Native Prairie Report

NATIVE PRAIRIE SURVEY
ROUGH RIDER I
WIND RESOURCE AREA
DICKEY COUNTY
NORTH DAKOTA

PREPARED FOR

FPL Energy, LLC

Prepared by

TETRA TECH EC, INC.

October 2008

Executive Summary

FPL Energy, LLC (FPL Energy) is planning to develop a wind energy conversion facility at the Rough Rider I Wind Resource Area (WRA). At the time the native prairie surveys were being completed, and based on the spatial data dated August 4 and 13, 2008 for the turbines and project area, respectively, the original proposed project area for Rough Rider I (hereafter called WRA) is 11,209 acres. Once the surveys were completed, Tetra Tech was informed that the project area was expanded. The proposed expansion to the WRA (hereafter called expanded WRA) extended the total area to 21,841 acres. This survey was only conducted on the original proposed project area.

The WRA is located in Dickey County, North Dakota. FPL Energy is committed to environmental due diligence at all of their wind energy facilities and have contracted Tetra Tech EC (Tetra Tech) to conduct a survey for native prairie habitat and to identify the locations of any lands within the WRA that are protected under conservation programs.

The entire original WRA was surveyed for native prairie. The WRA has 8,308 acres (74.1% of the WRA) of native prairie and 905 acres (8.1% of the WRA) of tame grasslands (croplands that are replanted as pastures and hayfields). The largest area of native prairie is found in the southeast region of the WRA. At the time of the survey, 105 GExle turbine locations were being considered for use within the WRA. Overall, 82% (86 out of 105) of the turbine locations are located in native prairie and 5% (5 out of 105) are located in tame grasslands.

The Dakota skipper, a species of butterfly which is currently classified as a federal candidate species, likely occurs within the WRA. Of the 9,213 acres of land classified as native prairie or tame grassland within the WRA, 49.9% is classified as being either good or excellent habitat for the Dakota skipper. There are a total of 294 acres of grassland habitat classified as excellent within the WRA which is approximately 3.2% of native prairie. Habitat classified as good made up 46.7% (4,304 acres) of the native prairie and fair/poor habitat made up 50.1% (4,615 acres) of the native prairie in the WRA.

With the assistance of the United States department of Agriculture (USDA) – Farm Services Agency (FSA), 825 acres (4%) within the WRA were identified as lands that are currently protected under the conservation reserve program (CRP). Five of the proposed turbine locations would fall within CRP lands. CRP is a voluntary program for agricultural landowners designed to protect millions of acres of topsoil from erosion. Acreage enrolled in the CRP is planted to native vegetation associated with the area, making the program a major contributor to increased wildlife populations in many parts of the country. CRP lands cannot be hayed, tilled, seeded, or otherwise disturbed (including disturbance associated with transmission lines or other project construction) without authorization from the USDA.

Native prairies are also critical habitat used by prairie grouse (e.g., sharp-tailed grouse, greater prairie-chicken) for lekking, nesting, brood rearing, and wintering Grouse lek habitat is classified as open, short grass vegetation with minimal amounts of agriculture. Development in grouse lekking habitat could result in direct habitat loss, habitat loss through avoidance, predator facilitation, and construction-related disturbance. Most prairie grouse are considered gamebirds and are often managed locally by state fish and game for hunting purposes.

WRA Project 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:

- Conduct a native prairie survey of the expanded WRA.
- 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 with a history of fire suppression and grazing regimes or areas encroached by non-native species, is preferred.
- Avoid development on any protected CRP lands. If it is unavoidable, consult with the USDA-FSA on any special permitting required.
- Recommend surveying for Dakota skippers within suitable native prairie habitat and map their locations.
- Regularly check with the appropriate agencies (USFWS, USDA-FSA and NDGF) to determine if they have developed a formal definition to evaluate prairie quality.
- If native vegetation is disturbed or removed during construction of roads or turbines or during on-going maintenance activities, these areas should be reseeded or planted with native material.
- Invasive species monitoring should be conducted and control measures implemented if invasive species are found within the WRA.

Because of the sensitive nature of prairie grouse to development of native prairie and the high value local communities place on local game hunting; Tetra Tech recommends surveying for grouse leks for any wind energy project that have a high amount of native prairie. Best time frame for surveying for grouse leks in North Dakota is late March to late May.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Introduction

FPL Energy is planning to develop a wind energy conversion facility in Dickey County, North Dakota about 15 miles west northwest of Ellendale (Figure 1). At the time of the native prairie surveys, the original proposed Roughrider I Wind Resource Area (WRA) was 11,209 acres. All of the WRA was surveyed for native prairie. The expanded WRA is an additional 10,632 acres (21,841 total acres) and was not surveyed. The WRA consists primarily of prairie grasslands (both tame pasturelands and native prairie), agricultural crops and wetlands ranging from small depressions up to permanent small lakes (Figure 2). Of these habitats, native prairie has been identified for special consideration.

FPL Energy is committed to environmental due diligence at all of their wind energy facilities and therefore contracted Tetra Tech EC (Tetra Tech) to conduct a native prairie survey. In addition, protected lands under the USDA-FSA's Conservation Reserve Program (CRP) were identified. CRP is a voluntary program for agricultural landowners designed to protect millions of acres of topsoil from erosion. Acreage enrolled in the CRP is planted to native vegetation associated with the area, making the program a major contributor to increased wildlife populations in many parts of the country.

The WRA is located in the Missouri Coteau region of the Northwestern Glaciated Plains (USGS 2007, Bryce et al. 1998). The Northwestern Glaciated Plains ecoregion marks the western most extent of continental glaciations and is characterized by significant surface irregularity and high concentrations of wetlands. The glacially carved rolling hummocks of the Missouri Coteau enclose numerous wetland depressions or potholes. Streams and rivers are nearly absent, as are upland deciduous forests. Land use on the Missouri Coteau is a mixture of tilled agriculture of hay and spring wheat in flatter areas and cattle grazing on steeper slopes. Much of the native prairie has been largely replaced by wheat, alfalfa and other commercial crops over most of the ecoregion (Bryce et al. 1998, Samson et al. 1998). Other types of grasslands found in the WRA include tame grasslands (i.e., pasturelands mostly used for cattle grazing), which are comprised primarily of non-native species. Native prairie differs from tame grasslands in that native prairie is found on unbroken soil whereas tame grasslands occur on tilled soil and have been planted (G. Yapp, pers. comm.).

Native prairie may be used in several ways on the landscape. Most native prairies in private holdings are used for cattle ranching and are managed as rangelands. On rangelands, the soil has not been 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 such as grassland preserves (either private or public) or as wildlife refuges. Preserves and refuges can be difficult to visually distinguish from rangelands because the same types of management (fire and grazing) are often applied.

Native prairies serve 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 native prairies' fertile soils and predominantly flat topography, large portions of the native prairie have been converted to agricultural lands. This wide spread loss of native prairie makes this 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.

Native prairies serve as vital habitat for the Dakota skipper, a species of butterfly which is currently classified as a federal candidate species. The Dakota skipper is classified as a candidate species because, although its historic range once consisted of vast unbroken native prairies in north-central U.S. and south-central Canada, its current range is now limited to scattered remnants of high quality native prairies 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, and the loss of native prairie habitat. The Dakota skipper's classification as a federal candidate species does not entitle it to legal protection under the Endangered Species Act (ESA); however, if a candidate species becomes listed as threatened or endangered, then protection for that species becomes mandated under the ESA. Immediately upon listing, any projects that impact the Dakota skipper are not "grandfathered" or exempt from providing protection.

Native prairies are also critical habitat used by prairie grouse (e.g., sharp-tailed grouse, greater prairie-chicken) for lekking, nesting, brood rearing, and wintering Grouse lek habitat is classified as open, short grass vegetation with minimal amounts of agriculture. Development in grouse lekking habitat could result in direct habitat loss, habitat loss through avoidance, predator facilitation, and construction-related disturbance. Most prairie grouse are considered gamebirds and are often managed locally by state fish and game for hunting purposes.

In addition to native habitats, man-made habitat can also provide value to wildlife and may require an additional level of permitting. The US Department of Agriculture (USDA) – Farm Service Agency (FSA) maintains records of lands reserved under the CRP as part of the conservation programs designated by the Farm Bill of 1985 (revised May 22, 2008). As mentioned above, 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.

2. Methods

Field surveys were conducted September 5, 10, and 16 of 2008. September is considered an appropriate time of year to identify plant species due to their flowering seasons and to assess grazing intensity due to grazing schedules. In order to systematically identify areas of native prairie, a range ecologist visually assessed the habitat by making roadside stops to mark the habitat within the WRA. In many areas, one square-mile sections of land were bordered by county roads and were easily evaluated. Roadside stops were made when needed (e.g., change in habitat or limited view). For most sections of land, the habitat was viewed from several points along the road, but large contiguous tracts of habitat that could not be identified from the road were accessed on foot to determine the habitat type, resulting in a complete coverage of the WRA.

When grasslands were encountered during field surveys, the range ecologist determined if the grasslands were native prairie or tame grasslands. The grassland type was determined based on several visual cues including the following: dominant visible plant species, particularly the proportion of native to non-native species in core areas away from fence lines; frequency of typical native prairie species, such as forbs (herbaceous flowering plants), that are not as common 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 growing in obvious rows (indicating prior tilling and seeding). Areas of presumably unbroken soil that were comprised mostly of native prairie plants were classified as native prairie, and may have included rangelands, conservation easements, or other types of reserves. Areas of broken soil that were comprised of mostly non-native species or had few forb species were classified as tame grasslands. In North Dakota, tame grasslands are mostly dominated by alfalfa, sweet clover, or brome grass plantings used for hayfields (L. Binstock, pers. comm.).

Grasslands are also evaluated to determine their suitability as habitat for the Dakota skipper. Grasslands were classified as excellent, good, or fair/poor quality habitat based on the criteria of usage by the Dakota skipper. The criteria used during field surveys were the level of grazing which had occurred within the grassland and the presence of key plant species which the Dakota skipper depends upon (bluestem, coneflower, or camas). Excellent habitat was defined as grasslands where only light grazing had occurred and at least 1 key plant species was present; good habitat was defined as areas with moderate grazing and where key plant species were either present or not; and fair/poor habitat was defined as grasslands where heavy grazing had occurred and key plant species were either present or not. Grazing intensity was recorded for grasslands by estimating the percentage of vegetation grazed in broad classes: <25% (light), 25-50% (moderate), and >50 % (heavy). The habitat types were drawn onto aerial photographs of each township/range section. The locations of native prairie and habitat quality were then digitized from the aerial photographs using ArcGIS 9.2.

The North Dakota State office of the USDA was contacted regarding the location of CRP lands within and adjacent to the WRA. The USDA provided this information as digital files which could be assessed using ArcGIS 9.2. This allowed the locations of CRP lands within the WRA to be compared to the proposed location of the turbines.

3. Results

The entire WRA was surveyed. A total of 8,308 acres (74% of the WRA) were classified as native prairie (Figure 2) and 905 acres (8.1% of the WRA) were classified as tame grasslands. An additional 1,996 acres (17.8%) were either active crops (corn, alfalfa, soybeans) or grazing pastures for cattle. The largest contiguous areas of native prairie were found in the southeast region of the WRA (Figure 2). A total of 17 grasses (4 non-native) and 44 forbs (8 non-natives) species were recorded in native prairie (Table 1). Three species are listed by the state of North Dakota as being noxious weeds (Table 1). Tame grasslands consisted of 5 grasses (all non-native) and 20 forbs (9 non-natives) species (Table 2). Three of the species found in tame grasslands are state listed noxious weeds (Table 2). None are species listed by the state of North Dakota or federally protected as endangered, threatened or species of concern.

Of the 9,213 acres classified as either native prairie or tame grassland within the WRA, 49.9% are classified as either good or excellent habitat for the Dakota skipper (Figure 3). Classification for Dakota skipper habitat consisted of 46.7% (4,304 acres) rated as good habitat to support the Dakota skipper, 3.2% (294 acres) was considered excellent habitat, and 50.4% (4,615 acres) was considered fair/poor habitat. The largest portion of continuous grassland habitat classified as excellent for the Dakota skipper is located in the southeast portion of the WRA (Figure 3).

With the assistance of the North Dakota office of the USDA – FSA, a total of 825 acres (3%) was identified as CRP lands within the expanded WRA (Figure 4). Most of the CRP lands are located along the northern project boundary with 88th Street and the northwest boundary of the WRA along 70th Street and 77th Avenue. A small portion of CRP land is also located in the southern part of the WRA just south of the 93rd Street and 77th Avenue intersection.

As of the time of the survey, a total of 105 turbine (model GExle) locations were proposed for use within the WRA. Overall, 82% (86 possible locations) are in native prairie (Figure 2 and Table 5). Five or 5% of the proposed turbine locations are in tame grasslands (Table 4). Under the project's current configuration, five of the proposed turbines are located in lands enrolled within the CRP (Figure 4). Most of these occur between 91st and 88th Street in the northern third of the WRA. Table 3 lists the UTM coordinates for each of the turbines located within CRP lands.

4. Discussion

Prairies are an ecosystem of conservation concern and many siting guidelines recommend that wind turbines not be placed in large, intact areas of native prairie (Samson et al. 2004). Native prairie comprised 74% of the original WRA and 82% of the proposed turbine locations were in native prairie. Many siting guidelines recommend that unfragmented and high quality areas of native prairie be avoided, but do not provide details regarding the level of fragmentation or how quality is determined. In this context, quality is a value-laden term, meaning that quality depends on the objectives of those who prepared the guidelines. North Dakota does not provide recommendations of how to measure prairie quality. This topic is still being internally debated by agencies and stakeholder groups; thus, further consultation is recommended to determine if and when the agencies will developed management objectives for native prairie.

If turbines, roads, or transmission lines are to be constructed in native prairie in the WRA, measures should be taken to ensure that the spread of non-native or invasive species is not facilitated. Periodic invasive species monitoring should be conducted and the appropriate measures should be taken to control invasive species if they are found within the WRA. Although non-native species were found in native prairies, not all non-native species are considered invasive. Invasive species are defined as those that can cause environmental or economic harm. Invasive species can crowd out native species and often colonize disturbed areas such as roadways (Reinking 2006). Three noxious weeds (i.e., aggressive invasive species) were detected in the WRA, but others could be transported into the WRA by construction equipment; therefore, coordination with local agencies is recommended in order to develop best management practices aimed at preventing the spread of noxious weeds.

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 (Paul Toon, pers. comm.). 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.

- The calculation for repayment of the area occupied by the tower and roadway would be as follows:

    1. Acres taken out X rental rate X years paid = monies owed back
    2. Acres taken out X rental rate X 25% = liquidated damages
    3. Possible cost share to establish grass cover (if applicable)
    4. Interest as calculated for each year's rental payment
    5. The total money owed would be the total of items 1 through 4

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

Suitable habitat for the Dakota skipper is present within the WRA. There are no legal prohibitions under the ESA against taking candidate species; however, the U.S. Fish and Wildlife Service implements conservation actions for candidate species (such as conservation easements and land protection under the CRP) which may eliminate the need to list the species as threatened or endangered (Jones et al. 2007). Large tracts classified as excellent and good habitat exist within the southern portion of the WRA (Figure 3). In addition, 49.9% of all habitat designated as native prairie or tame grasslands within the WRA is also rated as either being good or excellent habitat for the Dakota skipper (Figure 3).

Native prairies are also critical habitat used by prairie grouse (e.g., sharp-tailed grouse, greater prairie-chicken) for lekking, nesting, brood rearing, and wintering Grouse lek habitat is classified as open, short grass vegetation with minimal amounts of agriculture. Development in grouse lekking habitat could result in direct habitat loss, habitat loss through avoidance, predator facilitation, and construction-related disturbance. Most prairie grouse are considered gamebirds and are often managed locally by state fish and game for hunting purposes.

Unfragmented areas of native prairie in the WRA may be of greatest benefit to wildlife in general. Raptors, such as short-eared owl and ferruginous hawk, require 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 which are typically found in larger tracts of prairie (Schaffer et al. 2003, Davis et al. 2006). Although 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).

One concern about the conversion of native prairie is the potential impacts on breeding and migratory waterfowl and shorebirds. 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 et al. 2007). The region produces, on average, 50% 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 et al. 2007). For seven species—mallard, gadwall, blue-winged teal, northern shoveler, northern pintail, redhead, and canvasback— the prairie region accounts for more than 60% of the breeding population (Smith 1995). CRP grassland in the prairie region in North Dakota, South Dakota and northeastern Montana helped produce 26 million ducks (2 million annually) from 1992-2004 (Jones et al. 2007). 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 et al. 2007).

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 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:

- Conduct a native prairie survey of the expanded WRA.
- 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 with a history of fire suppression and grazing regimes or areas encroached by non-native species, is preferred.
- Avoid development on any protected CRP lands. If it is unavoidable, consult with the USDA-FSA on any special permitting required.
- Recommend surveying for Dakota skippers within suitable native prairie habitat and map their locations.
- Regularly check with the appropriate agencies (USFWS, USDA-FSA and NDGF) to determine if they have developed a formal definition to evaluate prairie quality.
- If native vegetation is disturbed or removed during construction of roads or turbines or during on-going maintenance activities, these areas should be reseeded or planted with native material.
- Invasive species monitoring should be conducted and control measures implemented if invasive species are found within the WRA.

Because of the sensitive nature of prairie grouse to development of native prairie and the high value local communities place on local game hunting; Tetra Tech also recommends surveying for grouse leks for any wind energy project that have a high amount of native prairie. Best time frame for surveying for grouse leks in North Dakota is late March to late May.

6. References

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

Bryce, S., J. M. Omernik, D. E. Pater, M. Ulmer, J. Schaar, J. Freeouf, R. Johnson, P. Kuck, and S. H. Azevedo. 1998. Ecoregions of North Dakota and South Dakota. Jamestown, N. D.: North Prairie Wildlife Research Center Online. Accessed 8/13/2008. http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/index.html

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

Grant, T. A., E. Madden, and G. B. Berkey. 2003. Tree and shrub invasion in northern mixed-grass prairie: implications for breeding grassland birds. Wilson Bulletin 32:807-818.

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

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

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

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

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

McGregor, R.L. et al. 1986. Flora of the Great Plains. The Great Plains Flora Association. University Press of Kansas. Lawrence, Kansas.

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

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

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

Skagan, Susan K. and Fritz L. Knopf. 1994. Migrating shorebirds and habitat dynamics at a prairie wetland complex. Wilson Bull., 106(l), pp. 91-105.

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

United States Department of Agriculture – Farm Services Agency (USDA-FSA). 2007. United States Department of Agriculture – Farm Services Agency website. http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=landing. Accessed August 15, 2008.

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

United States Geological Survey (USGS). 2007. Ecoregions of North Dakota and South Dakota. Northern Prairie Wildlife Research Center. Available online at: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/nodak.htm.

7. Tetra Tech Authors and Team Members who worked on this report:

ROLE	NAME	DATE REVIEWED
Tetra Tech Project Manager	Tracey M. Martorano	October 29, 2008
Tetra Tech Deputy Project Manager	Anne-Marie Griger	October 21, 2008
Field Staff	Western Plains Consulting – Sara Simmers	October 2, 2008
Report Author	James Kowalsky	October 3, 2008
Peer Review #1	Laura Nagy	October 7, 2008
GIS Technician	Peter Omdal and Eric Lubell	N/A

Table 1. Plant species observed in native prairie within the WRA.

Grasses	
Latin name[1]	**Common name**
***Agropyron cristatum* (L.) Gaertn**	**crested wheatgrass**#
***Agropyron repens* (L.) Beauv.**	**quack grass**#
Agropyron smithii Rydb.	western wheatgrass
Andropogon gerardii Vitman	big bluestem
Andropogon scoparius Michx.	little bluestem
Bouteloua curtipendula (Michx.) Torr	sideoats grama
Bouteloua gracilis (H.B.K.) Lag. ex. Griffiths	blue grama
***Bromus inermis* Leyss.**	**smooth brome**#
Calamovilfa longifolia (Hook.) Scribn.	prairie sandreed
Carex sp.	sedge species
Carex filifolia Nutt.	threadleaf sedge
Koeleria pyramidata (Lam.) Beauv.	junegrass
Muhlenbergia cuspidata (Torr.) Rydb	plains muhly
Panicum virgatum L.	switchgrass
***Poa pratensis* L.**	**Kentucky bluegrass**#
Spartina pectinata Link	prairie cordgrass
Stipa spartea Trin.	porcupine-grass
Stipa viridula Trin.	green needle grass

Trees and Shrubs	
Latin name[1]	**Common name**
Amorpha canescens Pursh	leadplant
Crataegus cf. *rotundifolia* Moench	northern hawthorn
Rosa arkansana Porter	prairie wildrose
Symphoricarpos occidentalis L.	western snowberry

Forbs	
Latin name[1]	**Common name**
Achillea millefolium L	common yarrow
Ambrosia psilostachya DC.	western ragweed
Anemone cylindrica A. Gray	candle anemone
Antennaria parviflora Nutt	pussy-toes
***Artemisia absinthium* L**	**absinthe wormwood**#*
Artemisia dracunculus L.	silky wormwood
Artemisia frigida Willd.	fringed sage
Artemisia ludoviciana Nutt.	white sagewort
Aster ericoides L.	heath aster
Aster oblongifolius Nutt.	aromatic aster
Chrysopsis villosa (Pursh) Nutt.	hairy gold aster
***Cirsium arvense* (L.) Scop.**	**Canada thistle***
Cirsium flodmanii (Rydb.) Arthur	Flodman's thistle
Dalea purpurea Vent.	purple prairie clover
Echinacea angustifolia DC.	purple coneflower
Erigeron strigosis Muhl. Ex Willd.	daisy fleabane
***Euphorbia esula* L.**	**leafy spurge**#*
Glycyrrhiza lepidota Pursh.	wild licorice
Grindelia squarrosa (Pursh) Dun.	curly-top gumweed
Gutierrizia sarothrae (Pursh) Britt. & Rusby	broom snakeweed
Helianthus annuus L.	common sunflower
Helianthus maximilianii Schrad	Maximilian sunflower
Helianthus rigidus (Cass.) Desf.	stiff sunflower
Liatris aspera Michx.	rough blazing star
Liatrus ligulistylis (A. Nels.) K. Schum.	northern plains blazing star
Liatris punctata Hook.	dotted blazing star
***Linaria vulgaris* Hill**	**butter-and-eggs**
***Medicago lupulina* L.**	**black medic**
***Medicago sativa* L.**	**alfalfa**#
***Melilotus officinalis* (L.) Pall.**	**yellow sweet clover**#
Monarda fistulosa L.	wild bergamot
Oenothera biennis L.	common evening primrose
Onosmodium molle Michx.	false gromwell
Psoralea argophylla Pursh	silver-leaf scurf pea

Table 1. Plant species observed in native prairie within the WRA cont.

Forbs	
Latin name[1]	**Common name**
Ratibida columnifera (Nutt.) Woot. & Standl.	prairie coneflower
Rudbeckia hirta L.	black eyed susan
Solidago canadensis L.	Canada goldenrod
Solidago mollis Bartl.	soft goldenrod
Solidago nemoralis Ait.	Gray goldenrod
Solidago ptarmicoides (Nees) Boivin	sneezewort aster
Solidago rigida L.	Rigid goldenrod
***Taraxacum officinale* Weber**	**common dandelion**
Toxicodendron rydbergii (Small) Greene	poison ivy
Viola pedatifida G. Don	prairie violet

[1]Nomenclature follows McGregor 1986.
Species in bold print are not native to North Dakota.
* State listed noxious (invasive) weed of North Dakota.
# Plants considered very weedy under certain conditions in North Dakota.

Table 2. Plant species observed in tame grasslands within the WRA.

Grasses		Forbs	
Latin name[1]	**Common name**	**Latin name[1]**	**Common name**
***Agropyron intermedium* (Host) Beauv.**	**intermediate wheatgrass**	*Ambrosia psilostachya* DC.	western ragweed
***Agropyron elongatum* (Host) Beauv.**	**tall wheatgrass**	***Artemisia absinthium* L.**	**absinthe wormwood***
***Agropyron repens* (L.) Beauv.**	**quackgrass**	*Artemisia frigida* Willd.	fringed sagewort
***Bromus inermis* Leyss.**	**smooth brome#**	*Asclepias syriaca* L.	common milkweed
***Poa pratensis* L.**	**Kentucky bluegrass#**	*Aster ericoides* L.	heath aster
		***Cirsium arvense* (L.) Scop.**	**Canada thistle#***
		Cirsium flodmanii (Rydb.) Arthur	Flodman's thistle
		***Convolvulus arvensis* L.**	**field bindweed**
		Conyza canadensis (L.) Cronq.	horseweed
		cf. *Descurainia sophia* (L.) Webb ex Prantl.	**flixweed**
		***Euphorbia esula* L.**	**leafy spurge#***
		Grindelia squarrosa (Pursh) Dun.	curly-top gumweed
		***Medicago sativa* L.**	**alfalfa#**
		***Melilotus alba* Medic.**	**white sweet clover**
		***Melilotus officinalis* (L.) Pall.**	**yellow sweet clover#**
		Ratibida columnifera (Nutt.) Woot. & Standl.	prairie coneflower
		Salsola iberica Senn. & Pau.	Russian thistle
		Solidago canadensis L.	Canada goldenrod
		Solidago rigida L.	rigid goldenrod
		***Sonchus arvensis* L.**	**field sow thistle**
		***Trifolium* sp.**	**clover species**

[1]Nomenclature follows McGregor 1986.
Species in bold print are not native to North Dakota.
* State listed noxious (invasive) weed of North Dakota.
# Plants considered very weedy under certain conditions in North Dakota.

Table 3. Locations of turbines currently proposed for placement within CRP lands (NAD83 UTM).

UTMx	UTMy
509518	5109508
511775	5107190
509511	5106394
512298	5107677
512027	5107469

Table 4. Locations of turbines currently proposed for placement within Tame Grasslands (NAD83 UTM).

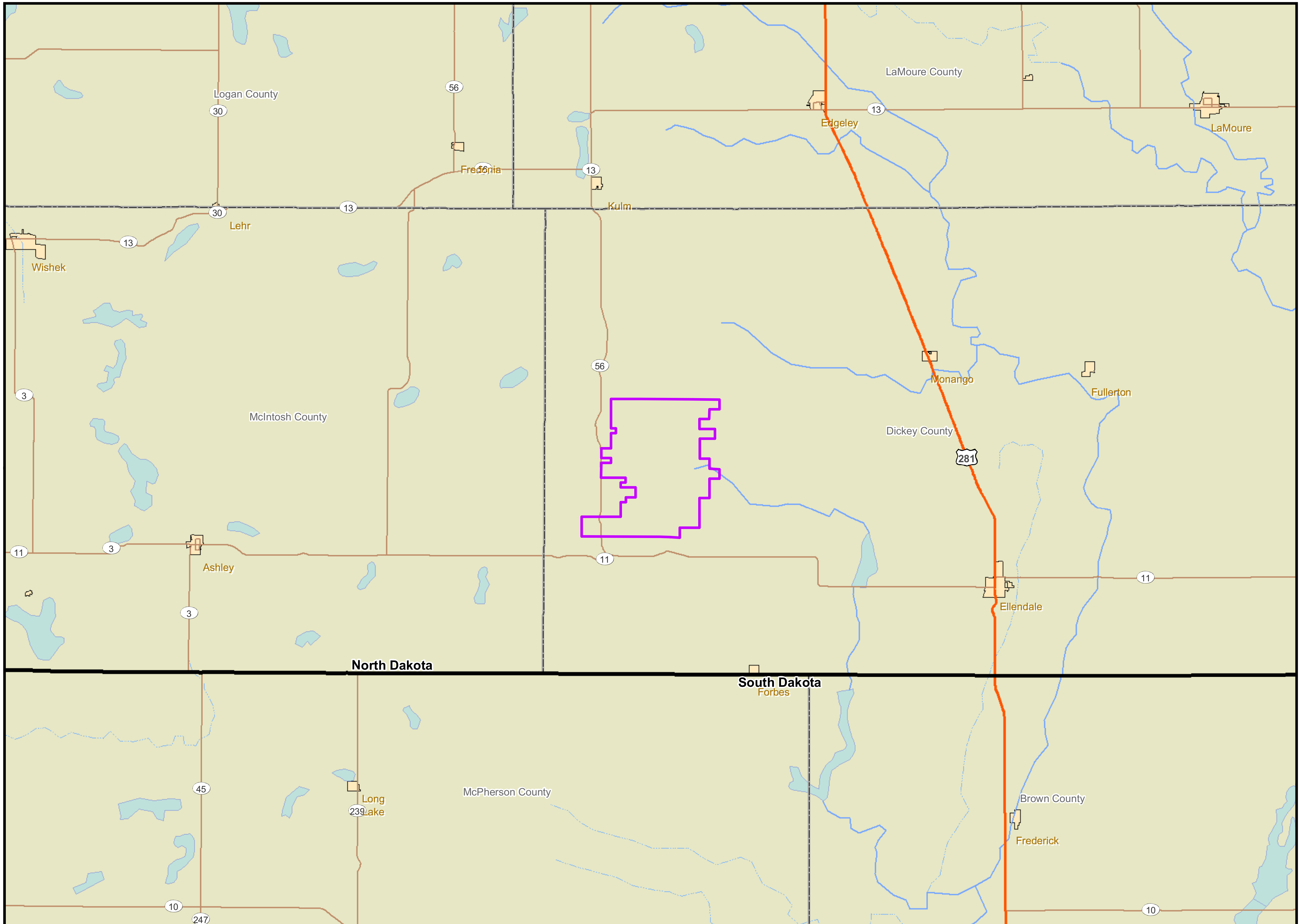
UTMx	UTMy
509518	5109508
509289	5109247
509727	5106667
512298	5107677
512027	5107469

Table 5. Locations of turbines currently proposed for placement within Native Grasslands (NAD83 UTM).

UTMx	UTMy
506802	5106813
509957	5098772
510791	5098630
509681	5098711
510440	5098564
508166	5101266
507777	5101292
510170	5098948
510619	5099274
510876	5099397
512974	5104783
512305	5109150
508679	5101182
510384	5099124
512925	5103925
510916	5109709
512023	5101969
509293	5106099
512073	5101476
510552	5101167
511899	5100849
512442	5103348
511341	5099712
507130	5106896
511127	5100514
508369	5107446
507482	5106986
512271	5103106
512670	5104701
509115	5108937
511208	5106878
510529	5100423
510651	5109616
509345	5101200
511464	5102824
510427	5109461
507823	5108213
510833	5100471
511671	5101935
511685	5100678
511619	5104800
512256	5108758
512065	5102920
511116	5099541

Table 5 continued. Locations of turbines currently proposed for placement within Native Grasslands (NAD83 UTM).

UTMx	UTMy
511226	5103648
510224	5100380
511134	5102857
509406	5102484
510027	5102583
511717	5101415
512117	5104516
511386	5104627
511438	5100557
510159	5109201
512324	5102091
512417	5104579
511777	5102832
508626	5108794
508357	5108610
510561	5107676
509919	5100338
511497	5107020
510182	5104132
512020	5108127
509348	5099759
509511	5106394
512643	5103888
511065	5104473
509351	5104144
510779	5104348
510485	5104261
511375	5101379
510855	5107740
511149	5107858
512153	5108418
512350	5103871
510552	5103465
509724	5102537
510913	5103557
511009	5101237
509636	5100304
510333	5102594
511491	5107928
509001	5101200
511783	5107979
509366	5100181

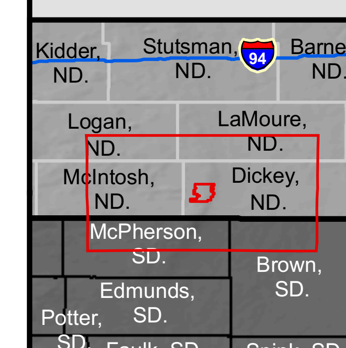


FPLE
Dickey County
Figure 1
Location Map

- Project Boundary
- Federal Highway
- Major Road
- Stream
- Intermittent Stream
- Water Body
- City/Town
- County Boundary
- State Boundary

Miles
0 3 6

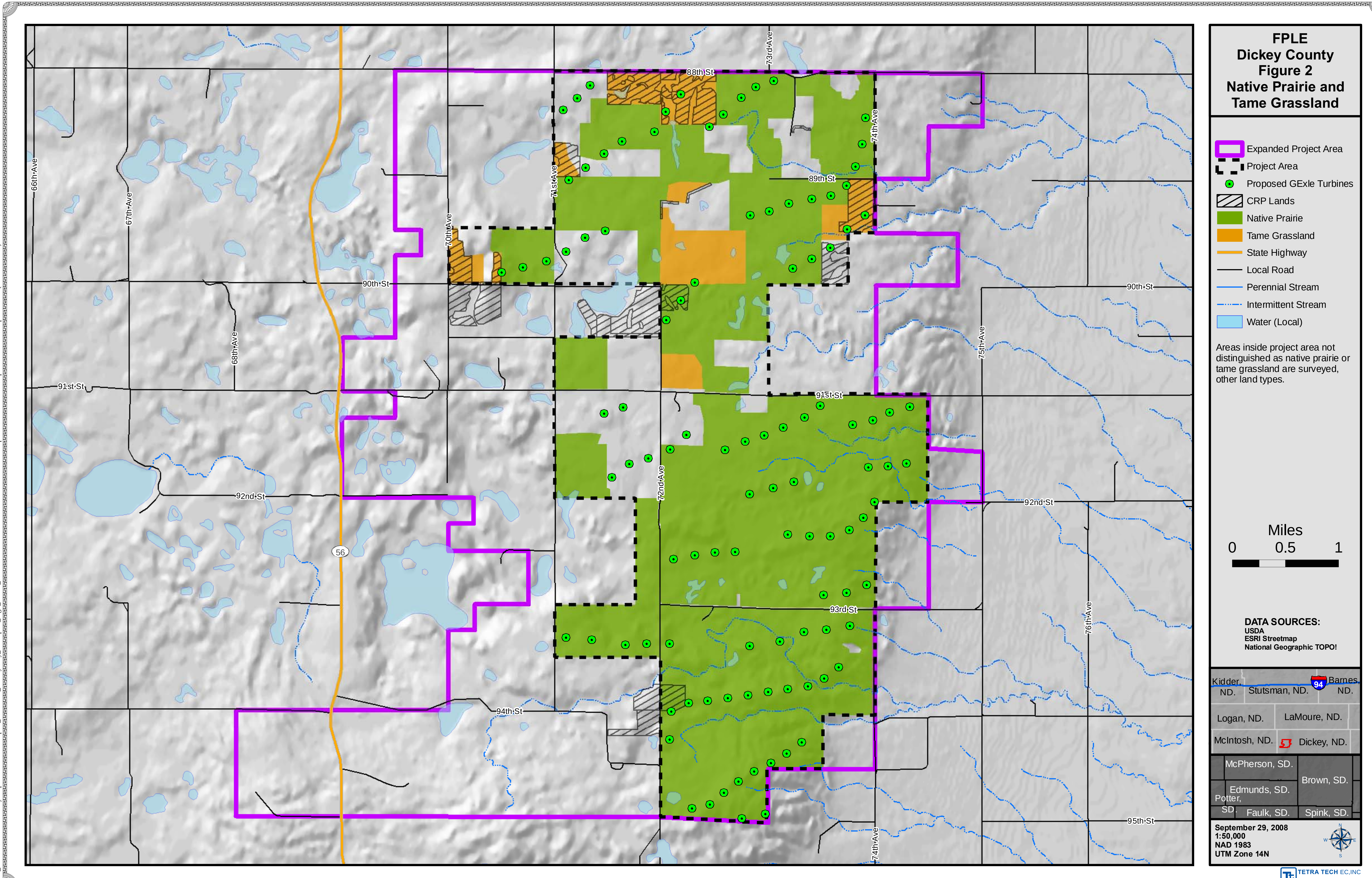
DATA SOURCES:
ESRI Streetmap
National Geographic TOPO!



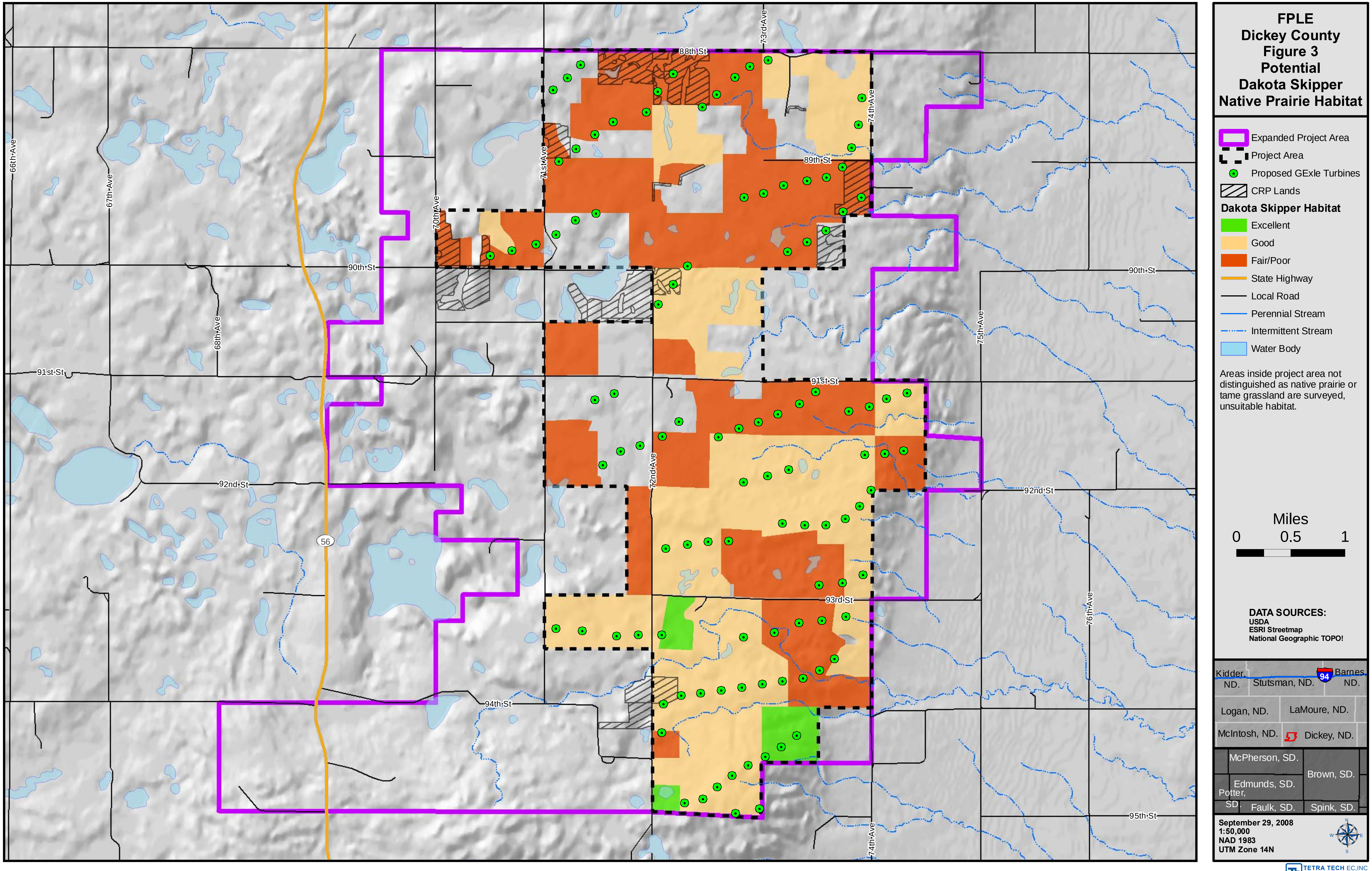
September 29, 2008
1:50,000
NAD 1983
UTM Zone 14N

TETRA TECH EC,INC

P:\GIS_PROJECTS\FPL\Dickey\maps\NativePrairieReport_2008\FPL_DickeyCnty_NPReport_Fig1_17i11i_092308.mxd - Last Accessed: 9/29/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

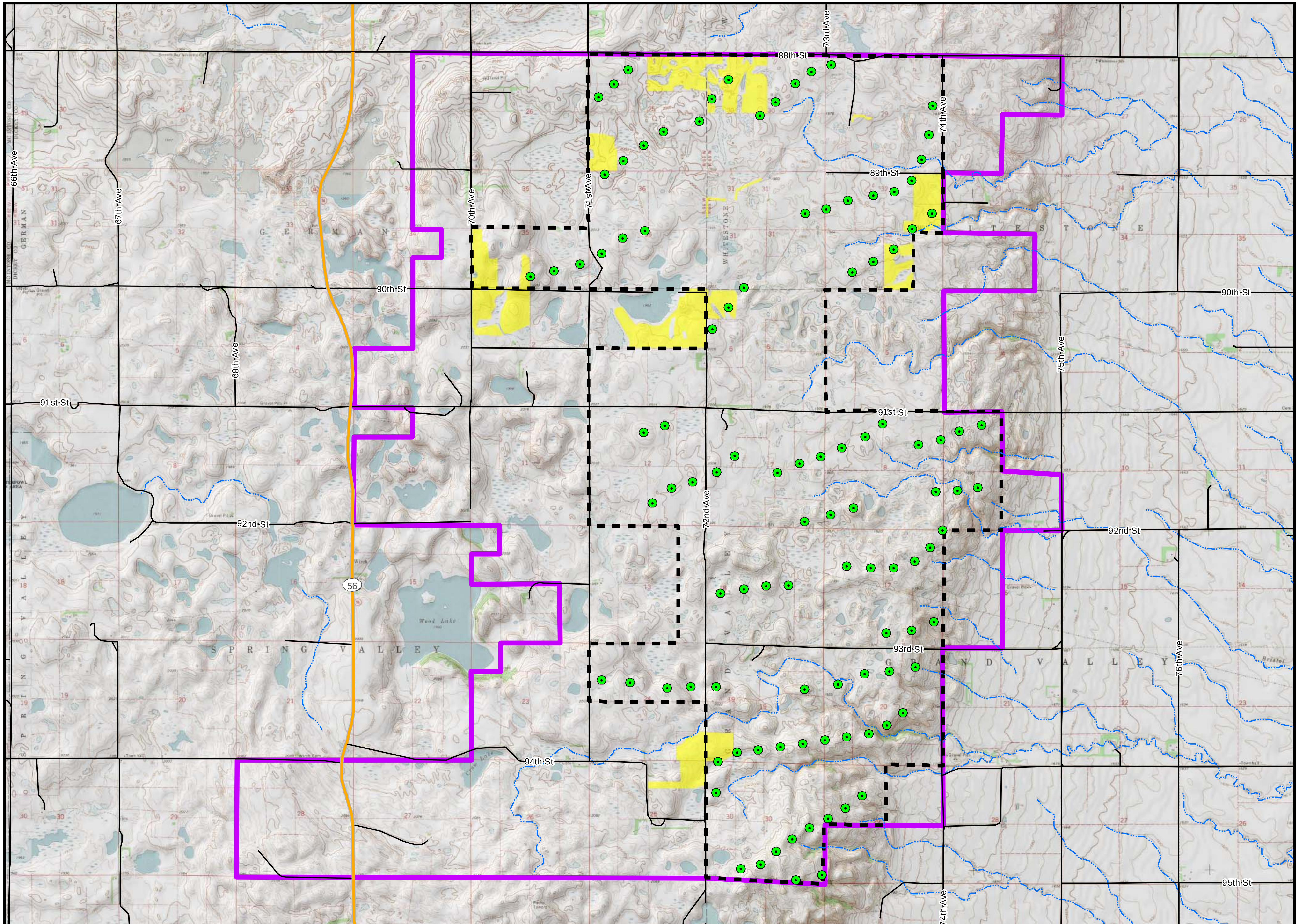


P:\GIS_PROJECTS\FPL\Dickey\maps\NativePrairieReport_2008\FPL_DickeyCnty_NPReport_Fig2_17i11i_092908.mxd - Last Accessed: 10/20/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)



P:\GIS_PROJECTS\FPL\Dickey\maps\NativePrairieReport_2008\FPL_DickeyCnty_NPReport_Fig3_17i11i_092908.mxd - Last Accessed: 10/20/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

FPLE
Dickey County
Figure 4
CRP Lands

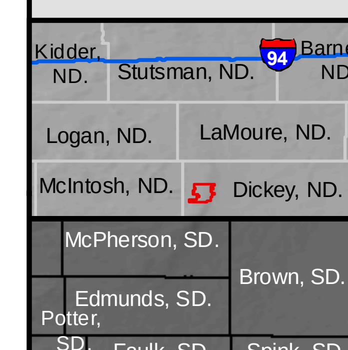


- Project Area
- Expanded Project Area
- Proposed GExle Turbines
- CRP Lands
- State Highway
- Local Road
- Perennial Stream
- Intermittent Stream

Miles

0 0.5 1

DATA SOURCES:
USDA
ESRI Streetmap
National Geographic TOPO!



September 29, 2008
1:50,000
NAD 1983
UTM Zone 14N

TETRA TECH EC,INC

P:\GIS_PROJECTS\FPL\Dickey\maps\NativePrairieReport_2008\FPL_DickeyCnty_NPReport_Fig4_17i11i_092308.mxd - Last Accessed: 10/20/2008 - Map Scale is correct when printed at: Landscape ANSI B (17 x 11 inches)

TETRA TECH EC, INC.

December 16, 2008

Allen Wynn
FPL Energy
823 Congress Ave, Suite 800
Austin, TX 78701

SUBJECT: Rough Rider I 2008 Fall Avian Survey Report

Dear Allen,

Tetra Tech is pleased to provide you the 2008 Fall Avian Survey Report for the Rough Rider I wind resource area. In addition to the report, below are suggested best management practices (BMPs) to avoid or reduce impacts to birds, as well as recommendations for further studies at Rough Rider I.

As discussed in the attached report, the greatest potential impact of the Rough Rider I WRA on avian species is direct mortality or injury from collisions with turbines and associated overhead transmission lines and loss of habitat. Tetra Tech recommends standard best management practices, siting turbines away from areas of high avian use and wetlands, and additional studies.

Project Specific Recommendations:

- Eight North Dakota State Species of Conservation Priority (American white pelican, American bittern, Swainson's hawk, ferruginous hawk, Wilson's phalarope, Franklin's gull, black tern, grasshopper sparrow) were observed during fall avian surveys. State wildlife personnel should be contacted to determine what avoidance or minimization measures, if necessary, are needed for these species.
- If possible, site turbines away from point count locations 1 and 10, which had the highest non-raptor use and were in close proximity to water.

Best Management Practices:

- Site access roads and turbines away from wetlands, waterbodies, and native prairies to the greatest extent practicable
- Studies have shown that birds, including bald eagles, are susceptible to electrocution by power lines. Therefore, the use of overhead power lines should be minimized; where 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.
- 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. Removal of trees should be avoided. If the nest is identified to belong to a species of concern, it may be designated a 'no disturbance zone' during the construction phase. Turbines should be placed out of a direct line of sight of the nest.

- 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 wetlands 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 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:

- As sharp-tailed grouse were identified during fall surveys and native prairie surveys conducted by Tetra Tech in September 2008 indicated a large amount of potential lek habitat, a grouse lek survey should be conducted in Spring 2009 in order to determine the location of breeding territories which should be avoided.
- FPL Energy has already authorized a 2009 Spring Avian survey; this proactive decision will serve to determine the level of avian use during spring migration, which is a critical piece of information as migration patterns differ between spring and fall.
- Raptor nest surveys should be conducted after leaves have dropped from trees. Any raptor nest identified during the nest survey should be revisited between April and July to determine breeding activity.
- As the Rough Rider I WRA falls within the eastern edge of the whooping crane migration corridor and suitable wetland habitat is present, specific-species targeted surveys or desktop risk analysis for whooping crane should be conducted.
- Post-construction mortality monitoring should be conducted after the facility is constructed.

Please feel free to contact me if you have any questions. We look forward to your comments.

Sincerely,

TETRA TECH EC, INCORPORATED

Tracey M. Martorano, P.E.
Senior Project Manager

2008 Fall Avian Point Count Survey

2008 Fall Avian Survey

Rough Rider I Wind Resource Area
Dickey County, 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 at the proposed Rough Rider I Wind Resource Area (WRA) in Dickey County, 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, power lines, and displacement due to the presence of the associated structures. Weekly surveys were performed at the Rough Rider I WRA between August 21 and November 11, 2008. Fixed point count surveys (800-meter radius) were conducted at 12 points distributed throughout the Rough Rider I WRA.

A total of 74 identified species and 8 unidentified species groups, consisting of 21,779 birds, were observed within the Rough Rider I WRA. Overall mean bird use within the Rough Rider I WRA was 140.51 birds/20 minutes (min) and ranged from zero to 1,988 birds per 20-min point count. Comparing the publicly available fall mean use rates from existing wind energy facilities throughout the country, the Rough Rider I WRA ranked highest out of 21 surveys for non-raptor use (139.66 birds/20 min) and 7th out of 31 surveys for raptor use (0.85 birds/20 min).

The very high mean use recorded at the Rough Rider I WRA was primarily driven by the waterfowl and waterbird groups. These two groups are likely attracted to the WRA due to the abundant wetlands, waterbodies, native prairies, and agricultural fields which can be found throughout the area. Many of the species from these two groups, such as the mallard, snow goose, blue-winged teal, Canada goose, and double-crested cormorant, had high encounter rates (greater than 1.0 birds flying within the RSA/20 min). To date, studies of waterfowl have shown that mortalities of geese have been low in proportional to their use. However, no studies have been published that document the relationship between mean use and mortality of ducks, although some duck fatalities have been documented at wind farms. If mortality is proportional to mean use, fatalities at this site could be high; however, if mortality patterns are similar to geese, fatalities at this site could be lower than use indicates. The populations of these five species are not in decline within North Dakota; therefore, moderate levels of individual mortality are not likely to have population-level effect. However, the WRA falls within the Prairie Pothole Region; according to Ducks Unlimited, this region is the most important waterfowl habitat on the continent. As a consequence, any waterfowl mortality will likely elicit concern from regulatory agencies.

The waterfowl and waterbird groups were not the only groups which contained species with high encounter rates. The ring-billed gull (from the gull/tern group), and the tree swallow and the red-winged blackbird (from the songbird group) all had high encounter rates. These are common, widespread species; therefore, potential turbine-related fatalities are unlikely to result in population-level impacts.

Encounter rates were low for raptor species. The red-tailed hawk had the highest encounter rate recorded for a raptor species (0.20 birds flying within the RSA/20 min); however, this species' encounter rate was still relatively low when compared to all other avian species detected at the

WRA. The red-tailed hawk's low encounter rate, coupled with its large potentially stable population, suggests that impacts with turbines are unlikely to result in population-level consequences. All other raptor species had encounter rates of less than 0.05 birds flying within the RSA/20 min, indicating that the potential for negative turbine-related impacts to these species are unlikely. The other raptor species detected include the northern harrier, Swainson's hawk, broad-winged hawk, merlin, bald eagle, turkey vulture, ferruginous hawk, and American kestrel.

Listed and Sensitive Species

Both the golden eagle and bald eagle, which are protected under the under the Bald and Golden Eagle Protection Act, were detected at the Rough Rider I WRA. The bald eagles detected during the surveys (three birds detected) had a low encounter rate. Two golden eagles were detected as incidental observations; therefore, no encounter rates were calculated. Overall, due to their low use of the area during fall, negative turbine-related impacts are unlikely during this season. In addition, no bald eagles have been reported during post-construction mortality monitoring at a WRA, indicating that negative turbine-related impacts are unlikely.

The North Dakota's list of 100 Species of Conservation Priority does not carry any regulatory or enforcement authority, and is only meant to guide conservation efforts. The species on this list are ranked in three priority levels based on status, funding availability, and presence of breeding habitat within North Dakota. The highest rank is Level I which contains species having a high level of conservation priority because of declining status either in North Dakota or across their range. Eight species listed as Level I under North Dakota's list of 100 Species of Conservation Priority were detected during fall surveys: American white pelican, American bittern, Swainson's hawk, ferruginous hawk, Wilson's phalarope, Franklin's gull, black tern, grasshopper sparrow. Except for the American bittern, which was only detected as an incidental observation and did not have an encounter rate calculated, these species all had low encounter rates, indicating that negative turbine-related impacts are unlikely for these species.

Table ES-1. Fall Avian Use Summary

Variable	Result	Details
Non-raptors		
Mean use	140.51 birds/20 min	Rank: first out of 21 studies (Table 8)
Number of species with high encounter rates (>1.0 birds/20 min)	8	See Section 4.1
Federally listed[1] species observed within the WRA	No	
State-listed species[2] within the WRA	Yes	6 species (See Section 4.3)
State-listed species within RSA	Yes	American white pelican Franklin's gull
Raptors		
Mean use	0.85 birds/20 min	Rank: 7th out of 31 studies (Table 8)
Number of species with high encounter rates (>1.0 birds/20 min)	None	
Eagles observed within the WRA	Yes	golden eagle bald eagle
Federally listed species observed within the WRA	No	
State-listed species within the WRA	Yes	ferruginous hawk Swainson's hawk
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	Abundant wetlands and waterbodies
Wetlands (attractant for cranes, waterfowl, and other water-based species)	Yes	Scattered throughout
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]North Dakota does not have a state threatened or endangered species list. Rather, North Dakota describes the 100 species of greatest concern.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

FPL Energy, LLC (FPL Energy) is planning to develop a wind energy conversion facility in multiple counties within North and South Dakota. The Rough Rider I Wind Resource Area (WRA), which is located in Dickey County, North Dakota, is the first phase in this larger wind development project (Figure 1). FPL Energy is committed to environmental due diligence and has contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct fall avian surveys at the Rough Rider I WRA, in order to quantify local avian use within the area and to identify potential avian impacts associated with building and/or operating the proposed facility.

Based on the latest project information (dated 12/02.2008), the Rough Rider I WRA encompasses 16,118 acres and is located in the Missouri Coteau portion of the Northwestern Glaciated Plains Ecoregion (USGS 2007). The Northwestern Glaciated Plains Ecoregion marks the westernmost extent of continental glaciation and is characterized by significant surface irregularity and high concentrations of wetlands. The rise in elevation along the eastern boundary of the ecoregion defines the beginning of the Great Plains. The glacially carved rolling hummocks of the Missouri Coteau enclose numerous wetland depressions or potholes. Streams and rivers are nearly absent, as are upland deciduous forests. Land use on the Missouri Coteau is a mixture of tilled agriculture consisting of hay and spring wheat in flatter areas and cattle grazing on steeper slopes. Some native mixed-grass prairies still remain on unbroken rangeland.

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, 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, which is one of the main bird migratory routes across the U.S. and is the critical flyway for waterfowl (Faanes and Stewart 1982, USFWS 2008). The Central Flyway runs through the central portion of the U.S. 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).

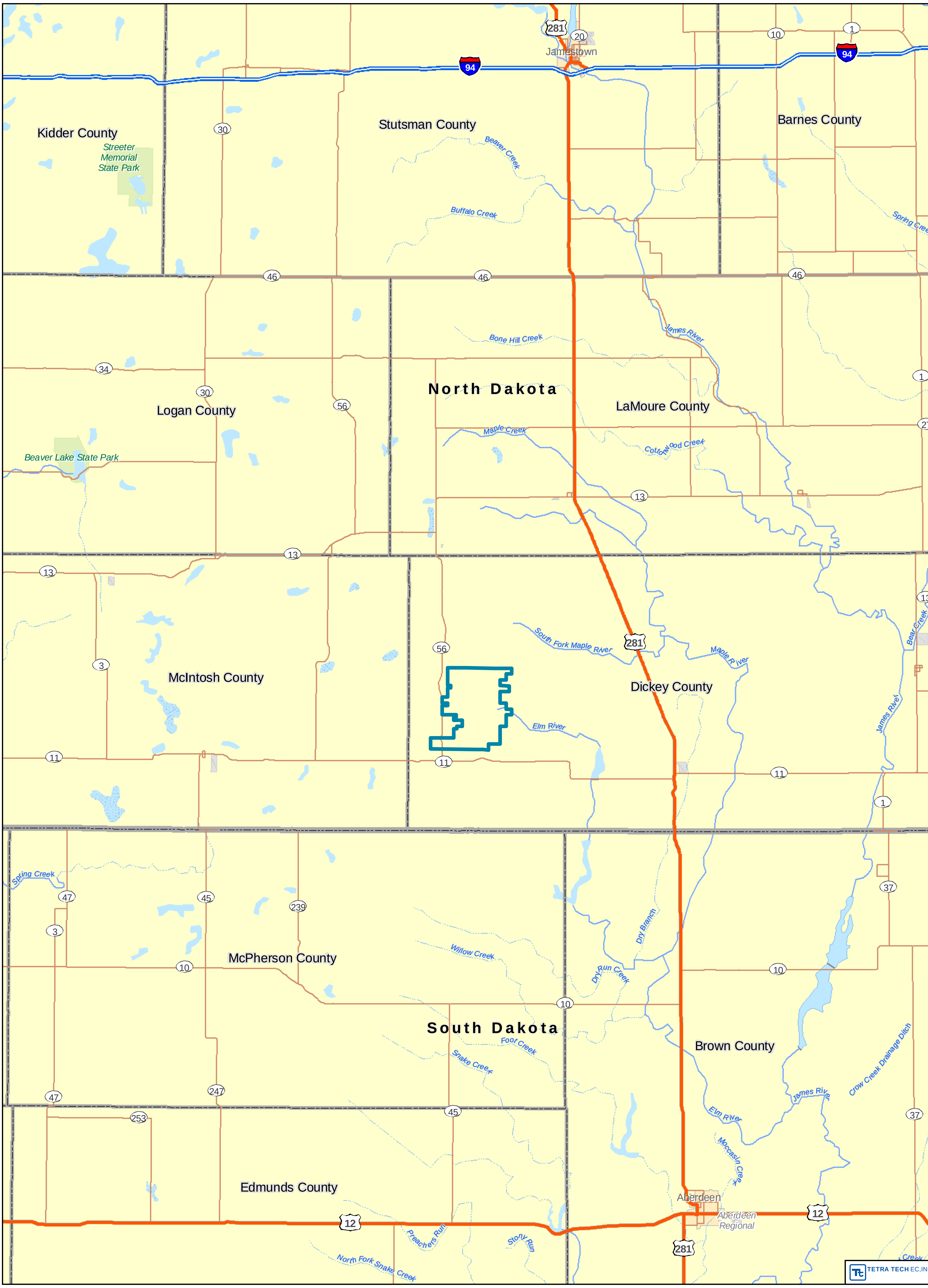


Figure 1. Rough Rider I WRA Vicinity Map

Dickey County, ND

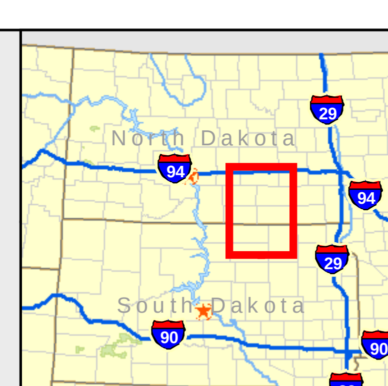
November 18, 2008

1:500,000

NAD 83 UTM Zone 14 North

0 5 10

Miles



P:\GIS_PROJECTS\FPL\Rough_Rider_I\maps\Figure_1_Rough_Rider_I_WRA_Vicinity_Map_111808.mxd - Last Accessed: 11/18/2008 - Map Scale correct at: Tabloid (11" x 17")

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. The data also serves as a pre-project baseline that can be compared to avian use after the project is constructed. 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 12 locations within the Rough Rider I WRA in order to evaluate avian use, behavior, and species composition during fall migration (Figure 2). Ornithologists conducted weekly surveys between August 21 and November 11 (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 ornithologists continuously scanned for birds and recorded any visual or auditory observations. Ornithologists 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 ornithologists 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 characterizing the bird community using the WRA during this time of year.

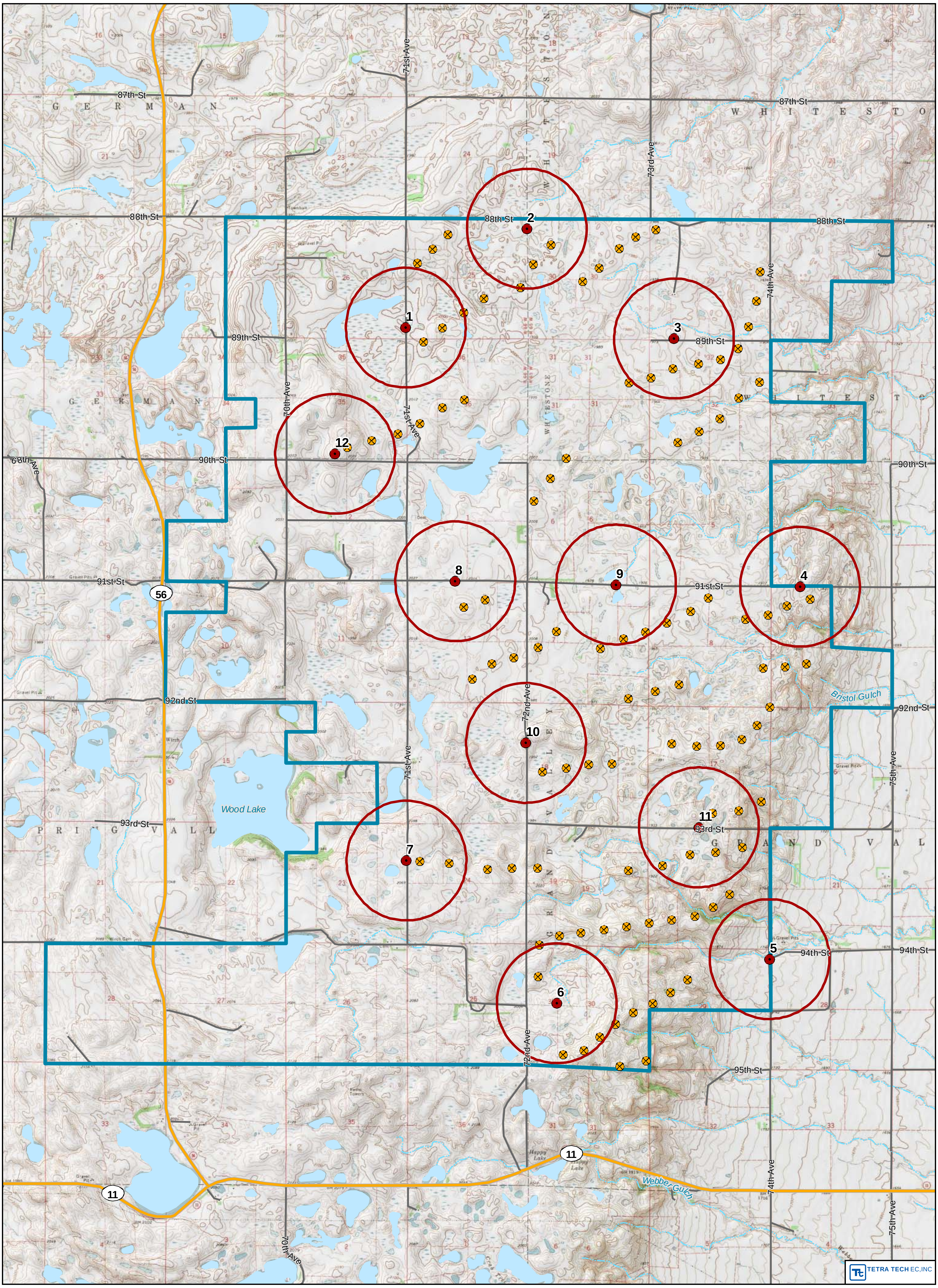


Figure 2. Avian Point Count Map for the Rough Rider I WRA

Dickey County, ND
November 18, 2008

1:48,000
NAD 83 UTM Zone 14 North
0 0.5 1
Miles

Project Facilities
- Project Area
- Avian Survey Point
- Survey Point - 800m buffer
- Turbines

Water Bodies
- Perennial Stream
- Intermittent Stream
- Lake/Reservoir

Transportation
- Interstate
- Highway
- Major Road
- Local Road

P:\GIS_PROJECTS\FPL\Rough_Rider_I\maps\Figure_2_Avian_Point_Count_Map_for_the_Rough_Rider_I_WRA_111808.mxd - Last Accessed: 11/18/2008 - Map Scale correct at: Tabloid (11" x 17")

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. Ornithologists recorded these observations on separate data sheets. 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 ornithologist 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 2 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 the analyses. Non-raptors were defined as all other species groups.

Avian Use of the Rough Rider I WRA

Tetra Tech derived avian use (mean use) of the Rough Rider I 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 Rough Rider I 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., a 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 Siemens 2.3 megawatt wind turbine is under consideration for this project; therefore, a RSA between 33.5 and 126.5 meters above ground was considered. 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 during point count surveys:

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

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; 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 mean 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.

3.0 RESULTS

3.1 Rough Rider I WRA

Ornithologists surveyed approximately 5,960 acres of the Rough Rider I WRA during point count surveys, covering 37.0 percent of the WRA's total area. The 12 point count locations were surveyed 13 times, resulting in 155 total 20-min surveys (point 3 was not surveyed on November 11 due to a snow drift which had blocked the road and immobilized the access gate).

3.2 Species Composition

Ornithologists recorded a total of 21,779 birds, consisting of 74 identified species and 8 unidentified species groups during the 155 fixed-point count surveys (Table 2). The most frequently observed birds were the mallard (26.6 percent of all birds observed), American coot (14.7 percent), snow goose (9.1 percent), and blue-winged teal (5.5 percent). Each remaining species comprised less than 5 percent of the total number of birds observed.

3.3 Avian Use

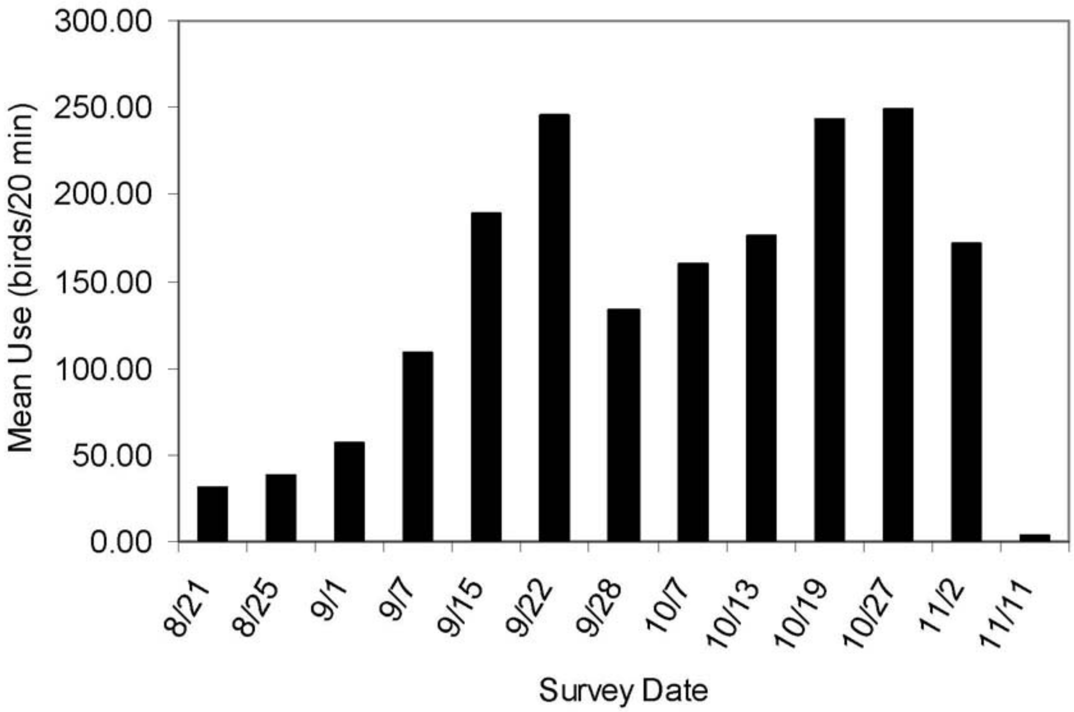
Overall mean avian use within the Rough Rider I WRA was 140.51 birds/20 min and ranged from zero to 1,988 birds per 20-min point count. Overall mean use by non-raptors was 139.66 birds/20 min. The non-raptors with the highest mean use were the mallard (37.32 birds/20 min), American coot (20.63 birds/20 min), and snow goose (12.81 birds/20 min; Table 2).

Among species groups, mean use was highest for waterfowl (81.86 birds/20 min; Table 3). The mallard was the most commonly observed species within the waterfowl group and accounted for 45.6 percent of the species within this group. Waterbirds had the second highest mean use amongst the species groups (25.98 birds/20 min); the American coot was the most commonly observed species within the waterbird group and accounted for 57.0 percent of the species within this group. Mean use for songbirds and gulls/terns were 20.30 and 10.68 birds/20 min respectively. All other species groups had a mean use estimates of less than 1.0 bird/20 min.

Non-raptor mean use was highest on September 22 (245.17 birds/20 min), October 19 (243.58 birds/20 min) and October 27 (248.50 birds/20 min; Figure 3). An unidentified species of gull contributed to the high mean use on September 22 (650 birds). Mallards (1604 birds) contributed to the high mean use on October 19; while both the mallard (1083 birds) and snow goose (1495 birds) contributed to the high mean use on October

27. Mean use for non-raptors was highest at point count locations 1 and 10 (433.69 and 400.92 birds/20 min respectively; Figure 4). Observations at these points consisted mostly of mallards (2,850 mallards at point 1 and 2,360 mallards at point 10; Table 4).

Figure 3: Non-raptor mean use by survey date (fall 2008)



The large numbers of waterfowl observed at point 1 is likely due to a large waterbody located adjacent to that point; however, the habitat at point 1 is not unique as multiple waterbodies of varying sizes are located throughout the WRA and can be found in the vicinity of each survey point.

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 0.85 birds/20 min (Table 3). The raptors with the highest mean use were the red-tailed hawk (0.32 birds/20) and northern harrier (0.25 birds/20; Table 3). Mean use for each additional raptor species was less than 0.10 birds/20 min: Swainson's hawk, broad-winged hawk, merlin, bald eagle, turkey vulture, and the rough-legged hawk (listed in order of descending mean use).

Mean use by raptors was highest on October 13 (2.25 birds/20) and September 15 (2.00 birds/20; Figure 5). Mean use by raptors was highest at point count location 7 (1.46 birds/20; Figure 6). Raptor species observed at point 7 included the red-tailed hawk (10 birds), northern harrier (3 birds), Swainson's hawk (2 birds), bald eagle (1 bird), and the turkey vulture (1 bird; Table 4).

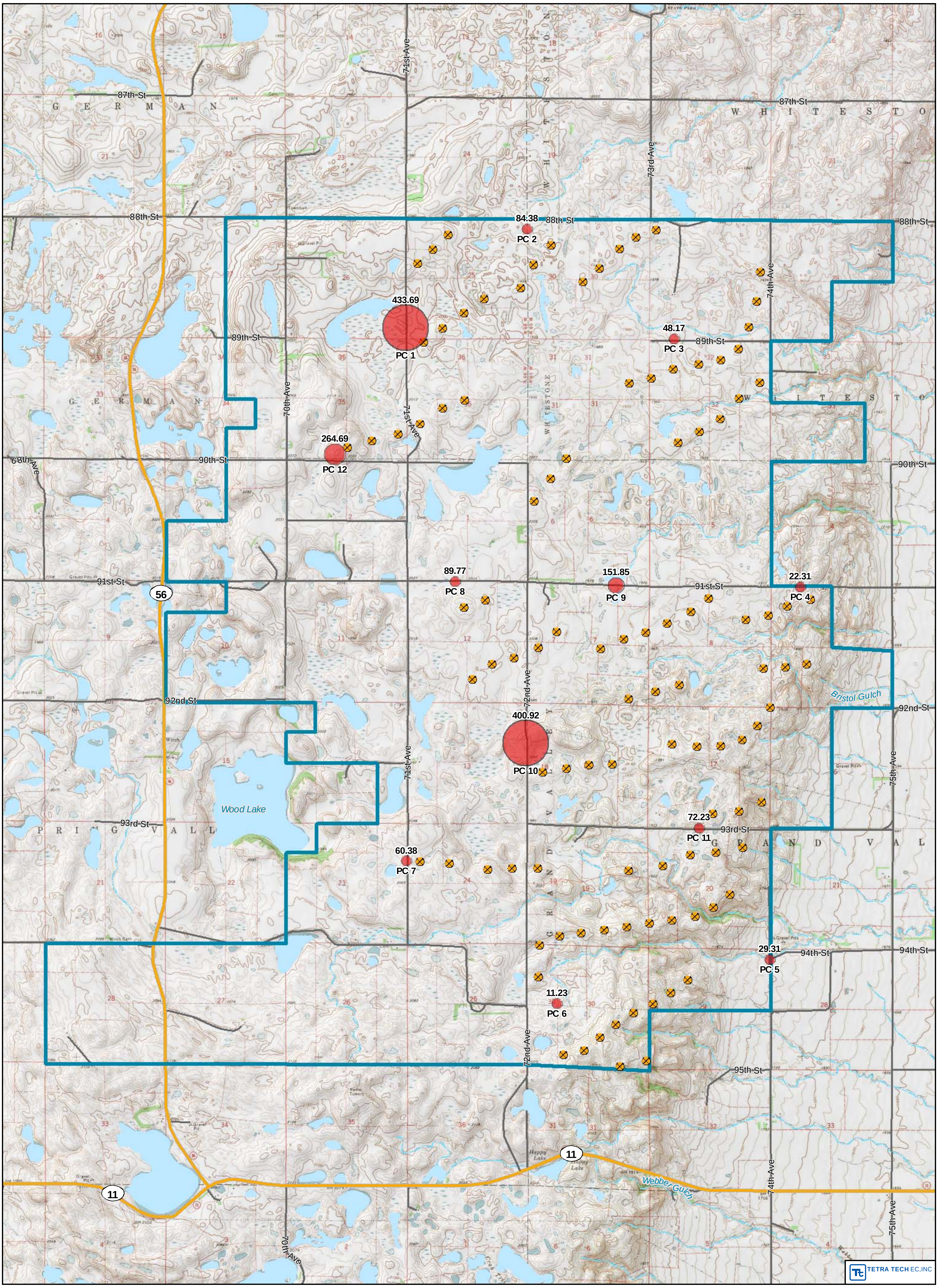


Figure 4. Non Raptor Mean Use by Point

Dickey County, ND

November 18, 2008

FPL Energy

1:48,000

NAD 83 UTM Zone 14 North

0 0.5 1

Miles

Non-Raptors per 20 Minutes

- 0.01 - 90
- 90.01 - 180
- 180.01 - 270
- 270.01 - 360
- 360.01 - 433.69

\# Mean Use Value

PC# Point Count Number

Project Facilities

- Project Area
- Turbines

Water Bodies

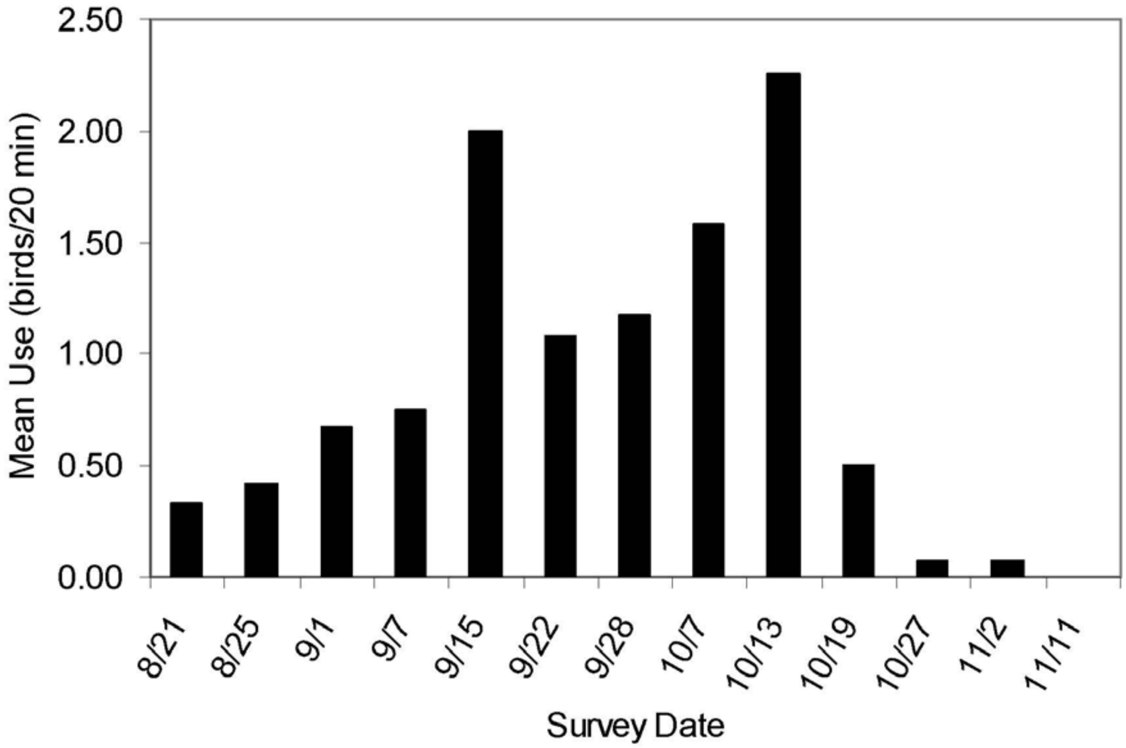
- Perennial Stream
- Intermittent Stream
- Lake/Reservoir

Transportation

- Interstate
- Highway
- Major Road
- Local Road

P:\GIS_PROJECTS\FPL\Rough_Rider_I\maps\Figure_4_Non_Raptor_Mean_Use_by_Point_111808.mxd - Last Accessed: 11/18/2008 - Map Scale correct at: Tabloid (11" x 17")

Figure 5: Raptor mean use by survey date (fall 2008)



3.4 Frequency of Occurrence

The mallard (detected in 32.9 percent of all surveys), barn swallow (detected in 31.0 percent of all surveys), and American coot (detected in 25.8 percent of all surveys) were the most commonly observed non-raptor species (Table 3). The mallard was detected at every point count location except for point 5, the barn swallow was detected at every point, and the American Coot was detected at 6 of the 12 points (Table 4).

Of the raptor species, the red-tailed hawk was detected in 23.2 percent of all surveys while the northern harrier was detected in 22.6 percent of all surveys (Table 3). All other raptor species were detected in less than 8.5 percent of surveys. The red-tailed hawk was detected at every point count location except for point 4, while the northern harrier was detected at every point count location (Table 4).

3.5 Flight Height and Encounter Rate

During fall avian use surveys, ornithologists collected behavioral data for 100 percent of birds observed during point count surveys. Ornithologists observed 41.8 percent of birds flying and collected flight height and direction data for 100 percent of observations. Of non-raptor species observed flying, 20.7 percent flew below the anticipated RSA, 55.3 percent flew within the anticipated RSA, and 24.0 percent flew above the anticipated RSA (Table 5). Of raptor species observed flying, 40.3 percent flew below the anticipated

RSA, 44.4 percent flew within the anticipated RSA, and 15.3 percent flew above the anticipated RSA. Data on flight direction are located in Appendix 1.

The ring-billed gull had the highest encounter rate of identified species (4.36 birds flying within the RSA/20 min), followed by the mallard (2.97 birds flying within the RSA/20 min), snow goose (2.94 birds flying within the RSA/20 min), tree swallow (2.55 birds flying within the RSA/20 min), blue-winged teal (2.49 birds flying within the RSA/20 min), and the Canada goose (2.44 birds flying within the RSA/20 min; Table 6). All remaining identifiable species had an encounter rate of 1.40 birds flying within the RSA/20 min or less.

3.6 Incidental Observations

Ornithologists documented 34 identified and a single unidentified species as incidental observations, for a total of 10,228 birds (Table 7). The red-winged blackbird was the most commonly recorded incidental species (6,970 birds). Ornithologists documented 5 incidental species that were not detected during fall point count surveys: canvasback, golden eagle, sharp-shinned hawk, great horned owl, and the American bittern (Table 7).

4.0 DISCUSSION AND CONCLUSIONS

4.1 Non-Raptor Use and Encounter Rate

Overall use by non-raptors at the Rough Rider I WRA was very high during the fall 2008 surveys (139.66 birds/20 min), and was composed primarily of the waterfowl and waterbirds groups. Comparing fall non-raptor use rates that have been publicly reported for existing wind energy facilities throughout the country, the Rough Rider I WRA ranked first out of 21 studies (Table 8; Figure 7). The mean use at the Rough Rider I WRA was four times higher then the next highest ranking WRA (the Sunshine Wind Park in Arizona, which had a non-raptor mean use of 33.29 birds/20 min in fall; Table 8). This very high non-raptor mean use is likely due to the proposed placement of the WRA within an area dominated by large wetlands and waterbodies, along with abundant native prairies and agricultural fields, which are used by migratory and breeding waterfowl/waterbirds. In addition, this general region of the Dakotas is considered the most productive waterfowl nesting habitat in North America (Kaminski and Weller 1992). The U.S. Fish and Wildlife Service (USFWS) Kulm Wetland Management District’s Waterfowl Breeding Pairs Distribution Map shows the area in and around the Rough Rider I WRA as having some of the highest duck pair densities in the district (USFWS 2007). The abundant hay and grain crops found within the agricultural fields are often utilized by migrating waterfowl species as a food resource, thereby attracting waterfowl to areas outside of the wetland/waterbodies (Cleary 1994). The plentiful wetland habitat and agricultural fields within the WRA are an attractant to waterfowl and other migrating birds and may increase the potential risk for collision with turbines (see below) and their distribution across the WRA may make micrositing to avoid these areas challenging.

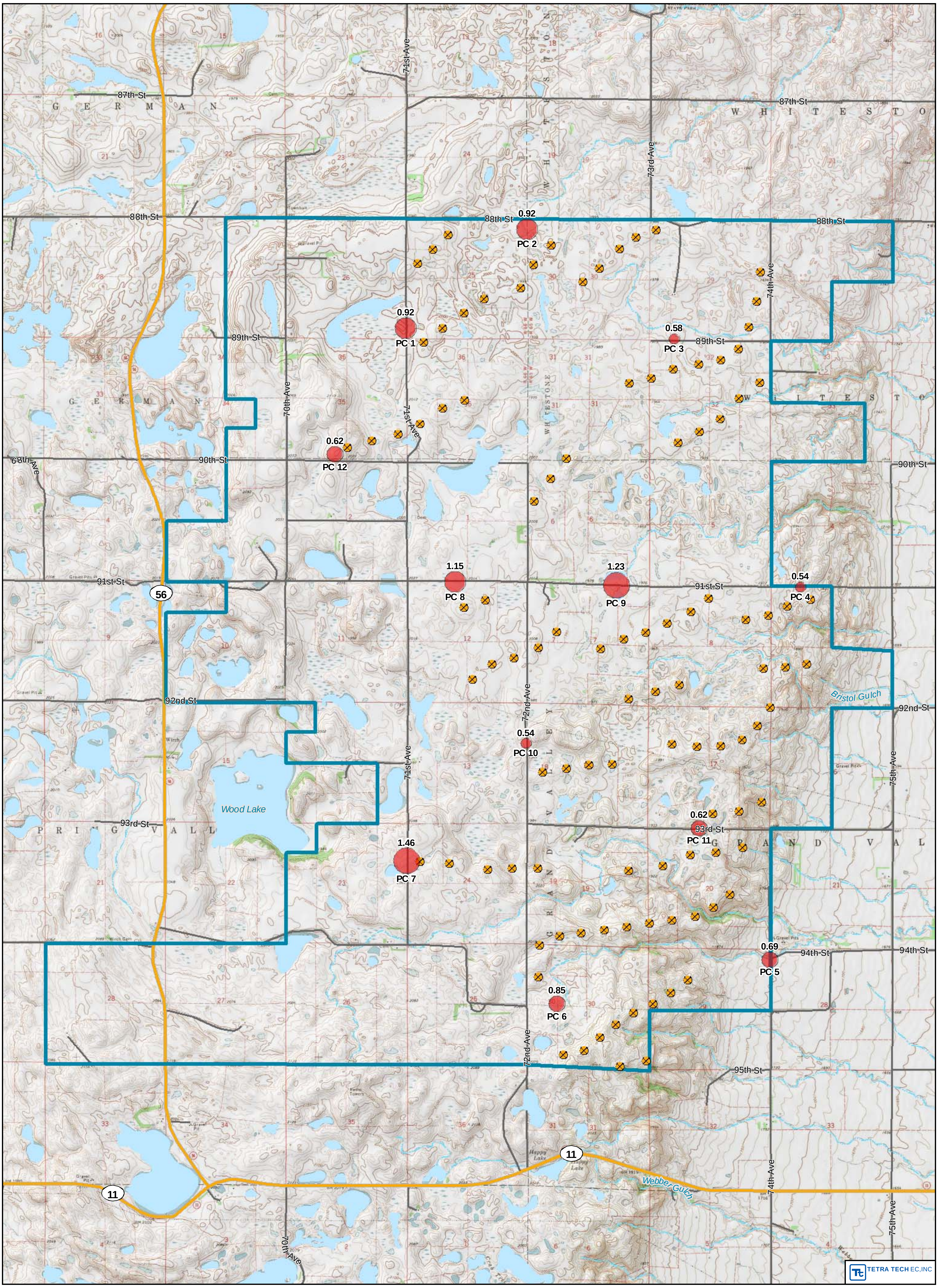


Figure 6. Raptor Mean Use by Point
Dickey County, ND
November 18, 2008

1:48,000
NAD 83 UTM Zone 14 North
0 0.5 1
Miles

Raptors per 20 Minutes
- 0.0 - 0.6
- 0.61 - 0.9
- 0.91 - 1.2
- 1.21 - 1.46
- # Mean Use Value
- PC# Point Count Number

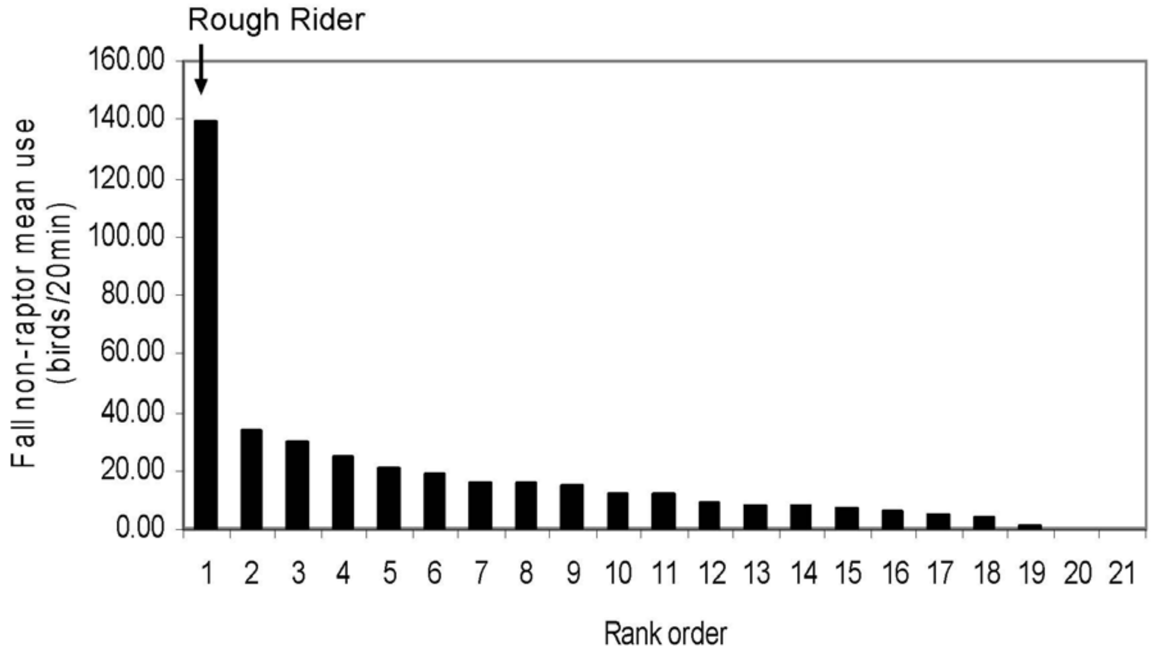
Project Facilities
- Project Area
- Turbines

Water Bodies
- Perennial Stream
- Intermittent Stream
- Lake/Reservoir

Transportation
- Interstate
- Highway
- Major Road
- Local Road

P:\GIS_PROJECTS\FPL\Rough_Rider_I\maps\Figure_6_Raptor_Mean_Use_by_Point_111808.mxd - Last Accessed: 11/18/2008 - Map Scale correct at: Tabloid (11" x 17")

Figure 7: Comparison of non-raptor mean use at Rough Rider I WRA to other mean use studies at wind projects



The very high non-raptor mean use recorded at the Rough Rider I WRA was primarily driven by waterfowl and waterbirds. The species of waterfowl and waterbirds that had a high encounter rate (greater than 1.00 bird flying within the RSA/20 min) included the mallard, snow goose, blue-winged teal, Canada goose, and double-crested cormorant (Table 6). To date, studies of waterfowl have shown that mortalities of geese have been low in proportional to their use (Jain 2005). However, no studies have been published that document the relationship between mean use and mortality of ducks. Duck fatalities have been found in low numbers during mortality monitoring (Erickson et al. 2002); however, these studies have not been conducted in areas of high duck mean use. If mortality is proportional to mean use, fatalities at this site could be high; however, if mortality patterns are similar to geese, fatalities at this site could be lower than use indicates. The populations of these five species are not in decline within North Dakota (PIF 2007; NatureServe 2008); therefore, moderate levels of individual mortality are not likely to have population-level effects. However, the WRA falls within the Prairie Pothole Region; according to Ducks Unlimited, this region is the most important waterfowl habitat on the continent. As a consequence, any waterfowl mortality will likely elicit concern from regulatory agencies.

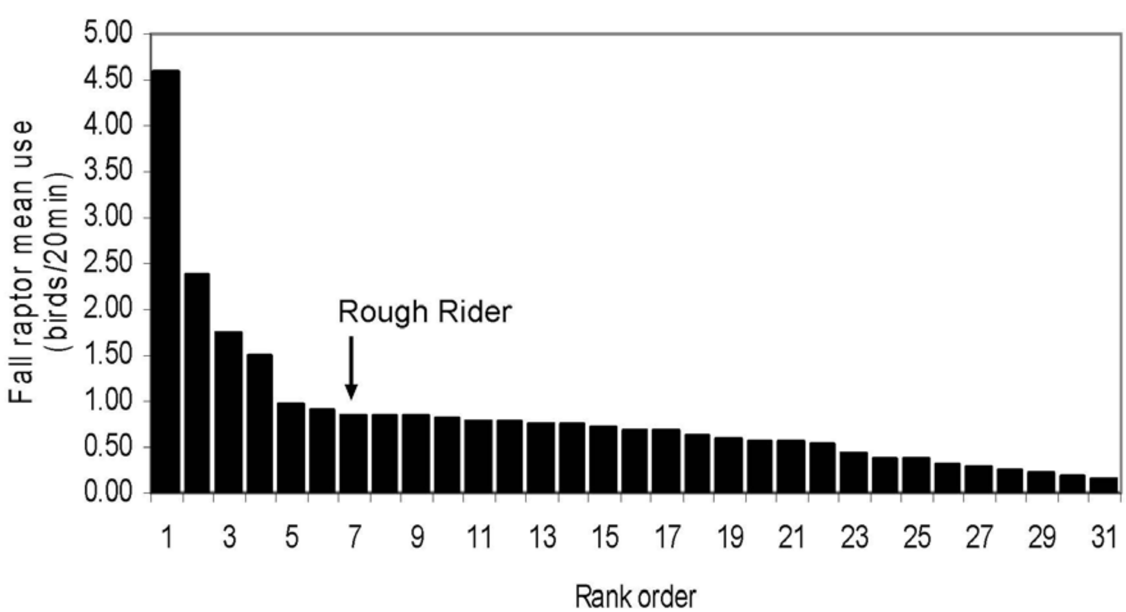
Songbirds are typically the most common species detected at WRAs, and are found more often in post-construction mortality monitoring compared to other groups of birds (Erickson et al. 2001, Drewitt and Langston 2006, Johnson et al. 2007a, Strickland and Morrison 2008); however, songbird were not as abundant at the Rough Rider I WRA when compared to other groups. The two songbirds detected during fall surveys that had high encounter rates were the tree swallow and red-winged blackbird. These two species are widespread and have large stable populations in North Dakota (PIF 2007; NatureServe 2008); therefore, local mortality is unlikely to have population-level consequences on these two species.

The ring-billed gull, from the gull/tern group, had the highest encounter rate recorded of identifiable species at the Rough Rider I WRA. Although gulls have been found during post-construction mortality monitoring at existing wind facilities (Anderson et al. 2005, Drewitt and Langston 2006), mortality rates, to date, have not been high. Thus, potential interactions with turbines may result in individual fatalities; however, due to the gull's stable to increasing population potential impacts are unlikely to have population-level impacts.

4.2 Raptor Use and Encounter Rate

Raptor mean use at the Rough Rider I WRA was 0.85 birds/20 min, and ranked 7 out of 31 when compared to the fall rates reported at existing wind energy facilities throughout the country (Table 8; Figure 8). Erickson (2007) defines raptor mean use as high when it is greater than 2.00 birds/20 min and low when it is less then 1.00 bird/20 min. High raptor use has been associated with high raptor mortality at wind farms (Erickson 2007); however, the strength of this conclusion is based on 2 data points for high raptor use. Conversely, raptor mortality appears to be low when raptor use is low (as defined by Erickson 2007 as less than 1.00 birds/20 min). Under Erickson's (2007) definition of high/low raptor mean use, the Rough Rider I WRA would rank as low.

Figure 8: Comparison of raptor mean use at Rough Rider I WRA to other mean use studies at wind projects



The red-tailed hawk was the most commonly detected raptor species during fall surveys, and was observed at all but one point count location. Although this species had the highest encounter rate recorded for a raptor species at the WRA (0.19 birds flying within the RSA/20 min), this species' encounter rate was still relatively low when compared to all other avian species detected at the WRA. There are an estimated 34,000 red-tailed hawks within North Dakota, and the North Dakota populations are not considered at risk (PIF 2007; NatureServe 2008). The red-tailed hawk's low encounter rate, coupled with its large, stable, population, suggests that impacts with turbines are unlikely to result in population-level consequences.

Other raptor species detected during fall point count surveys included the northern harrier Swainson's hawk, broad-winged hawk, merlin, bald eagle, turkey vulture, ferruginous hawk, and American kestrel. These species had encounter rates of less than 0.05 birds flying within the RSA/20 min, indicating that the potential for negative turbine-related impacts to these species is low. Two golden eagles were observed during incidental surveys, and did not have an encounter rate calculated.

4.3 Listed and Sensitive Species

Both the golden eagle and bald eagle were detected during fall surveys. These two species are federally protected under the Bald and Golden Eagle Protection Act (BGEPA), which prohibits wounding, killing, molesting, or disturbing eagles, even if the harm to the eagle is the result of otherwise legal activities (16U.S.C 668a-d). To date, the USFWS has used discretion in enforcing the BGEPA, and has not prosecuted if a company shows good faith to reduce impacts to eagles; however, a company may be referred for prosecution if suggestions made by the USFWS are ignored (United States Government Accountability Office 2005). Currently, there is no permitting process available in order to allow for the incidental take of eagles during construction or operation of any proposed action; however, the USFWS anticipates modifications to the BGEPA that will allow for incidental take permits at some point.

As the two golden eagles were only detected during incidental surveys, no encounter rate was calculated. Golden eagles have been recorded to have high mortality rates at 'old generation' wind energy facilities that use wind turbines with smaller rotor blades compared to those used on modern turbines (Hunt 2002). Although bird mortality rates are lower at wind energy facilities that use modern turbines, golden eagle mortality has not been completely eliminated by advances in turbine technology (Kerlinger et al. 2005). Golden eagles are more likely to be struck by turbine blades while they are hunting. However, due to the golden eagle's low use of the area during fall, negative turbine-related impacts are unlikely during this season. The three bald eagles had an encounter rate of 0.01 birds flying within the RSA/20 min. To date, no bald eagles have been found during post-construction mortality monitoring at a WRA, indicating that negative turbine-related impacts are unlikely for this species.

North Dakota does not maintain a state list of threatened and endangered species which differs from the ESA federal list; instead North Dakota has identified 100 Species of Conservation Priority within their Comprehensive Wildlife Conservation Strategy (Hagen et al. 2005). This list does not carry any regulatory or enforcement authority and is only intended to aid in conservation efforts. The species on this list are ranked in three priority levels based on status, funding availability, and presence of breeding habitat within North

Dakota (Hagen et al. 2005). The highest rank is Level 1 which contains species having a high level of conservation priority because of declining status either in North Dakota or across their range. Species can also be listed as Level 1 if North Dakota contains the core of the species' breeding range, they are at-risk range wide, and non- State Wildlife Grants funding is not readily available to them. Eight species listed as Level I were detected during fall surveys: American white pelican, American bittern, Swainson's hawk, ferruginous hawk, Wilson's phalarope, Franklin's gull, black tern, grasshopper sparrow. Except for the American bittern, which was only detected as an incidental and did not have an encounter rate calculated, these species all had low encounter rates, which were less than 1.00 bird flying within the RSA/20 min (Table 6). This suggests that impacts with turbines are unlikely to result in population-level consequences for these eight sensitive species.

4.4 Potential Impacts to Avian Species

The possible impacts to avian species from the construction and operation of the Rough Rider I 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. 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 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 to heights of 80 to 250 m (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 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. To date, one study is underway within the WRA to assess potential displacement to breeding ducks.

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 been charged for violations of the MBTA.

4.5 Rough Rider I WRA Conclusions

Non-raptor mean use during the fall was very high, ranking first out of 21 when compared to other mean use studies conducted at wind generation facilities throughout the country. This very high mean use was due to large numbers of waterfowl/waterbirds using the abundant wetlands, waterbodies, agricultural fields, and native prairies found throughout the WRA. Due to the very high mean use at the Rough Rider I WRA, abundant suitable habitat which serves as an attractant to these species, and the elevated encounter rates for waterfowl and waterbirds, the potential exists for turbine related mortalities. To date, studies of waterfowl have shown that mortalities of geese have been low in proportional to their use (Jain 2005). However, no studies have been published that document the relationship between mean use and mortality of ducks. Duck fatalities have been found in low numbers during mortality monitoring (Erickson et al. 2002);

however, these studies have not been conducted in areas of high duck mean use. If mortality is proportional to mean use, fatalities at this site could be high; however, if mortality patterns are similar to geese, fatalities at this site could be lower than use indicates.

The waterfowl and waterbird groups were not the only non-raptor group which contained species with high encounter rates. The ring-billed gull (from the gull/tern group), and the tree swallow and the red-winged blackbird (from the songbird group) had high encounter rates. These are common, widespread species; therefore, potential turbine-related fatalities are unlikely to result in population-level impacts.

Encounter rates were low for raptor species. The red-tailed hawk had the highest encounter rate recorded for a raptor species; however, this species' encounter rate was still relatively low (0.19 birds flying within the RSA/20 min). The red-tailed hawk's low encounter rate, coupled with its large and stable population, suggests that impacts with turbines are unlikely to result in population-level consequences. All other raptor species had encounter rates of less than 0.05 birds flying within the RSA/20 min, indicating that the potential for negative turbine-related impacts to these species is low.

Both the golden eagle and bald eagle were detected during fall surveys. These two species are federally protected under the BGEPA. Due to the golden eagle's low use of the area during fall, negative turbine-related impacts are unlikely during this season. The three bald eagles detected at the WRA had a low encounter rate (0.01 birds flying within the RSA/20 min). In addition, no bald eagles have been found during post construction mortality monitoring at a WRA, indicating that negative turbine-related impacts are unlikely for this species.

Eight species listed as level 1 under North Dakota's list of 100 Species of Conservation Priority were detected during fall surveys: American white pelican, American bittern, Swainson's hawk, ferruginous hawk, Wilson's phalarope, Franklin's gull, black tern, grasshopper sparrow. Except for the American bittern, which was only detected as an incidental and did not have an encounter rate calculated, these species all had low encounter rates, indicating that negative turbine-related impacts are unlikely for these eight sensitive species.

5.0 REFERENCES

Anderson, R., J. Tom, N. Neumann, W.P. Erickson, M.D. Strickland, M. Bourasse, K.J. Bay, and K.J. Sernka. 2005. Avian monitoring and risk assessment at the San Gorgonio Wind Resource Area. Technical report prepared by State Energy Resources Conservation and Development Commission and Western EcoSystems Technology, Inc. for National Renewable Energy Laboratory. Golden, CO.

Arnett, E.B., D.B. Inkley, D.H. Johnson, R.P. Larkin, S. Manes, A.M. Manville, J.R. Mason, M.L. Morrison, M.D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat.Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, MA.

Ballam, J.M. 1984. The use of soaring by the red-tailed hawk (*Buteo jamaicensis*). Auk 3:519-524.

Beveridge, L.J. 2005. The Migratory Bird Treaty Act and wind development. North American Wind Power September:36-38.

Cleary, E.C. 1994. The handbook: prevention and control of wildlife damage. University of Nebraska, Lincoln, USA. Available online at:

http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1072&context=icwdm handbook.

Drewitt, A.L., and R.H.W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148:29-42.

Erickson, W.P. 2007. Summary of methods and results for prediction and estimation of impacts and risk. Presented at NWCC Probability of Impact Workshop, 13 November 2007, Golden, CO.

Erickson, W.P., G.D. Johnson, and D.P. Young, Jr. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Final Report, July 2001—December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee.

Erickson, W.P., J. Jeffrey, D. Young, K. Bay, R. Good, and K. Sernka. 2003a. Wildlife Baseline Study for the Kittitas Valley Wind Project. Prepared for Zilkha Renewable Energy.

Erickson, W.P., D. Young, G. Johnson, J. Jeffrey, K. Bay, R. Good, and H. Sawyer. 2003b. Wildlife Baseline Study for the Wild Horse Wind Project, Summary of Results from 2002-2003 Wildlife Surveys. Prepared for Zilkha Renewable Energy, Portland, OR.

Erickson, W.P., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality information from proposed and existing wind developments. Technical report prepared by WEST, Inc., for Bonneville Power Administration, Portland, OR.

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young Jr., K.J. Sernka, and R E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, Washington, DC.

Faanes, C.A., and R. E. Stewart. 1982. Revised checklist of North Dakota birds. The Prairie Naturalist 14:81-92. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/birds/chnbird/chnbird.htm (Version 16JUL97).

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

Hunt, G. 2002. Golden eagles in a perilous landscape: predicting the effects of mitigation for wind turbine blade-strike mortality. California Energy Commission Report, P500-02-043F.

Jain, A. 2005. Bird and bat behavior and mortality at a northern Iowa wind farm. Thesis. Iowa State University, Ames, IA.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project postconstruction bird and bat fatality study—2006. Prepared by Curry and Kerlinger, LLC for PPM Energy, Horizon Energy, and Technical Advisory Committee for the Maple Ridge Project.

Jeffrey, J.D., V.K. Poulton, K.J. Bay, K.F. Flaig, C.C. Roderick, W.P. Erickson, and J.E. Baker. 2007. Wildlife and Habitat Baseline Study for the Proposed Vantage Wind Power Project, Kittitas County, Washington. Prepared for Invenergy.

Johnson, G.D. 2007. Cumulative impacts analysis for birds and bats from existing and permitted wind energy projects in Klickitat County, Washington. Technical report submitted to Windy Point Partners.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2007a. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879-887.

Johnson, G.D., J. Jeffrey, J. Baker, and K. Bay. 2007b. Baseline Avian Studies for the Windy Flats Wind Energy Project, Klickitat County Washington. Prepared for Windy Point Partners.

Johnson, G.D., V. Poulton, and K. Bay. 2007c. Baseline Ecological Studies for the Sand Ridge Wind Energy Project Klickitat County Washington. Prepared for Northwest Wind Partners.

Johnson, G.D., J. Baker, and K. Bay. 2007d. Baseline Ecological Studies for the Lower Linden Ranch Wind Energy Project Klickitat County Washington. Prepared for Northwest Partners.

Johnson, G.D., W.P Erickson, and J.D. Jeffrey. 2006a. Analysis of potential wildlife impacts from the Windy Point wind energy project, Klickitat County, Washington. Technical Report prepared by Western EcoSystems Technology, Inc., for Ecology and Environment, Portland, OR.

Johnson, G.D., J. Jeffrey, V. Poulton, and K. Baker. 2006b. Baseline Ecological Studies for the Hoctor Ridge Wind Energy Project Klickitat County Washington. Prepared for Windtricity Ventures.

Johnson, G.D., and W.P. Erickson. 2004. Analysis of Potential Wildlife/Wind Plant interactions Bighorn Site Klickitat County Washington. Prepared for CH2M Hill.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879-887.

Johnson, G.D., D.P. Young, Jr., W.P. Erickson, C.E. Derby, M.D. Strickland, and R.E. Good. 2000. Wildlife monitoring studies, SeaWest Windpower Project, Carbon County, Wyoming. 1995-1999. Technical Report prepared by Western EcoSystems Technology, Inc., for SeaWest Energy Corporation and Bureau of Land Management.

Kaminski, R. and M. Weller. 1992. Breeding habitats of nearctic waterfowl. Pages 568-589 in B. Batt, A. Afton, M. Anderson, C. Ankney, D. Johnson, and G. Krapu, editors. The ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis.

Kerlinger, P., L. Culp, and R. Curry. 2005. Post construction avian monitoring study for the High Winds Wind Power Project, Solano County, California. Prepared for High Winds, LLC. FPL Energy.

Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual report for 2003. Technical report prepared by Curry and Kerlinger, LLC for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee.

Kronner, K., B. Gritski, J. Baker, V. Marr, G. Johnson, B. Kimberl, R. Good, and E. Lack. 2005a. Ecological Baseline Studies and Wildlife Impact Assessment for the White Creek Wind Power Project. Prepared for Last Mile Electric Cooperative.

Kronner, K., B. Gritski, J. Baker, V. Marr, G. Johnson, and B. Kimberly. 2005b. Wildlife Baseline Study for the Learning Juniper Wind Power Project Gilliam County Oregon. Prepared for PPM Energy and CH2M Hill.

Leddy, K.L., K.F. Higgins, and D.E. Naugle. 1999. Effects of wind turbines on upland nesting birds in CRP grasslands. Wilson Bulletin 111:100-104.

Mabee, T.J., B.A. Cooper, and C. Grinnell. 2005. Baseline Avian Use at the Klondike III Wind Project, Oregon, Winter 2004/2005. Prepared by ABR, Inc.—Environmental Research and Services for David Evans & Associates, Inc.

Manville, A.M., II. 2004. Prairie grouse leks and wind turbines: U.S. Fish and Wildlife Service justification for a 5-mile buffer from leks; additional grassland songbird recommendations. Division of Migratory Bird Management, USFWS, Arlington, VA, peer-reviewed briefing paper.

NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available online at http://www.natureserve.org/explorer.

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County Wind Resource Areas, 1989-1991. Final report prepared by Biosystems Analysis, Inc. for Alameda, Contra Costa, and Solano Counties and the California Energy Commission.

Pickwell, B. 1931. The prairie horned lark. St. Louis Academy of Sciences Transactions 27:1-153.

PIF (Partners in Flight). 2007. PIF Landbird Population Estimates Database. Available online at http://rmbo.org/pif_db/laped/PED3.aspx

Pitman, J.C., C.A. Hagen, R.J. Robel, T.M. Loughin, and R.D. Applegate. 2005. Location and success of lesser prairie-chicken nests in relation to vegetation and human disturbance. Journal of Wildlife Management 69:1259-1269.

Smallwood, K. S. and C. G. Therlander. 2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report by BioResouce Consultants to the California Energy Commission, Public Interest Energy-Research Environmental Area, 500-01-019.

Strickland, D., and M.L. Morrison. 2008. A summary of avian/wind facility interactions in the U.S. Federal Guidelines Committee for Wind Siting Guidelines, February 26, 2008, Washington, DC.

Thompson, W.L. 2002. Towards reliable bird surveys: accounting for individuals present but not detected. Auk 119:18-25.

URS Corporation and WEST (Western EcoSystems Technology, Inc.). 2001. Avian baseline study for the Stateline Project. Prepared for ESI Vansycle Partners, L.P.

USDI (United States Department of the Interior) and BLM (Bureau of Land Management, Twin Falls District, Burley Field Office). 2005. Draft environmental impact statement for the proposed Cotterel Wind Power Project and draft resource management plan amendment Burley, Cassia County, Idaho.

USFWS (U.S. Fish and Wildlife Service). 2008. Flyways. Retrieved from: http://flyways.us/flyways/central.

USFWS (U.S. Fish and Wildlife Service). 2007. Chase Lake Wetland Management District Duck Pair Density Maps. Available online at:

http://www.fws.gov/arrowwood/ChaseLake%5FWMD/duck_pair_maps.html.

United States Government Accountability Office. 2005. Wind Power - Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife. GAO-05-906

USGS (United States Geological Survey). 2007. Ecoregions of North Dakota and South Dakota. Northern Prairie Wildlife Research Center. Available online at: http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/nodak.htm.

Welch, R., and L. Schleder. 2006. Wildlife Assessment for the Shepherds Flat Wind Farm. Prepared for Lifeline Renewable Energy.

WEST (Western Ecosystems Technology Inc), Colorado Plateau Research Station, and Ecological Monitoring & Assessment Program. 2006. Avian and Biological Studies for the Proposed Sunshine Wind Park, Coconino County, AZ.

WEST (Western EcoSystems Technology Inc.). 2005a. Ecological Baseline Study at the Elkhorn Wind Power Project. Prepared fro Zikha Renewable Energy.

WEST (Western EcoSystems Technology, Inc.). 2005b. Wildlife and habitat baseline study for the proposed Biglow Canyon wind power project, Sherman County, Oregon. Prepared for Orion Energy LLC.

WEST (Western EcoSystems Technology Inc.) and NWC (Northwest Wildlife Consultants). 2004. Stateline wildlife monitoring final report. July 2001-December 2003. Prepared for FPL Energy, Stateline Technical Advisory Committee, and Oregon Department of Energy.

Young, D.P., G.D. Johnson, V.K. Poulton, and K. Bay. 2007a. Ecological Baseline Studies for the Hatchet Ridge Wind Energy Project Shasta County California. Prepared for Hatchet Ridge Wind.

Young, D.P., K.P. Victoria, and K. Bay. 2007b. Ecological Baseline Studies Report Proposed Dry Lake Wind Project Navajo County Arizona. Prepared for PPM Energy.

Young, D.P., C.S. Nations, V.K. Poulton, J. Kerns, and L. Pavilonis. 2006. Avian and Bat Studies for the Proposed Dairy Hills Wing Project, Wyoming County, New York. Prepared for Horizon Wind Energy.

Young, D.P., Jr., W.P. Erickson, R.E. Good, M.D. Strickland, and G.D. Johnson. 2003. Avian and bat mortality associated with the initial phase of the Foote Creek Rim Wind Power Project, Carbon County, Wyoming: November 1998 - June 2002. Technical Report prepared by WEST, Inc. for Pacificorp, Inc., SeaWest Windpower, Inc. and Bureau of Land Management.

Young, D., W. Erickson, K. Bay, R. Good, and K. Kronner. 2002a. Baseline avian studies for the proposed Maiden Wind Farm, Yakima and Benton Counties, Washington. Final Report prepared for Bonneville Power Administration.

Young, D., W. Erickson, J.D. Jeffrey, K. Bay, and M. Bourassa. 2002b. Avian and Sensitive Species Baseline Study Plan and Interim Report TPC Combine Hills Turbine Ranch Umatilli County Oregon. Prepared for Tomen Power Corporation USA.

Tetra Tech personnel involved in preparation of report:

John Crookston	**11/20/2008**
Report Author	Date
Jason Jones	**11/20/2008**
Peer Review #1	Date
Laura Nagy	**11/25/2008**
Peer Review #2	Date
Anne-Marie Griger	**12/03/2008**
Deputy Project Manager	Date
Tracey Martorano	**12/11/2008**
Project Manager	Date
Peter Omdal	**N/A**
GIS Technician	Date

TABLES

Table 1. Rough Rider I Wind Resource Area, Fall 2008 point count survey dates.

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

Table 2. Avian species observed during Fall point count surveys at the Rough Rider I 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
mallard	5785	67	37.32	(17.78-56.86)	32.9	26.6%
American coot	3197	53	20.63	(9.79-31.47)	25.8	14.7%
snow goose	1985	12	12.81	(3.79-21.83)	5.2	9.1%
unidentified duck	1269	15	8.19	(3.47-12.91)	8.4	5.8%
blue-winged teal	1189	30	7.67	(2.86-12.48)	16.1	5.5%
Canada goose	1053	25	6.79	(1.65-11.93)	12.9	4.8%
unidentified gull	780	3	5.03	(0.00-11.99)	1.9	3.6%
ring-billed gull	714	13	4.61	(0.00-9.78)	7.7	3.3%
barn swallow	600	50	3.87	(2.34-5.40)	31.0	2.8%
double-crested cormorant	475	16	3.06	(0.70-5.42)	9.7	2.2%
lesser scaup	468	10	3.02	(0.88-5.16)	6.5	2.1%
tree swallow	395	2	2.55	(0.00-6.53)	1.3	1.8%
American white pelican	300	12	1.94	(0.45-3.43)	7.1	1.4%
green-winged teal	295	15	1.90	(0.86-2.94)	9.7	1.4%
Lapland longspur	294	7	1.90	(0.50-3.30)	4.5	1.3%
brown-headed cowbird	284	4	1.83	(0.00-4.20)	2.6	1.3%
common grackle	263	4	1.70	(0.00-3.40)	2.6	1.2%
unidentified songbird	260	3	1.68	(0.00-3.47)	1.9	1.2%
red-winged blackbird	259	15	1.67	(0.45-2.89)	9.0	1.2%
ruddy duck	184	10	1.19	(0.22-2.16)	5.2	0.8%
American goldfinch	175	12	1.13	(0.14-2.12)	7.7	0.8%
Franklin's gull	153	4	0.99	(0.00-2.06)	2.6	0.7%
unidentified swallow	100	2	0.65	(0.00-1.57)	1.3	0.5%
northern shoveler	94	8	0.61	(0.12-1.10)	5.2	0.4%
European starling	92	4	0.59	(0.00-1.30)	2.6	0.4%
horned lark	89	6	0.57	(0.00-1.32)	3.2	0.4%
ring-necked duck	79	6	0.51	(0.06-0.96)	3.9	0.4%

Table 2. Avian species observed during Fall point count surveys at the Rough Rider I 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
northern pintail	77	5	0.50 (0.00-1.14)	3.2	0.4%
savannah sparrow	70	4	0.45 (0.00-1.14)	2.6	0.3%
American wigeon	67	3	0.43 (0.00-0.92)	1.9	0.3%
pied-billed grebe	55	12	0.35 (0.13-0.57)	7.7	0.3%
red-tailed hawk	49	45	0.32 (0.23-0.41)	23.2	0.2%
bufflehead	49	2	0.32 (0.00-0.80)	1.3	0.2%
gadwall	47	3	0.30 (0.01-0.59)	1.9	0.2%
northern harrier	38	37	0.25 (0.19-0.31)	22.6	0.2%
American robin	38	3	0.25 (0.00-0.53)	1.9	0.2%
yellow-headed blackbird	36	5	0.23 (0.00-0.50)	3.2	0.2%
ring-necked pheasant	35	7	0.23 (0.00-0.57)	1.9	0.2%
bank swallow	35	2	0.23 (0.00-0.49)	1.3	0.2%
western meadowlark	33	18	0.21 (0.11-0.31)	11.0	0.2%
pine siskin	30	2	0.19 (0.00-0.46)	1.3	0.1%
tundra swan	28	6	0.18 (0.03-0.33)	3.2	0.1%
cliff swallow	20	3	0.13 (0.00-0.27)	1.9	0.1%
redhead	17	2	0.11 (0.00-0.27)	1.3	0.1%
killdeer	16	9	0.10 (0.03-0.17)	5.8	0.1%
Swainson's hawk	14	14	0.09 (0.05-0.13)	8.4	0.1%
northern rough-winged swallow	14	5	0.09 (0.01-0.17)	3.2	0.1%
eastern bluebird	14	2	0.09 (0.00-0.20)	1.3	0.1%
vesper sparrow	13	3	0.08 (0.00-0.17)	1.9	0.1%
western kingbird	12	3	0.08 (0.01-0.15)	1.9	0.1%
northern flicker	12	6	0.08 (0.01-0.15)	3.2	0.1%
sharp-tailed grouse	10	5	0.06 (0.01-0.11)	3.2	0.0%
mourning dove	9	6	0.06 (0.02-0.10)	3.9	0.0%
broad-winged hawk	8	7	0.05 (0.01-0.09)	2.6	0.0%

Table 2. Avian species observed during Fall point count surveys at the Rough Rider I 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
Wilson's phalarope	7	1	0.05 (0.00-0.12)	0.6	0.0%
unidentified buteo	7	5	0.05 (0.02-0.08)	3.2	0.0%
dark-eyed junco	7	2	0.05 (0.00-0.11)	1.3	0.0%
common nighthawk	7	2	0.05 (0.00-0.11)	1.3	0.0%
American crow	7	2	0.05 (0.00-0.11)	1.3	0.0%
unidentified sandpiper	6	1	0.04 (0.00-0.10)	0.6	0.0%
spotted sandpiper	6	1	0.04 (0.00-0.10)	0.6	0.0%
merlin	5	5	0.03 (0.01-0.05)	3.2	0.0%
eastern kingbird	5	3	0.03 (0.00-0.06)	1.9	0.0%
black tern	5	1	0.03 (0.00-0.08)	0.6	0.0%
lesser yellowlegs	4	3	0.03 (0.00-0.06)	1.9	0.0%
great egret	4	2	0.03 (0.00-0.06)	1.3	0.0%
American tree sparrow	4	2	0.03 (0.00-0.06)	1.3	0.0%
northern shrike	3	3	0.02 (0.00-0.04)	1.9	0.0%
herring gull	3	1	0.02 (0.00-0.05)	0.6	0.0%
great blue heron	3	3	0.02 (0.00-0.04)	1.9	0.0%
bald eagle	3	3	0.02 (0.00-0.04)	1.9	0.0%
turkey vulture	2	2	0.01 (0.00-0.02)	1.3	0.0%
rough-legged hawk	2	2	0.01 (0.00-0.02)	1.3	0.0%
grasshopper sparrow	2	2	0.01 (0.00-0.02)	1.3	0.0%
common merganser	2	1	0.01 (0.00-0.03)	0.6	0.0%
black-crowned night-heron	2	2	0.01 (0.00-0.02)	1.3	0.0%
unidentified shorebird	1	1	0.01 (0.00-0.02)	0.6	0.0%
unidentified hawk	1	1	0.01 (0.00-0.02)	0.6	0.0%
gray partridge	1	1	0.01 (0.00-0.02)	0.6	0.0%
ferruginous hawk	1	1	0.01 (0.00-0.02)	0.6	0.0%
blue jay	1	1	0.01 (0.00-0.02)	0.6	0.0%

Table 2. Avian species observed during Fall point count surveys at the Rough Rider I 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
American kestrel	1	1	0.01 (0.00-0.02)	0.6	0.0%
Grand Total	**21779**	**682**	**140.51** (107.23-173.79)		

Table 3. Avian species, by species grouping, observed during Fall point count surveys at the Rough Rider I 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
Waterfowl						
mallard	5785	67	37.32	(17.78-56.86)	32.9	26.6%
snow goose	1985	12	12.81	(3.79-21.83)	5.2	9.1%
unidentified duck	1269	15	8.19	(3.47-12.91)	8.4	5.8%
blue-winged teal	1189	30	7.67	(2.86-12.48)	16.1	5.5%
Canada goose	1053	25	6.79	(1.65-11.93)	12.9	4.8%
lesser scaup	468	10	3.02	(0.88-5.16)	6.5	2.1%
green-winged teal	295	15	1.90	(0.86-2.94)	9.7	1.4%
ruddy duck	184	10	1.19	(0.22-2.16)	5.2	0.8%
northern shoveler	94	8	0.61	(0.12-1.10)	5.2	0.4%
ring-necked duck	79	6	0.51	(0.06-0.96)	3.9	0.4%
northern pintail	77	5	0.50	(0.00-1.14)	3.2	0.4%
American wigeon	67	3	0.43	(0.00-0.92)	1.9	0.3%
bufflehead	49	2	0.32	(0.00-0.80)	1.3	0.2%
gadwall	47	3	0.30	(0.01-0.59)	1.9	0.2%
tundra swan	28	6	0.18	(0.03-0.33)	3.2	0.1%
redhead	17	2	0.11	(0.00-0.27)	1.3	0.1%
common merganser	2	1	0.01	(0.00-0.03)	0.6	0.0%
Group Total	**12688**	**220**	**81.86**	(53.08-110.64)		**58.3%**
Waterbirds						
American coot	3197	53	20.63	(9.79-31.47)	25.8	14.7%
double-crested cormorant	475	16	3.06	(0.70-5.42)	9.7	2.2%
American white pelican	300	12	1.94	(0.45-3.43)	7.1	1.4%
pied-billed grebe	55	12	0.35	(0.13-0.57)	7.7	0.3%
Group Total	**4027**	**93**	**25.98**	(14.76-37.20)		**18.5%**
Songbirds						
barn swallow	600	50	3.87	(2.34-5.40)	31.0	2.8%
tree swallow	395	2	2.55	(0.00-6.53)	1.3	1.8%
Lapland longspur	294	7	1.90	(0.50-3.30)	4.5	1.3%
brown-headed cowbird	284	4	1.83	(0.00-4.20)	2.6	1.3%
common grackle	263	4	1.70	(0.00-3.40)	2.6	1.2%
unidentified songbird	260	3	1.68	(0.00-3.47)	1.9	1.2%

Table 3. Avian species, by species grouping, observed during Fall point count surveys at the Rough Rider I 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**
red-winged blackbird	259	15	1.67	(0.45-2.89)	9.0	1.2%
American goldfinch	175	12	1.13	(0.14-2.12)	7.7	0.8%
unidentified swallow	100	2	0.65	(0.00-1.57)	1.3	0.5%
European starling	92	4	0.59	(0.00-1.30)	2.6	0.4%
horned lark	89	6	0.57	(0.00-1.32)	3.2	0.4%
savannah sparrow	70	4	0.45	(0.00-1.14)	2.6	0.3%
American robin	38	3	0.25	(0.00-0.53)	1.9	0.2%
yellow-headed blackbird	36	5	0.23	(0.00-0.50)	3.2	0.2%
bank swallow	35	2	0.23	(0.00-0.49)	1.3	0.2%
western meadowlark	33	18	0.21	(0.11-0.31)	11.0	0.2%
pine siskin	30	2	0.19	(0.00-0.46)	1.3	0.1%
cliff swallow	20	3	0.13	(0.00-0.27)	1.9	0.1%
northern rough-winged swallow	14	5	0.09	(0.01-0.17)	3.2	0.1%
eastern bluebird	14	2	0.09	(0.00-0.20)	1.3	0.1%
vesper sparrow	13	3	0.08	(0.00-0.17)	1.9	0.1%
western kingbird	12	3	0.08	(0.01-0.15)	1.9	0.1%
dark-eyed junco	7	2	0.05	(0.00-0.11)	1.3	0.0%
eastern kingbird	5	3	0.03	(0.00-0.06)	1.9	0.0%
American tree sparrow	4	2	0.03	(0.00-0.06)	1.3	0.0%
northern shrike	3	3	0.02	(0.00-0.04)	1.9	0.0%
grasshopper sparrow	2	2	0.01	(0.00-0.02)	1.3	0.0%
Group Total	**3147**	**171**	**20.30**	(13.66-26.94)		**14.4%**
Gulls/Terns						
unidentified gull	780	3	5.03	(0.00-11.99)	1.9	3.6%
ring-billed gull	714	13	4.61	(0.00-9.78)	7.7	3.3%
Franklin's gull	153	4	0.99	(0.00-2.06)	2.6	0.7%
black tern	5	1	0.03	(0.00-0.08)	0.6	0.0%
herring gull	3	1	0.02	(0.00-0.05)	0.6	0.0%
Group Total	**1655**	**22**	**10.68**	(2.01-19.35)		**7.6%**
Raptors/Vultures/Owls						
red-tailed hawk	49	45	0.32	(0.23-0.41)	23.2	0.2%
northern harrier	38	37	0.25	(0.19-0.31)	22.6	0.2%

Table 3. Avian species, by species grouping, observed during Fall point count surveys at the Rough Rider I 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
Swainson's hawk	14	14	0.09	(0.05-0.13)	8.4	0.1%
broad-winged hawk	8	7	0.05	(0.01-0.09)	2.6	0.0%
unidentified buteo	7	5	0.05	(0.02-0.08)	3.2	0.0%
merlin	5	5	0.03	(0.01-0.05)	3.2	0.0%
bald eagle	3	3	0.02	(0.00-0.04)	1.9	0.0%
turkey vulture	2	2	0.01	(0.00-0.02)	1.3	0.0%
rough-legged hawk	2	2	0.01	(0.00-0.02)	1.3	0.0%
unidentified hawk	1	1	0.01	(0.00-0.02)	0.6	0.0%
ferruginous hawk	1	1	0.01	(0.00-0.02)	0.6	0.0%
American kestrel	1	1	0.01	(0.00-0.02)	0.6	0.0%
Group Total	**131**	**123**	**0.85**	(0.68-1.02)		**0.6%**
Gamebirds						
ring-necked pheasant	35	7	0.23	(0.00-0.57)	1.9	0.2%
sharp-tailed grouse	10	5	0.06	(0.01-0.11)	3.2	0.0%
gray partridge	1	1	0.01	(0.00-0.02)	0.6	0.0%
Group Total	**46**	**13**	**0.30**	(0.00-0.67)		**0.2%**
Shorebirds						
killdeer	16	9	0.10	(0.03-0.17)	5.8	0.1%
Wilson's phalarope	7	1	0.05	(0.00-0.12)	0.6	0.0%
unidentified sandpiper	6	1	0.04	(0.00-0.10)	0.6	0.0%
spotted sandpiper	6	1	0.04	(0.00-0.10)	0.6	0.0%
lesser yellowlegs	4	3	0.03	(0.00-0.06)	1.9	0.0%
unidentified shorebird	1	1	0.01	(0.00-0.02)	0.6	0.0%
Group Total	**40**	**16**	**0.26**	(0.13-0.39)		**0.2%**
Woodpeckers						
northern flicker	12	6	0.08	(0.01-0.15)	3.2	0.1%
Group Total	**12**	**6**	**0.08**	(0.01-0.15)		**0.1%**
Wadingbirds						
great egret	4	2	0.03	(0.00-0.06)	1.3	0.0%
great blue heron	3	3	0.02	(0.00-0.04)	1.9	0.0%
black-crowned night-heron	2	2	0.01	(0.00-0.02)	1.3	0.0%
Group Total	**9**	**7**	**0.06**	(0.02-0.10)		**0.0%**

Table 3. Avian species, by species grouping, observed during Fall point count surveys at the Rough Rider I 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
Pigeons/Doves						
mourning dove	9	6	0.06	(0.02-0.10)	3.9	0.0%
Group Total	**9**	**6**	**0.06**	(0.02-0.10)		**0.0%**
Crows and Allies						
American crow	7	2	0.05	(0.00-0.11)	1.3	0.0%
blue jay	1	1	0.01	(0.00-0.02)	0.6	0.0%
Group Total	**8**	**3**	**0.05**	(0.00-0.11)		**0.0%**
Goatsuckers						
common nighthawk	7	2	0.05	(0.00-0.11)	1.3	0.0%
Group Total	**7**	**2**	**0.05**	(0.00-0.11)		**0.0%**
Grand Total	**21779**	**682**	**140.51**	(107.23-173.79)		

Table 4. Avian species observed by point during Fall point count surveys at the Rough Rider I 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	5785	67	2850	112	5	3	0	8	142	23	53	2360	130	99
American coot	3197	53	718	0	0	0	0	0	169	0	123	609	1	1577
snow goose	1985	12	65	670	0	0	0	0	0	460	105	0	160	525
unidentified duck	1269	15	0	45	45	0	0	0	16	80	0	296	0	787
blue-winged teal	1189	30	440	38	3	0	0	6	16	3	2	620	26	35
Canada goose	1053	25	607	63	0	65	1	0	12	0	0	287	10	8
unidentified gull	780	3	0	0	0	0	0	0	0	45	650	0	85	0
ring-billed gull	714	13	15	0	0	0	0	0	1	2	0	446	0	250
barn swallow	600	50	23	17	77	65	10	8	22	142	107	7	106	16
double-crested cormorant	475	16	1	3	1	0	135	0	125	88	19	6	0	97
lesser scaup	468	10	398	0	0	0	0	0	16	0	0	54	0	0
tree swallow	395	2	0	0	0	0	0	0	0	0	375	0	20	0
American white pelican	300	12	15	22	0	0	0	0	0	22	84	15	131	11
green-winged teal	295	15	106	0	0	0	0	0	9	0	3	172	0	5
Lapland longspur	294	7	85	0	30	0	80	0	42	42	15	0	0	0
brown-headed cowbird	284	4	0	0	0	0	23	0	0	6	35	0	220	0
common grackle	263	4	42	0	46	0	30	0	0	0	145	0	0	0
unidentified songbird	260	3	0	0	150	45	0	0	0	0	65	0	0	0
red-winged blackbird	259	15	0	56	2	64	0	85	0	48	4	0	0	0
ruddy duck	184	10	156	0	0	0	0	0	0	0	0	28	0	0
American goldfinch	175	12	2	13	132	6	2	6	0	9	0	0	5	0
Franklin’s gull	153	4	45	0	8	0	0	0	90	0	10	0	0	0
unidentified swallow	100	2	0	0	0	0	0	15	0	0	85	0	0	0
northern shoveler	94	8	2	0	0	0	0	0	12	0	0	79	0	1
European starling	92	4	16	3	8	0	65	0	0	0	0	0	0	0

Table 4. Avian species observed by point during Fall point count surveys at the Rough Rider I Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
horned lark	89	6	0	0	0	0	8	0	6	70	5	0	0	0
ring-necked duck	79	6	0	0	0	0	0	0	57	0	11	11	0	0
northern pintail	77	5	0	0	0	0	0	0	0	0	0	74	0	3
savannah sparrow	70	4	0	0	4	0	1	0	0	65	0	0	0	0
American wigeon	67	3	0	0	0	0	0	0	20	0	0	47	0	0
pied-billed grebe	55	12	23	0	0	0	0	0	11	0	16	0	3	2
red-tailed hawk	49	45	5	4	2	0	4	3	10	9	3	3	3	3
bufflehead	49	2	4	0	0	0	0	0	0	0	0	45	0	0
gadwall	47	3	0	0	0	0	0	0	0	0	0	31	0	16
northern harrier	38	37	4	5	3	1	2	2	3	2	5	4	2	5
American robin	38	3	0	25	0	8	5	0	0	0	0	0	0	0
yellow-headed blackbird	36	5	1	0	0	0	0	0	0	31	2	0	2	0
ring-necked pheasant	35	7	0	0	0	1	0	0	0	0	34	0	0	0
bank swallow	35	2	0	0	0	15	0	0	0	20	0	0	0	0
western meadowlark	33	18	0	6	10	1	5	1	6	2	1	0	1	0
pine siskin	30	2	0	5	25	0	0	0	0	0	0	0	0	0
tundra swan	28	6	6	11	5	0	0	0	4	0	0	2	0	0
cliff swallow	20	3	0	0	2	0	0	0	6	0	0	0	12	0
redhead	17	2	0	0	0	0	0	0	0	0	0	15	2	0
killdeer	16	9	2	1	1	4	0	0	0	0	1	0	7	0
Swainson's hawk	14	14	2	3	1	0	1	2	2	1	1	0	1	0
northern rough-winged swallow	14	5	0	0	0	1	2	0	0	0	9	0	2	0
eastern bluebird	14	2	0	0	0	0	0	6	0	0	0	0	0	8
vesper sparrow	13	3	0	0	6	0	0	0	0	6	0	0	1	0
western kingbird	12	3	0	0	0	0	4	5	0	0	3	0	0	0

Table 4. Avian species observed by point during Fall point count surveys at the Rough Rider I 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 flicker	12	6	0	1	0	0	6	1	0	0	3	0	1	0
sharp-tailed grouse	10	5	4	0	0	0	0	0	2	1	3	0	0	0
mourning dove	9	6	0	0	0	3	4	1	0	0	1	0	0	0
broad-winged hawk	8	7	0	0	0	2	0	3	2	0	0	0	1	0
Wilson's phalarope	7	1	7	0	0	0	0	0	0	0	0	0	0	0
unidentified buteo	7	5	0	0	0	2	1	0	0	3	1	0	0	0
dark-eyed junco	7	2	0	0	5	0	0	0	0	0	2	0	0	0
common nighthawk	7	2	0	0	7	0	0	0	0	0	0	0	0	0
American crow	7	2	0	0	0	7	0	0	0	0	0	0	0	0
unidentified sandpiper	6	1	0	6	0	0	0	0	0	0	0	0	0	0
spotted sandpiper	6	1	0	0	0	0	0	0	0	0	0	0	6	0
merlin	5	5	1	0	0	2	0	0	0	0	1	0	1	0
eastern kingbird	5	3	0	0	0	2	0	2	0	1	0	0	0	0
black tern	5	1	0	0	0	0	0	0	0	0	0	0	5	0
lesser yellowlegs	4	3	1	0	1	0	0	0	0	0	0	2	0	0
great egret	4	2	0	0	0	0	0	0	0	0	0	4	0	0
American tree sparrow	4	2	0	0	3	0	0	0	0	0	1	0	0	0
northern shrike	3	3	0	0	0	0	0	1	0	0	1	0	0	1
herring gull	3	1	3	0	0	0	0	0	0	0	0	0	0	0
great blue heron	3	3	0	0	0	0	0	1	0	1	0	1	0	0
bald eagle	3	3	0	0	0	0	0	1	1	0	1	0	0	0
turkey vulture	2	2	0	0	1	0	0	0	1	0	0	0	0	0
rough-legged hawk	2	2	0	0	0	0	0	0	0	0	2	0	0	0
grasshopper sparrow	2	2	1	0	0	0	0	0	0	0	0	1	0	0
common merganser	2	1	0	0	0	0	0	0	0	0	0	0	2	0

Table 4. Avian species observed by point during Fall point count surveys at the Rough Rider I Wind Resource Area, 2008.

Species	Number of Birds	Number of Obs.	Points											
			1	2	3	4	5	6	7	8	9	10	11	12
black-crowned night-heron	2	2	0	0	0	0	0	0	1	0	1	0	0	0
unidentified shorebird	1	1	0	0	0	0	0	0	0	0	0	0	1	0
unidentified hawk	1	1	0	0	0	0	0	0	0	0	1	0	0	0
gray partridge	1	1	0	0	1	0	0	0	0	0	0	0	0	0
ferruginous hawk	1	1	0	0	0	0	1	0	0	0	0	0	0	0
blue jay	1	1	0	0	1	0	0	0	0	0	0	0	0	0
American kestrel	1	1	0	0	0	0	0	0	0	0	1	0	0	0
Grand Total	**21779**	**682**	**5650**	**1109**	**585**	**297**	**390**	**157**	**804**	**1182**	**1990**	**5219**	**947**	**3449**

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 Rough Rider I Wind Resource Area, 2008.

	Observations		**Individuals**	
	Number	**Percentage**	**Number**	**Percentage**
Non-raptors				
Above RSA (>126.5m)	17	5.8%	2154	24.0%
Below RSA (<33.5m)	184	63.0%	1858	20.7%
Within RSA (33.5m–126.5m)	91	31.2%	4957	55.3%
Raptors/Vultures/Owls				
Above RSA (>126.5m)	16	13.8%	19	15.3%
Below RSA (<33.5m)	50	43.1%	50	40.3%
Within RSA (33.5m–126.5m)	50	43.1%	55	44.4%

[1]These values assume a rotor diameter of 93 (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 Rough Rider I 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
unidentified gull	5.03	5.03 (0.00 - 11.99)	100.0	0.0	100.0	0.0
ring-billed gull	4.36	4.61 (0.00 - 9.78)	97.1	2.5	97.5	0.0
mallard	2.97	37.32 (17.78 - 56.86)	9.4	15.1	84.9	0.0
snow goose	2.94	12.81 (3.79 - 21.83)	100.0	0.0	22.9	77.1
tree swallow	2.55	2.55 (0.00 - 6.53)	100.0	0.0	100.0	0.0
blue-winged teal	2.49	7.67 (2.86 - 12.48)	38.3	15.2	84.8	0.0
Canada goose	2.44	6.79 (1.65 - 11.93)	45.5	1.0	79.1	19.8
unidentified duck	1.46	8.19 (3.47 - 12.91)	21.4	16.6	83.4	0.0
double-crested cormorant	1.39	3.06 (0.70 - 5.42)	98.7	0.9	46.1	53.1
unidentified songbird	1.26	1.68 (0.00 - 3.47)	100.0	0.0	75.0	25.0
red-winged blackbird	1.01	1.67 (0.45 - 2.89)	91.5	34.2	65.8	0.0
barn swallow	0.95	3.87 (2.34 - 5.40)	100.0	75.5	24.5	0.0
Franklin’s gull	0.87	0.99 (0.00 - 2.06)	100.0	11.8	88.2	0.0
Lapland longspur	0.52	1.90 (0.50 - 3.30)	100.0	72.8	27.2	0.0
savannah sparrow	0.42	0.45 (0.00 - 1.14)	97.1	4.4	95.6	0.0
European starling	0.42	0.59 (0.00 - 1.30)	91.3	22.6	77.4	0.0
red-tailed hawk	0.20	0.32 (0.23 - 0.41)	91.8	20.0	66.7	13.3
common grackle	0.19	1.70 (0.00 - 3.40)	11.4	0.0	100.0	0.0
American robin	0.16	0.25 (0.00 - 0.53)	86.8	24.2	75.8	0.0
bank swallow	0.13	0.23 (0.00 - 0.49)	100.0	42.9	57.1	0.0
unidentified swallow	0.10	0.65 (0.00 - 1.57)	15.0	0.0	100.0	0.0
tundra swan	0.10	0.18 (0.03 - 0.33)	71.4	20.0	80.0	0.0
American white pelican	0.07	1.94 (0.45 - 3.43)	90.7	16.9	4.0	79.0
common nighthawk	0.05	0.05 (0.00 - 0.11)	100.0	0.0	100.0	0.0
unidentified sandpiper	0.04	0.04 (0.00 - 0.10)	100.0	0.0	100.0	0.0
broad-winged hawk	0.04	0.05 (0.01 - 0.09)	100.0	0.0	75.0	25.0

Table 6. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)[1] at the Rough Rider I 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	0.03	0.09 (0.05 - 0.13)	92.9	53.8	38.5	7.7
northern harrier	0.03	0.25 (0.19 - 0.31)	100.0	76.3	13.2	10.5
unidentified buteo	0.02	0.05 (0.02 - 0.08)	100.0	0.0	42.9	57.1
herring gull	0.02	0.02 (0.00 - 0.05)	100.0	0.0	100.0	0.0
yellow-headed blackbird	0.01	0.23 (0.00 - 0.50)	94.4	97.1	2.9	0.0
turkey vulture	0.01	0.01 (0.00 - 0.02)	100.0	50.0	50.0	0.0
northern shrike	0.01	0.02 (0.00 - 0.04)	100.0	66.7	33.3	0.0
northern pintail	0.01	0.50 (0.00 - 1.14)	2.6	0.0	100.0	0.0
merlin	0.01	0.03 (0.01 - 0.05)	80.0	50.0	50.0	0.0
great blue heron	0.01	0.02 (0.00 - 0.04)	100.0	33.3	66.7	0.0
bald eagle	0.01	0.02 (0.00 - 0.04)	100.0	0.0	66.7	33.3
American kestrel	0.01	0.01 (0.00 - 0.02)	100.0	0.0	100.0	0.0
American crow	0.01	0.05 (0.00 - 0.11)	100.0	71.4	28.6	0.0
Wilson's phalarope	0.00	0.05 (0.00 - 0.12)	0.0	0.0	0.0	0.0
western meadowlark	0.00	0.21 (0.11 - 0.31)	69.7	100.0	0.0	0.0
western kingbird	0.00	0.08 (0.01 - 0.15)	66.7	100.0	0.0	0.0
vesper sparrow	0.00	0.08 (0.00 - 0.17)	7.7	100.0	0.0	0.0
unidentified shorebird	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
unidentified hawk	0.00	0.01 (0.00 - 0.02)	100.0	0.0	0.0	100.0
sharp-tailed grouse	0.00	0.06 (0.01 - 0.11)	70.0	100.0	0.0	0.0
spotted sandpiper	0.00	0.04 (0.00 - 0.10)	100.0	100.0	0.0	0.0
ruddy duck	0.00	1.19 (0.22 - 2.16)	0.0	0.0	0.0	0.0
ring-necked pheasant	0.00	0.23 (0.00 - 0.57)	57.1	100.0	0.0	0.0
ring-necked duck	0.00	0.51 (0.06 - 0.96)	0.0	0.0	0.0	0.0
rough-legged hawk	0.00	0.01 (0.00 - 0.02)	50.0	100.0	0.0	0.0
redhead	0.00	0.11 (0.00 - 0.27)	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 Rough Rider I 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
pine siskin	0.00	0.19 (0.00 - 0.46)	100.0	100.0	0.0	0.0
pied-billed grebe	0.00	0.35 (0.13 - 0.57)	0.0	0.0	0.0	0.0
northern shoveler	0.00	0.61 (0.12 - 1.10)	0.0	0.0	0.0	0.0
northern rough-winged swallow	0.00	0.09 (0.01 - 0.17)	100.0	100.0	0.0	0.0
northern flicker	0.00	0.08 (0.01 - 0.15)	50.0	100.0	0.0	0.0
mourning dove	0.00	0.06 (0.02 - 0.10)	66.7	100.0	0.0	0.0
lesser yellowlegs	0.00	0.03 (0.00 - 0.06)	25.0	100.0	0.0	0.0
lesser scaup	0.00	3.02 (0.88 - 5.16)	0.0	0.0	0.0	0.0
killdeer	0.00	0.10 (0.03 - 0.17)	62.5	100.0	0.0	0.0
horned lark	0.00	0.57 (0.00 - 1.32)	100.0	100.0	0.0	0.0
green-winged teal	0.00	1.90 (0.86 - 2.94)	0.3	100.0	0.0	0.0
grasshopper sparrow	0.00	0.01 (0.00 - 0.02)	0.0	0.0	0.0	0.0
great egret	0.00	0.03 (0.00 - 0.06)	0.0	0.0	0.0	0.0
gray partridge	0.00	0.01 (0.00 - 0.02)	0.0	0.0	0.0	0.0
gadwall	0.00	0.30 (0.01 - 0.59)	0.0	0.0	0.0	0.0
ferruginous hawk	0.00	0.01 (0.00 - 0.02)	100.0	100.0	0.0	0.0
eastern kingbird	0.00	0.03 (0.00 - 0.06)	100.0	100.0	0.0	0.0
eastern bluebird	0.00	0.09 (0.00 - 0.20)	100.0	100.0	0.0	0.0
dark-eyed junco	0.00	0.05 (0.00 - 0.11)	71.4	100.0	0.0	0.0
common merganser	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
cliff swallow	0.00	0.13 (0.00 - 0.27)	100.0	100.0	0.0	0.0
bufflehead	0.00	0.32 (0.00 - 0.80)	0.0	0.0	0.0	0.0
black tern	0.00	0.03 (0.00 - 0.08)	100.0	100.0	0.0	0.0
blue jay	0.00	0.01 (0.00 - 0.02)	0.0	0.0	0.0	0.0
brown-headed cowbird	0.00	1.83 (0.00 - 4.20)	100.0	100.0	0.0	0.0
black-crowned night-heron	0.00	0.01 (0.00 - 0.02)	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 Rough Rider I 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
American tree sparrow	0.00	0.03 (0.00 - 0.06)	75.0	100.0	0.0	0.0
American wigeon	0.00	0.43 (0.00 - 0.92)	0.0	0.0	0.0	0.0
American goldfinch	0.00	1.13 (0.14 - 2.12)	100.0	100.0	0.0	0.0
American coot	0.00	20.63 (9.79 - 31.47)	0.0	0.0	0.0	0.0

[1]These values assume a rotor diameter of 93 (m) and a hub height of 80 (m)

Table 7. Incidental observations of birds during Fall point counts at the Rough Rider I Wind Resource Area, 2008.

Species	Number of individuals
red-winged blackbird	6970
mallard	860
lesser scaup	670
American coot	475
mourning dove	286
dark-eyed junco	214
tundra swan	166
barn swallow	105
Canada goose	73
canvasback	65
killdeer	42
northern shoveler	35
cliff swallow	35
American tree sparrow	35
redhead	30
northern flicker	30
red-tailed hawk	27
northern harrier	20
American wigeon	20
Swainson's hawk	16
ring-billed gull	12
Franklin's gull	10
bufflehead	9
American kestrel	9
unidentified buteo	2
golden eagle	2
ferruginous hawk	2
turkey vulture	1
sharp-shinned hawk	1
rough-legged hawk	1
northern shrike	1
merlin	1
great horned owl	1
great blue heron	1
American bittern	1
Grand Total	**10228**

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
Rough Rider I, ND			**0.85**					**139.66**			**20**	**This Study**	
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)	
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)	

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			
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)	
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	Jefferey 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
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)	

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			
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. (2005)	
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 Rough Rider I 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
snow goose	1985	12	0.0	0.0	0.0	33.8	41.6	14.1	10.6	0.0	0.0
unidentified gull	780	3	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	94.2
ring-billed gull	693	8	0.0	0.0	0.0	0.1	0.1	0.0	0.7	0.0	99.0
barn swallow	600	50	1.0	0.0	4.2	0.5	25.5	0.0	0.2	0.0	68.7
mallard	542	19	1.8	1.5	3.9	4.6	21.4	57.0	6.6	3.1	0.0
Canada goose	479	15	37.0	0.0	0.6	9.4	49.7	1.3	2.1	0.0	0.0
double-crested cormorant	469	14	0.9	0.0	0.4	0.0	98.3	0.0	0.0	0.2	0.2
blue-winged teal	455	18	0.7	1.3	13.6	0.4	15.6	9.7	58.7	0.0	0.0
tree swallow	395	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Lapland longspur	294	7	5.1	0.0	5.1	0.0	48.3	14.3	27.2	0.0	0.0
brown-headed cowbird	284	4	12.3	0.0	85.6	0.0	0.0	0.0	0.0	0.0	2.1
American white pelican	272	8	0.4	0.0	0.0	8.1	86.8	0.0	0.0	4.8	0.0
unidentified duck	271	5	0.0	0.0	0.0	0.0	94.1	0.0	5.9	0.0	0.0
unidentified songbird	260	3	0.0	0.0	0.0	0.0	25.0	57.7	0.0	0.0	17.3
red-winged blackbird	237	14	53.6	0.0	1.3	0.8	44.3	0.0	0.0	0.0	0.0
American goldfinch	175	12	0.0	0.0	5.1	2.9	79.4	4.6	8.0	0.0	0.0
Franklin’s gull	153	4	0.0	58.8	0.0	0.0	0.0	0.0	41.2	0.0	0.0
horned lark	89	6	0.0	0.0	0.0	0.0	82.0	0.0	18.0	0.0	0.0
European starling	84	3	3.6	0.0	77.4	0.0	19.0	0.0	0.0	0.0	0.0
savannah sparrow	68	2	0.0	0.0	0.0	4.4	95.6	0.0	0.0	0.0	0.0
red-tailed hawk	45	41	13.3	4.4	6.7	6.7	42.2	0.0	2.2	0.0	24.4
northern harrier	38	37	7.9	13.2	2.6	2.6	36.8	2.6	2.6	2.6	28.9

Appendix 1. Flight directions of birds observed during Fall point count surveys at the Rough Rider I 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
bank swallow	35	2	0.0	0.0	0.0	0.0	57.1	0.0	0.0	0.0	42.9
yellow-headed blackbird	34	4	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
American robin	33	2	24.2	0.0	0.0	0.0	0.0	75.8	0.0	0.0	0.0
pine siskin	30	2	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
common grackle	30	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
western meadowlark	23	9	0.0	8.7	26.1	0.0	8.7	0.0	56.5	0.0	0.0
tundra swan	20	4	0.0	25.0	0.0	0.0	50.0	0.0	0.0	25.0	0.0
ring-necked pheasant	20	4	0.0	0.0	0.0	70.0	10.0	0.0	20.0	0.0	0.0
cliff swallow	20	3	0.0	0.0	0.0	0.0	70.0	0.0	0.0	0.0	30.0
unidentified swallow	15	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
northern rough-winged	14	5	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	92.9
eastern bluebird	14	2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Swainson's hawk	13	13	7.7	0.0	0.0	7.7	69.2	7.7	0.0	0.0	7.7
killdeer	10	6	20.0	0.0	10.0	20.0	0.0	10.0	40.0	0.0	0.0
western kingbird	8	2	0.0	0.0	0.0	0.0	37.5	0.0	62.5	0.0	0.0
broad-winged hawk	8	7	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
unidentified buteo	7	5	0.0	0.0	0.0	0.0	85.7	0.0	14.3	0.0	0.0
sharp-tailed grouse	7	3	0.0	0.0	57.1	0.0	42.9	0.0	0.0	0.0	0.0
common nighthawk	7	2	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	85.7
American crow	7	2	28.6	0.0	0.0	0.0	0.0	0.0	71.4	0.0	0.0
unidentified sandpiper	6	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
spotted sandpiper	6	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 1. Flight directions of birds observed during Fall point count surveys at the Rough Rider I 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
northern flicker	6	4	50.0	0.0	0.0	16.7	16.7	0.0	16.7	0.0	0.0
mourning dove	6	5	0.0	16.7	16.7	0.0	50.0	0.0	16.7	0.0	0.0
eastern kingbird	5	3	0.0	0.0	0.0	0.0	60.0	0.0	40.0	0.0	0.0
dark-eyed junco	5	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
black tern	5	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
merlin	4	4	25.0	0.0	25.0	0.0	50.0	0.0	0.0	0.0	0.0
northern shrike	3	3	33.3	0.0	33.3	0.0	0.0	0.0	33.3	0.0	0.0
herring gull	3	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
great blue heron	3	3	66.7	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0
bald eagle	3	3	0.0	0.0	0.0	33.3	66.7	0.0	0.0	0.0	0.0
American tree sparrow	3	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
turkey vulture	2	2	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
northern pintail	2	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
vesper sparrow	1	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
unidentified shorebird	1	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
unidentified hawk	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
rough-legged hawk	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
lesser yellowlegs	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
green-winged teal	1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
ferruginous hawk	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
American kestrel	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Grand Total	**9093**	**408**	**4.5**	**1.4**	**5.7**	**8.8**	**35.5**	**9.5**	**8.4**	**0.4**	**25.8**

Comsearch Microwave Study

Executive Summary – Wind Power GeoPlanner™

Licensed Microwave Search & Worst Case Fresnel Zone

Comsearch performed an analysis to evaluate the potential effects of the planned Rough Rider wind project area in McIntosh, Dickey, Lamoure, Logan, and Kidder Counties, North Dakota and McPherson County, South Dakota on existing non-Federal Government microwave telecom systems.

Microwave Search Results: Comsearch's Wind Power GeoPlanner™ provides a graphical representation of affected microwave paths and provides supporting technical parameters. The microwave path data is overlaid on topographic basemaps. Comsearch identified 33 microwave paths that intersect the project area (see Figure 1 and Table 1 below).

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

$$Rn \cong 17.3\sqrt{\frac{n}{F_{GHz}}\left(\frac{d_1 d_2}{d_1 + d_2}\right)}$$

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

note: For WCFZ calculation d1 = d2

The calculated WCFZ radius, giving the linear path an area or swath, buffers each microwave path in the project area. The distance unit is in meters and can be found in the column attribute "WCFZ." In general, this is the XY area where the planned wind turbines should be avoided, if possible. These areas are shown in Figures 2 through 6.

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

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

Comsearch Contact:

Denise Finney, Account Manager
Phone: (703) 726-5650 Fax: (703) 726-5599
Email: dfinney@comsearch.com

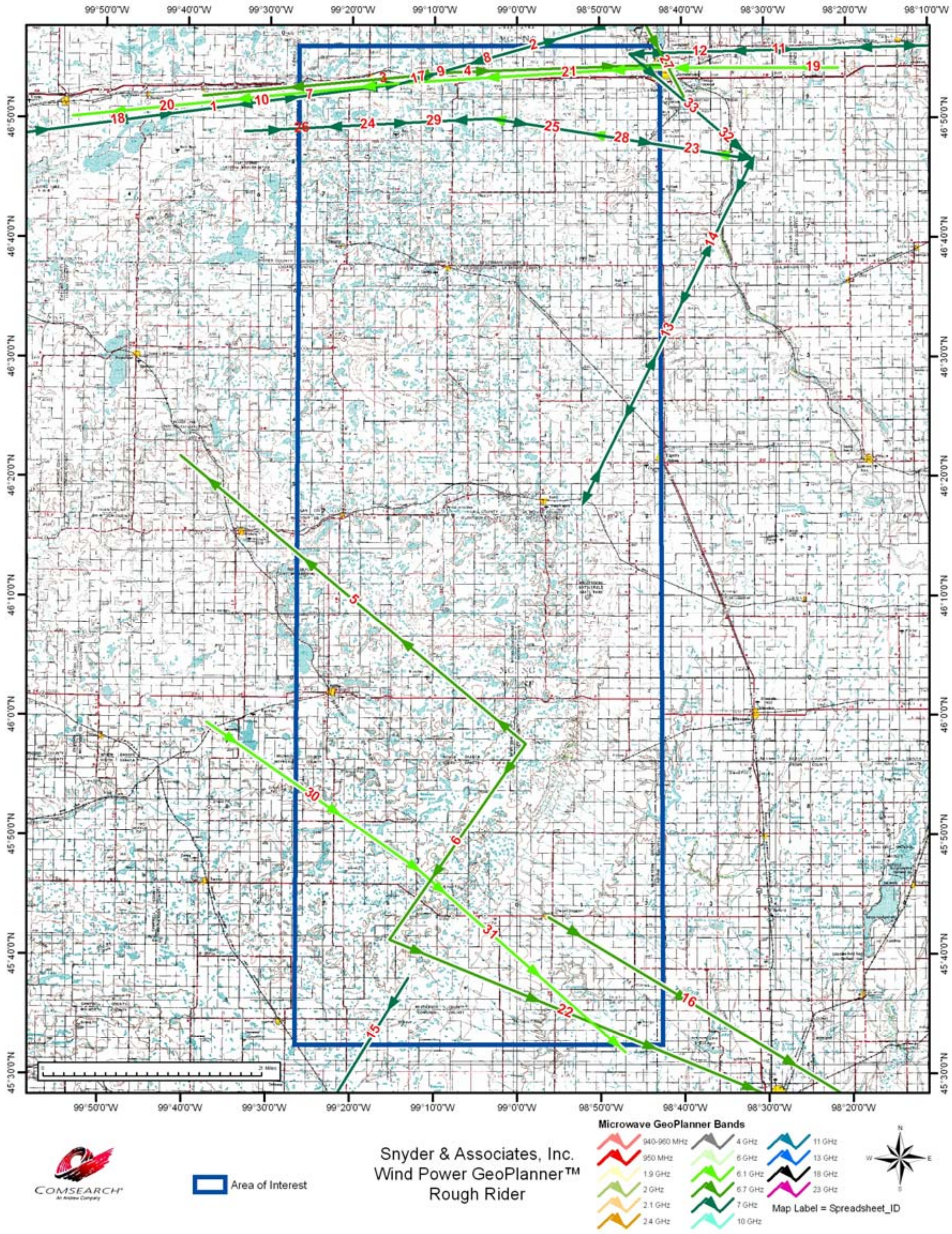


Figure 1 – Wind Power GeoPlanner™

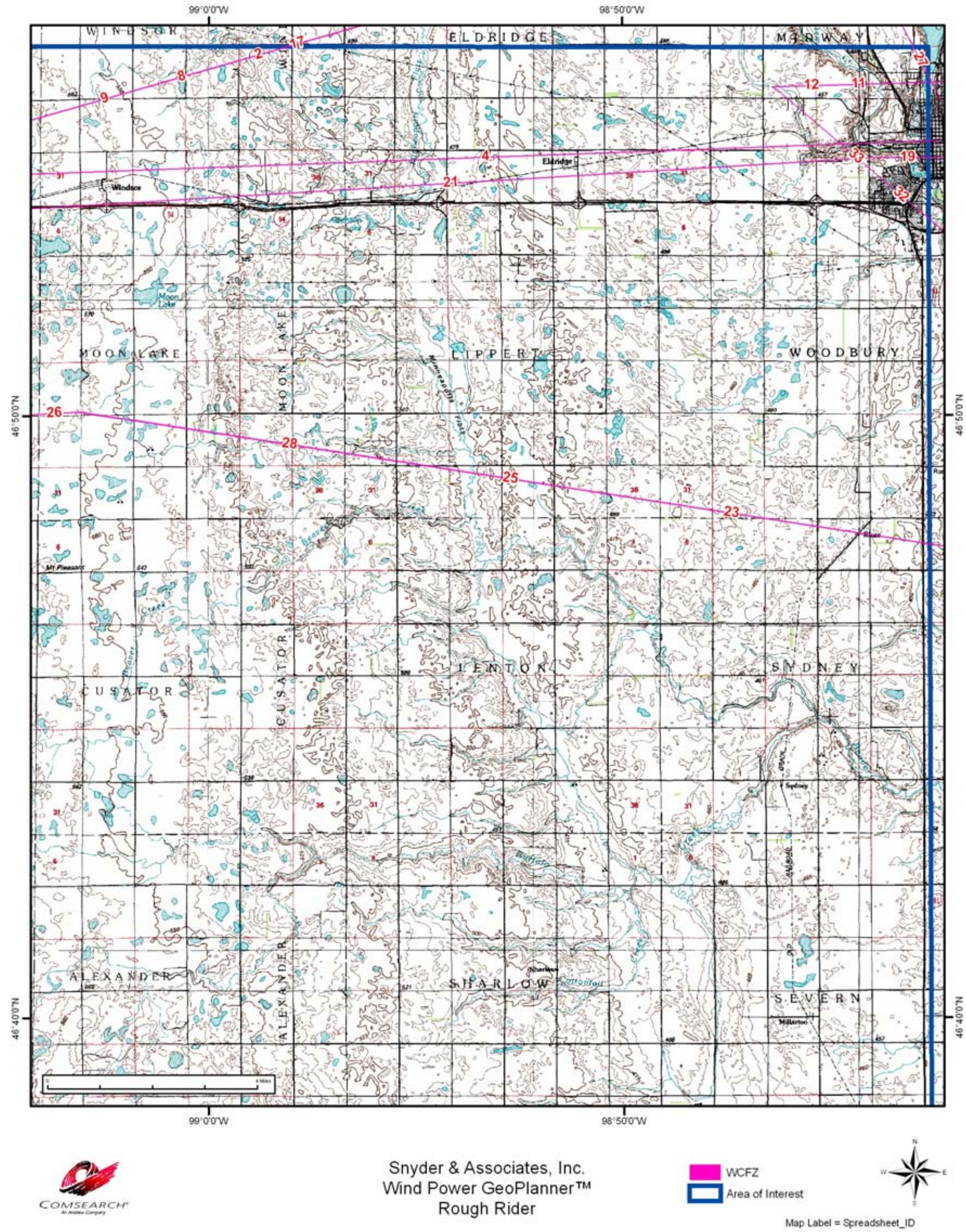


Figure 2 – Wind Power GeoPlanner™ & WCFZ (NE)

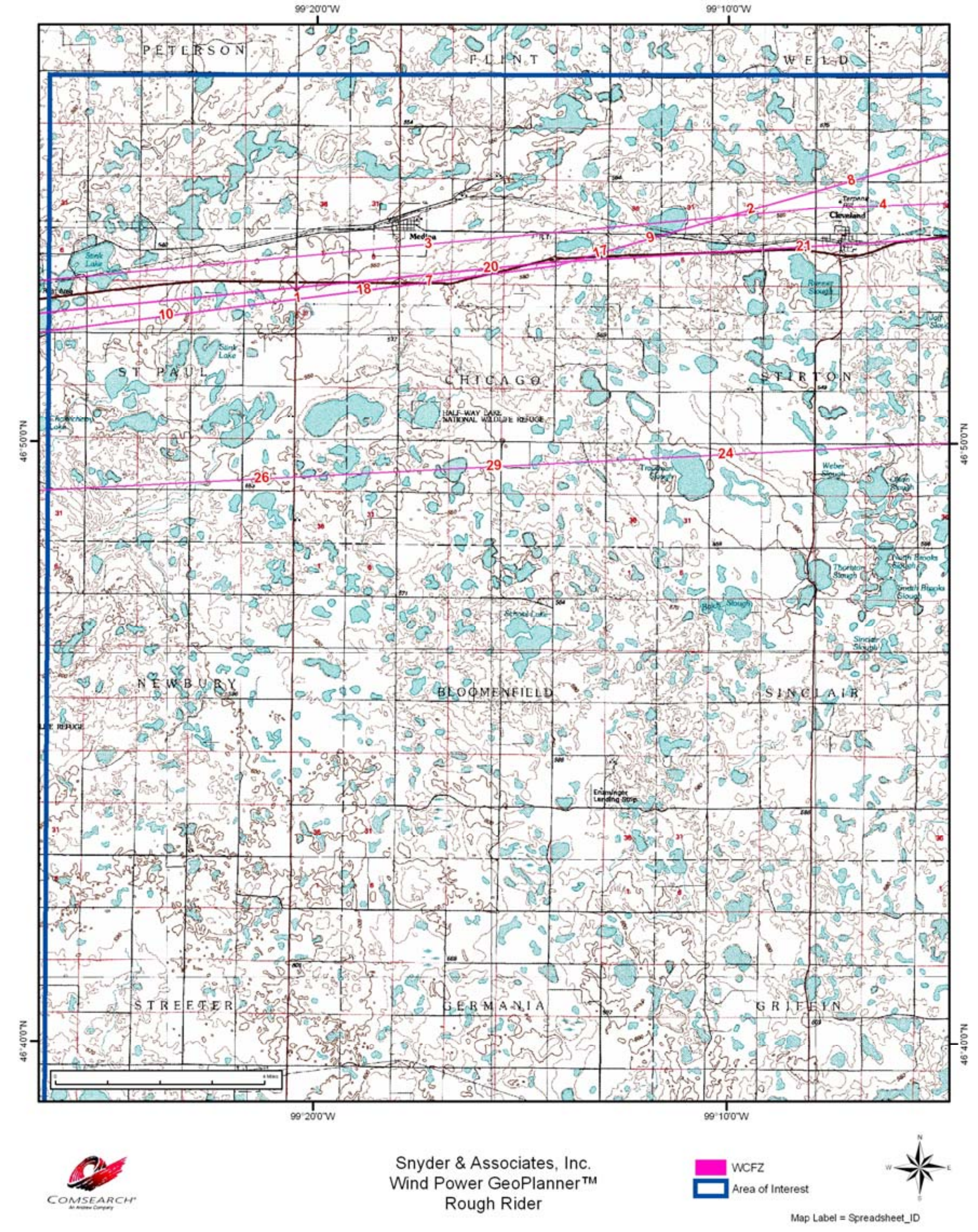


Figure 3 – Wind Power GeoPlanner™ & WCFZ (NW)

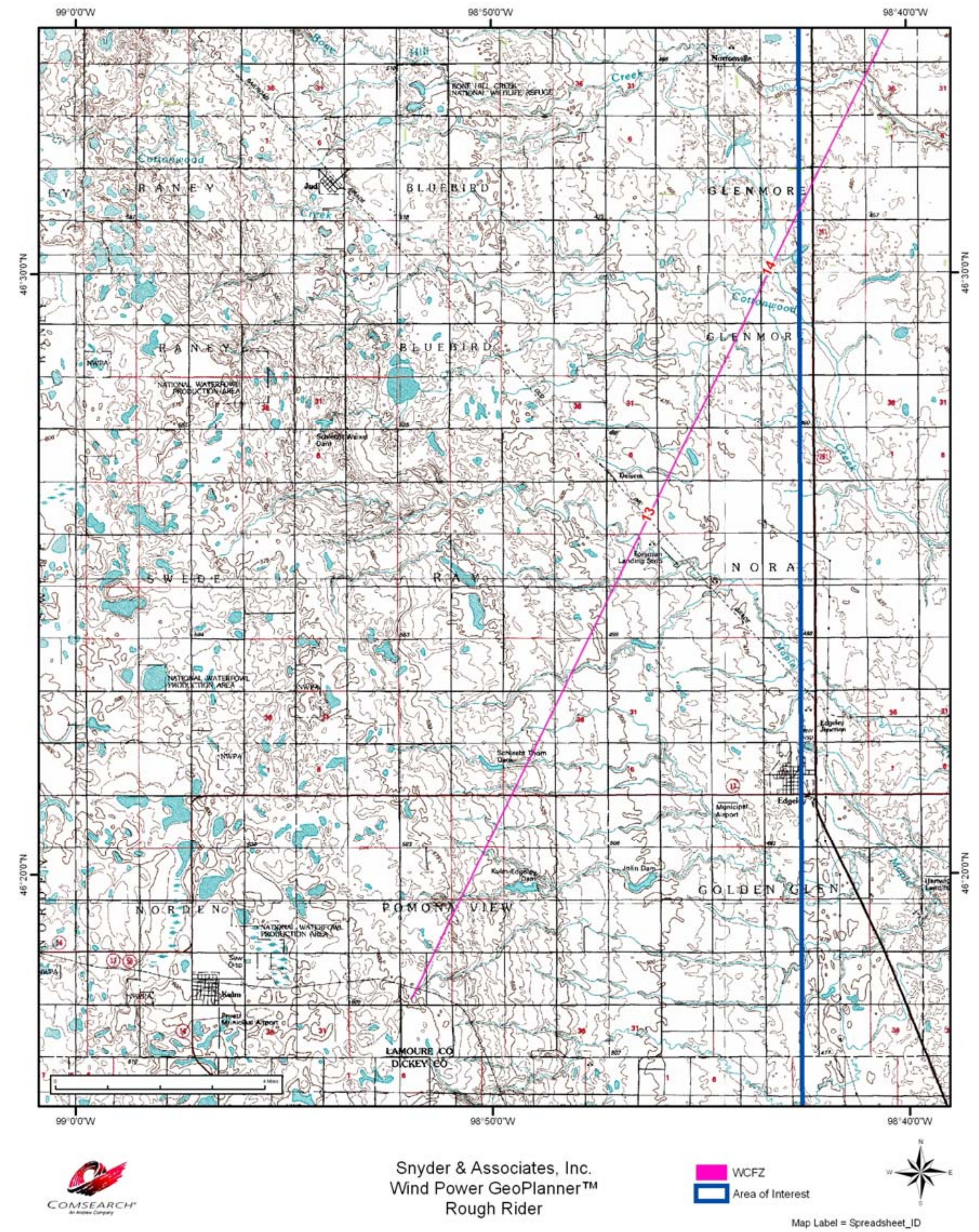


Figure 4 – Wind Power GeoPlanner™ & WCFZ (Middle)

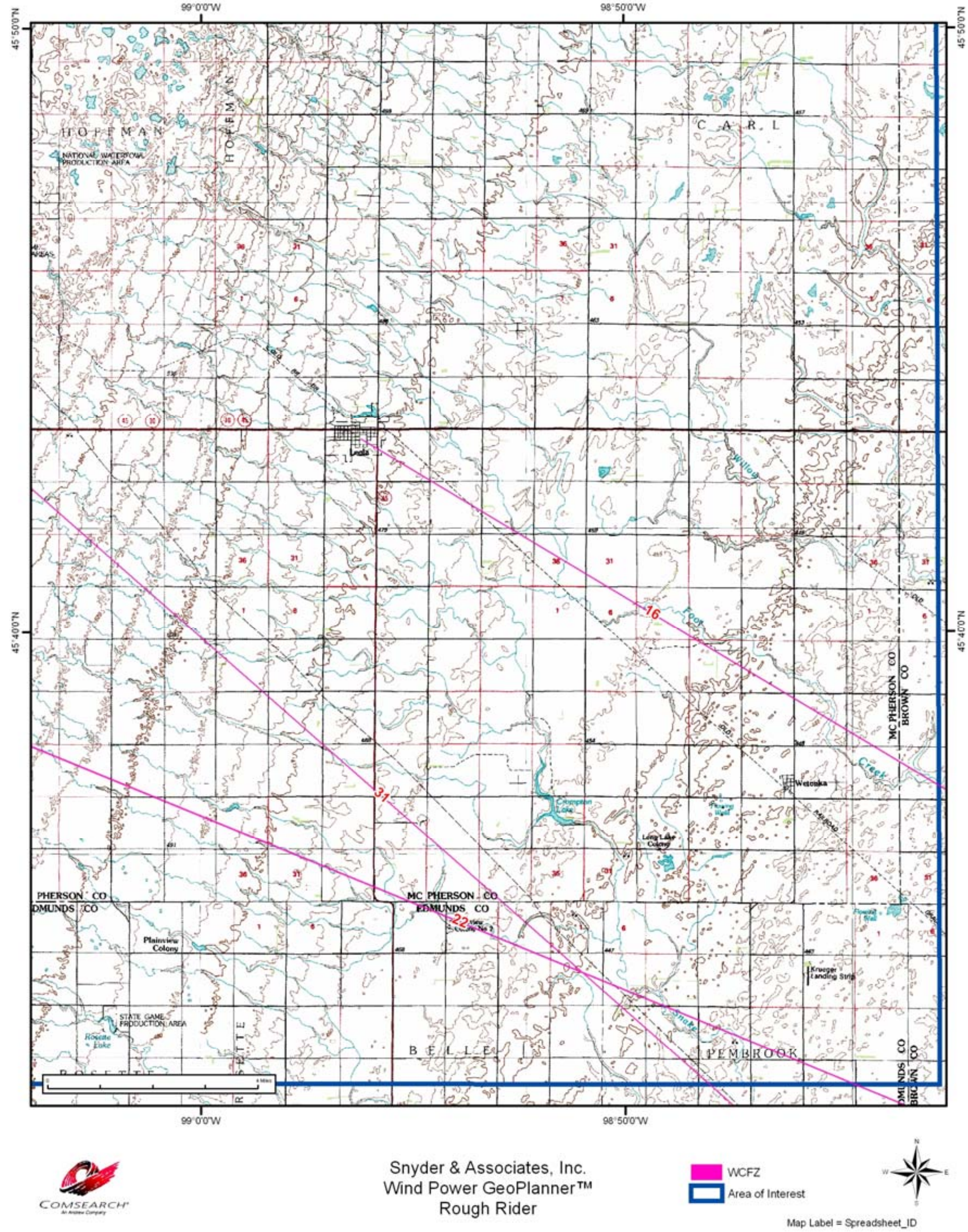


Figure 5 – Wind Power GeoPlanner™ & WCFZ (SE)

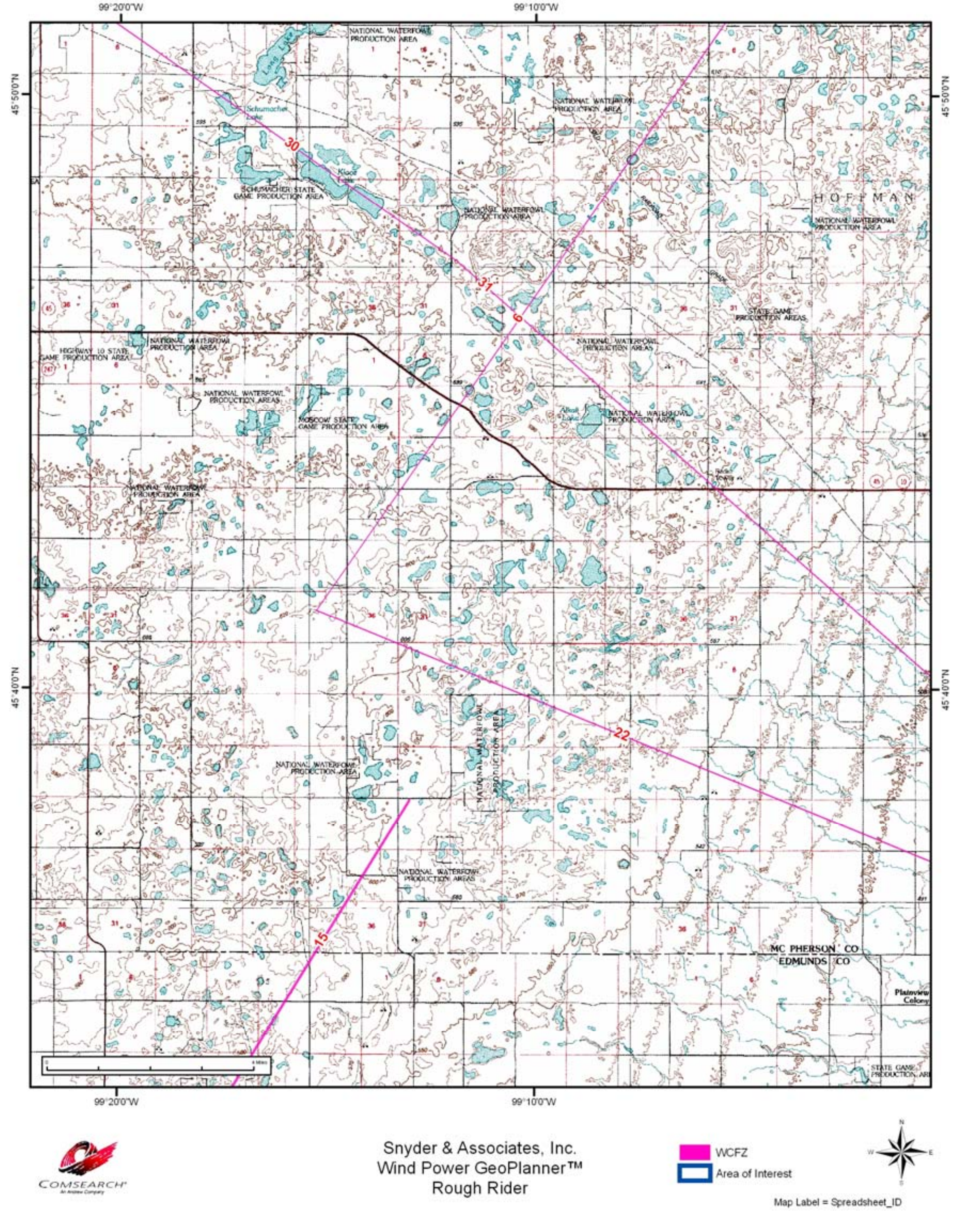


Figure 6 – Wind Power GeoPlanner™ & WCFZ (SW)

ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	BAND NAME	Licensee	WCFZ (m)
1	STUTSMAN	STEELE	KBD41	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	25.46
2	CLEMENTSVILL	MEDINA	KBD42	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	24.46
3	CLEVELAND	TAPPEN	KVY69	KVY53	Upper 6 GHz	BNSF Railway Company	20.81
4	CLEVELAND	JAMESTOWN	KVY69	KVY72	Upper 6 GHz	BNSF Railway Company	19.04
5	FORBES	WISHEK	WBD235	WBD236	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	27.89
6	FORBES	LEOLA RPTR	WBD235	WPOS232	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	20.33
7	STUTSMAN	STEELE	WLD481	RXONLY	7 GHz	KBMY KMCY LLC (KBMY)	25.46
8	CLEMENTSVILL	STUTSMAN	WLD482	RXONLY	7 GHz	KBMY KMCY LLC (KBMY)	24.46
9	MEDINA	STEELE	WLF689	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	24.46
10	STEELE	STUTSMAN	WLF691	RXONLY	7 GHz	HOAK MEDIA OF DAKOTA LICENSE, LLC	25.46
11	VALLEY CITY	JAMESTOWN	WLI370	RXONLY	7 GHz	RED RIVER BROADCAST CO., LLC	25.48
12	JAMESTOWN	VALLEY CITY	WLI701	RXONLY	7 GHz	RED RIVER BROADCAST CO., LLC	25.48
13	KULM	YPSILANTI	WLI955	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	25.18
14	YPSILANTI	KULM	WLI956	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	25.18
15	ROSCO	FT PIERRE	WLO986	RXONLY	7 GHz	SOUTH DAKOTA 5 CNTY TV TRANSLATOR DISTRI	42.87
16	LEOLA AVE	BATH	WNTW528	RXONLY	Upper 6 GHz	NORTH CENTRAL AREA INTERCONNECT	24.75
17	STUTSMAN	CLEMENTSVILL	WPNF862	RXONLY	7 GHz	KBMY KMCY LLC (KBMY)	24.46
18	STEELE	STUTSMAN	WPNK718	RXONLY	7 GHz	KBMY KMCY LLC (KBMY)	25.46
19	SANBORN	JAMESTOWN	WPON204	WPOP549	Lower 6 GHz	WWC Holding Co., Inc	18.85
20	MEDINA	STEELE	WPOP548	WPON205	Lower 6 GHz	WWC Holding Co., Inc	24.80
21	JAMESTOWN	MEDINA	WPOP549	WPOP548	Lower 6 GHz	WWC Holding Co., Inc	21.66
22	LEOLA RPTR	ABERDEEN	WPOS232	WPOS231	Upper 6 GHz	BASIN ELECTRIC POWER COOPERATIVE	26.40
23	YPSILANTI	CLEVELAND	WPOU442	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	20.92
24	CLEVELAND	TAPPEN	WPOU443	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	20.19
25	CLEVELAND	YPSILANTI	WPOU448	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	20.92
26	TAPPEN	CLEVELAND	WPOU449	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	20.19
27	PINGREE	JAMESTOWN	WQBN233	WQBN235	Upper 6 GHz	North Dakota 5-Kidder Limtd Partnership	19.37

ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	BAND NAME	Licensee	WCFZ (m)
28	YPSILANTI	CLEVELAND	WQDF962	WQDF963	Lower 6 GHz	PRAIRIE PUBLIC BROADCASTING INC	22.28
29	CLEVELAND	TAPPEN	WQDF981	WQDF984	Lower 6 GHz	PRAIRIE PUBLIC BROADCASTING INC	21.50
30	ASHLEY	LONG LAKE	WQDT320	WQDT321	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	21.97
31	LONG LAKE	CS09	WQDT321	WQDT322	Lower 6 GHz	NORTHERN BORDER PIPELINE COMPANY	22.81
32	YPSILANTI	JAMESTOWN	WQGH726	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	16.38
33	JAMESTOWN	YPSILANTI	WQGH730	RXONLY	7 GHz	PRAIRIE PUBLIC BROADCASTING INC	16.38

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