have high humidity.
northern myotis	*Myotis septentrionalis*	None	Uncommon year-round resident. Southwest part of the state.	0.85 square miles	Associated with large forest galleries in floodplains in plains and badland habitat. Forages in the area of the tree canopy. Aerial hawking and gleaning insects.	Typically small numbers (5 individuals) but has been documented as up to 75 individuals in the Black Hills, SD.	Diverse range of roost substrates: tree cavities, under loose bark, in buildings, caves, mines. Seeks cooler temperatures.	Not found in large aggregations- known from a single cave in the Black Hills	Winters in caves and mines.
silver-haired bat	*Lasionycteris noctivagans*	None	Uncommon migratory species. Erratic statewide distribution	2.8 square miles	Found in forested areas, most abundant in Oregon in older Douglas-fir/western hemlock forests. Forages over ponds and streams in woods. Aerial hawking.	6-65 individuals	Roosts on tree foliage, tree cavities and under loose bark.	Usually solitary	Winters in small tree hollows, underneath bark, in woodpiles and cliff faces.

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

Table 2. Total amount of forest-aquatic matrix (FAM) habitat and percent composition within the Oliver Expansion, Phase III and their respective 3-mile buffers.

Area	Size of Area (acres)	Acres of FAM	% FAM in Area
Oliver Expansion	184,665	18,208	9.9
Oliver Expansion buffer	280,296	41,732	14.9
Phase III	22,368	2,738	12.2
Phase III buffer	183,931	15,634	8.5

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

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

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

Element	Oliver Expansion	Phase III
Forest-Aquatic Matrix (FAM)	3.00	1.00
Number of natural areas within 2 miles	0.50	0.50
Perennial streams present	0.50	0.50
Number of residential communities within 2 miles	0.33	0.00
Species ranking index	0.92	0.92
Species landscape index	3.96	8.64
Total Likelihood Index	**9.21**	**11.56**

FIGURES

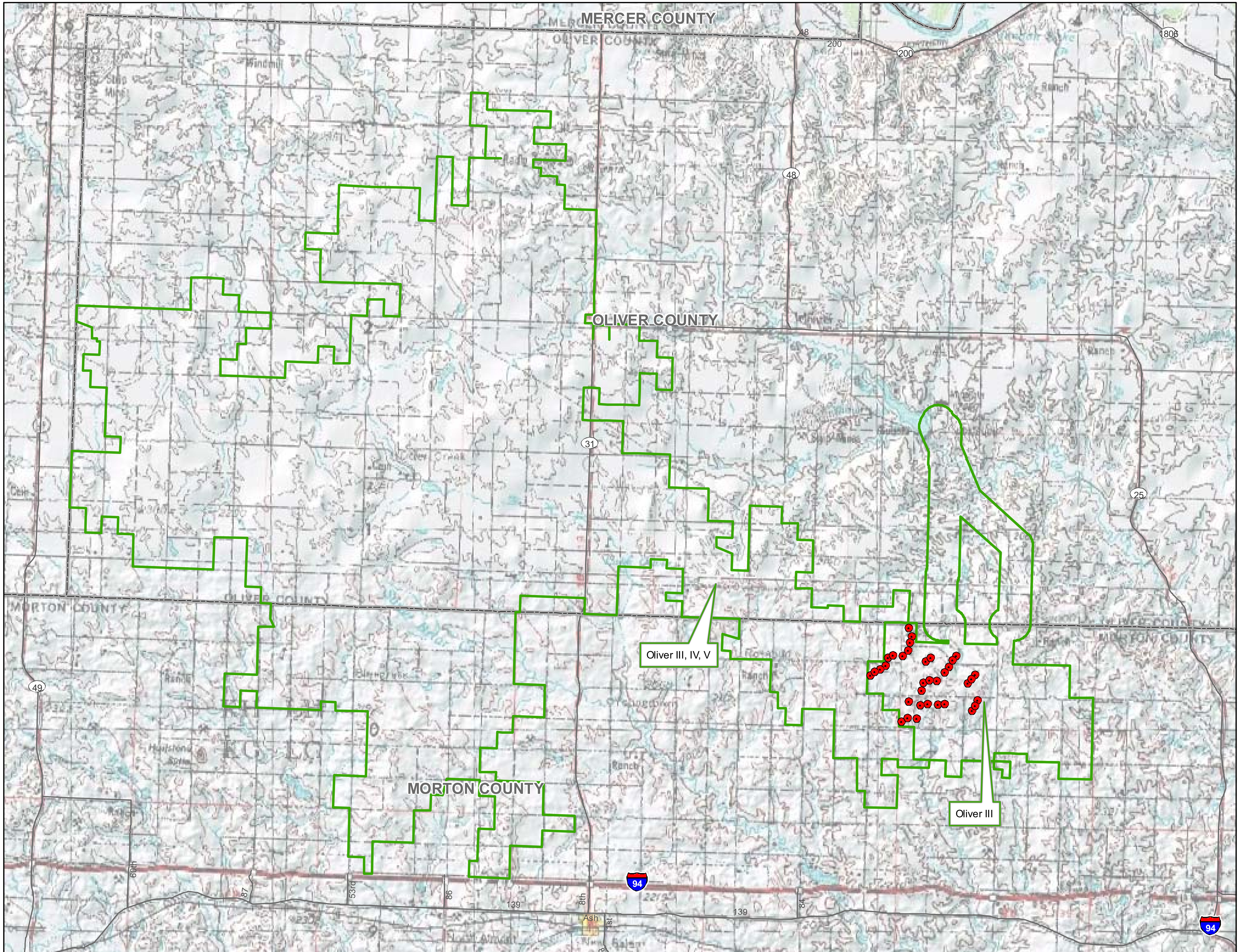

Figure 1.
Oliver Expansion Wind Energy Phases III, IV, and V Project Vicinity Map

Morton and Oliver Counties
North Dakota

November 2009

L E G E N D

- Oliver III GE XIe 33T 2 Alts (dated 8/7/09)
- Oliver III, IV, & V Boundary (8/25/09)
- County Boundary
- State Boundary
- Highway
- Major Road
- Local Road

Data Sources:
National Geographic Topo Maps
ESRI Streetmap 9.3

00.3750.75 1.5 2.25 3
Miles

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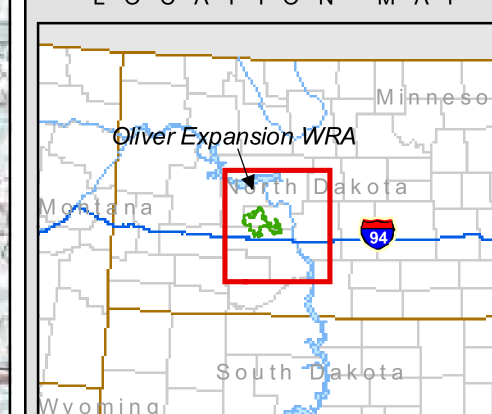
Prepared By: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

L O C A T I O N   M A P



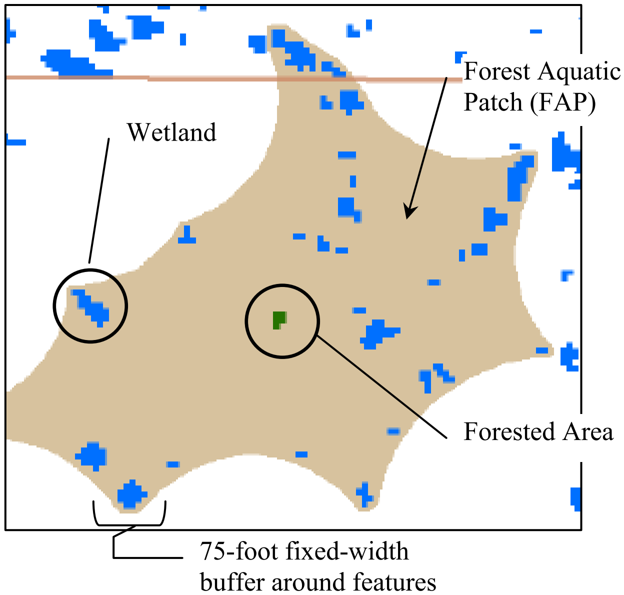


Figure 2. Representation of elements used to calculate FAP. Distance from the forested area is 0.8 mile. Multiple FAPs constitute the FAM.

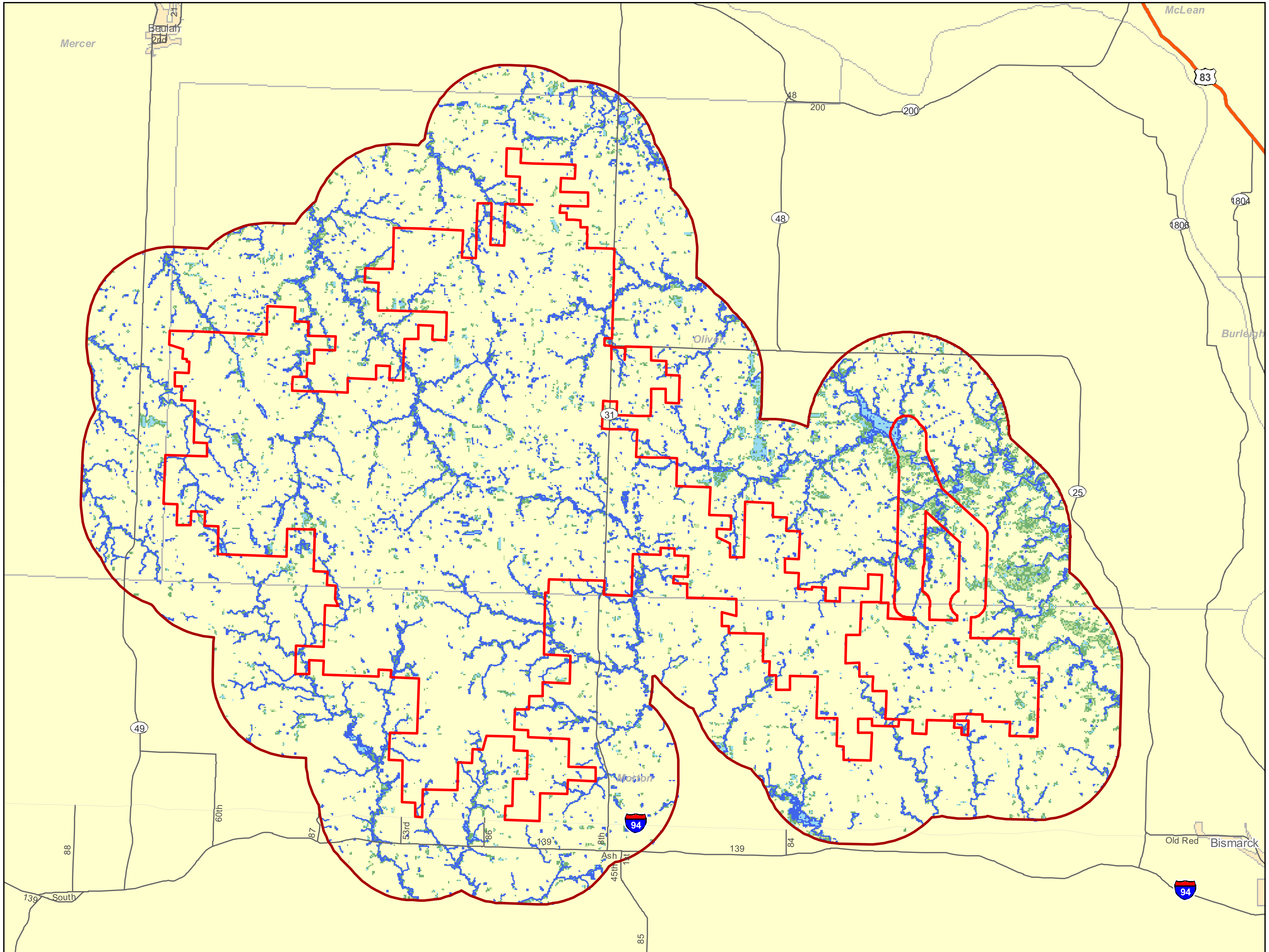


Figure 3.
Oliver Expansion Wind Energy
Phases III, IV, and V
Bat Habitat Map

Morton and Oliver Counties
North Dakota

November 2009

L E G E N D

- Oliver III, IV, & V Boundary (8/25/09)
- 3 Mile Buffer
- NWI Stream
- NWI Wetland
- NLCD Wetland
- NLCD Forest
- Forest Aquatic Matrix
- Highway
- Major Road
- Local Road

Data Sources:
USGS 2001 NLCD Data
NWI Wetland Data
USFWS Whooping Crane Data
ESRI Streetmap 9.3

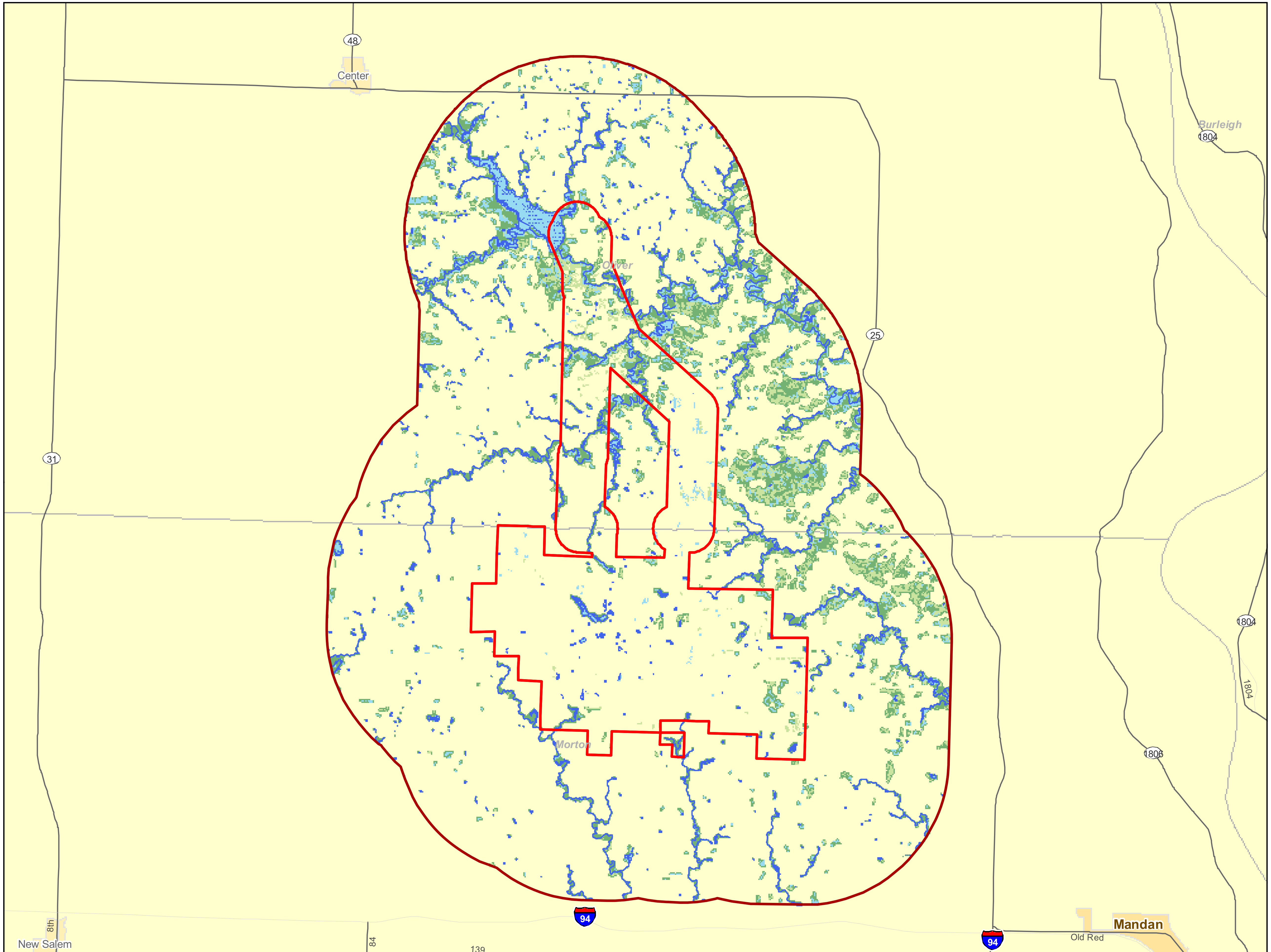
0 0.5 1 2 3 4
Miles

L O C A T I O N   M A P

Figure 4.
Oliver Expansion Phase III
Bat Habitat Map

Morton and Oliver Counties
North Dakota

November 2009



LEGEND

- Oliver III Boundary (8/25/09)
- 3 Mile Buffer
- NWI Stream
- NWI Wetland
- NLCD Wetland
- NLCD Forest
- Forest Aquatic Matrix
- Highway
- Major Road
- Local Road

Data Sources:
USGS 2001 NLCD Data
NWI Wetland Data
USFWS Whooping Crane Data
ESRI Streetmap 9.3

0 0.3 0.6 1.2 1.8 2.4
Miles

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

LOCATION MAP