

**Site Characterization Study
of the Oak Glen Wind Farm Resource Area**

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EXECUTIVE SUMMARY

The proposed Oak Glen Wind Farm Resource Area, (OGWFRA), approximately 4093 acres (1,656 hectares), consists of five non-contiguous blocks and is located in Steele County, Minnesota, near the community of Bixby. Avant Energy Services is proposing to construct approximately 30 turbines within the project area. The OGWFRA is located entirely within the Oak Savannah ecological subsection of the Eastern Broadleaf Forest ecological province. The OGWFRA soils are mostly Hayden loams, Bixby clay loams, and Webster clay loams. The landscape within the project area has a limited number of wetlands. Topography is gently rolling, with elevations ranging from 1,240 to 1,342 feet (378 to 409 meters) above sea level. Ownership within the OGWFRA is private; however, there are three state areas, Aurora, Oak Glen, and Pogones Wildlife Management Areas, located near the project area. There is also a US Fish and Wildlife Service Waterfowl Production Area along the southwest boundary of the project area. About 75% of the OGWFRA is cropland with the next most common land use being grassland (24%).

Biological resources within the OGWFRA were evaluated through a search of existing data and a site visit from public roads on April 1, 2009. During the site visit, biological features and potential wildlife habitat were identified. All wildlife species observed during the site visit were recorded and photographs were taken of the OGWFRA. Information about sensitive species presence and locations was requested from the Minnesota Department of Natural Resources and US Fish and Wildlife Service. The requests for information were made for a slightly smaller project area but with similar biological characteristics; all references to agency responses in this report pertain to the smaller project area. Responses from the agencies were received and are included in this report.

No federally listed endangered, threatened, or candidate plant species or critical habitats are known to occur in the OGWFRA. The state completed a search of the Minnesota Natural Heritage Information System (NHIS) for rare plant species known to occur within an approximate 1-mile radius of the project area; results of the search included plains wild indigo and rattlesnake-master. The plains wild indigo was observed on the shore of Oak Glen Lake in 1951. Rattlesnake-master has been recorded in several areas proximal to the project area during a 1997-98 railroad right-of-way prairie survey.

Based on National Wetland Inventory polygon data, there are about 28 acres (about 11 ha) of wetlands, not including streams and rivers, found throughout the OGWFRA. Less than 1% of the total OGWFRA is wetlands, excluding rivers and streams. The highest percentage (78%) of wetlands are freshwater emergent wetlands. Freshwater forested/shrub wetland (about 17%), freshwater ponds (about 5%), and lakes (less than 1 acre) account for the remainder of the wetlands. A tributary of Turtle Creek drains the northwestern portion of the OGWFRA while the rest of the project area drains to the southwest to the Straight River via several tributaries. Oak Glen Lake is located adjacent to the most eastern block of the project area. An unnamed lake, located on the Aurora State Wildlife Management Area, is found along the northern boundary of the project area. Rickert Lake is located southeast of the project area. According the Natural Heritage Information System database search results, a calcareous fen is located on Pogones

Wildlife Management Area. Calcareous fens are a rare and distinctive wetland that are dependent on groundwater that is cold, oxygen-poor, rich in calcium and magnesium bicarbonates.

No federally listed endangered, threatened, or candidate wildlife species are known to occur in the OGWFRA. The Minnesota Natural Heritage Information System search results included records for the Henslow's sparrow, loggerhead shrike, and Blanding's turtle. Adult and juvenile Henslow's sparrows were observed in 2008 within the project area. The Henslow's sparrow is a Minnesota endangered species that requires uncultivated grasslands, old fields with standing, dead vegetation, and a litter layer. The loggerhead shrike is a Minnesota threatened species that has been documented multiple times in two years in the vicinity of the project area. This species also requires a very specific habitat which is large areas of open grassland interspersed with hedgerows, shrubs, and small trees. The Blanding's turtle is a Minnesota threatened species that was observed over 50 years ago near the southwestern boundary of the project area.

The following raptor species could occur in or near the project area during some portion of the year: bald eagle, golden eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, broad-winged hawk, Swainson's hawk, red-tailed hawk, rough-legged hawk, American kestrel, merlin, peregrine falcon, red-shouldered hawk, and osprey. Other species often grouped with raptors that could be found in the project area include the great-horned owl, eastern screech owl, snowy owl, barred owl, long-eared owl, short-eared owl, and turkey vulture. Of these, the Cooper's hawk, Swainson's hawk, red-tailed hawk, American kestrel, red-shouldered hawk, great-horned owl, eastern screech owl, barred owl, and long-eared owl are most likely to be nest in the vicinity of the project area. During the site visit, red-tailed hawk, Cooper's hawk, and American kestrel were observed in the project area.

No raptor nests were observed during the site visit. Potential nest structures for above ground nesting species were present in the form of living and dead trees scattered throughout the project area. Grassland areas could provide nesting habitats for ground-nesting raptors, such as the great-horned owl.

No signs of colonial rodents were observed during the site visit; these types of areas are known to attract feeding raptors. Potential raptor prey sources include rodents, rabbits, and waterfowl; all consistent with a cultivated agriculture and grassland region. However, overall prey densities are not expected to be significantly different than areas outside of the proposed OGWFRA. It is likely that raptors will use the area but not to a greater degree than the surrounding areas with similar habitat. The Steele County landfill is located about 1 mile northwest of Bixby, Minnesota, within the project boundary. During the site visit, numerous gulls and American crows were observed in and around the landfill.

Topography in the OGWFRA is gently rolling to rolling. There are no big hills, steep ridges, or other topographical features that might cause bottlenecks or significant updrafts where raptors might concentrate.

It is likely that birds migrate through the proposed OGWFRA, including passerines, raptors, and waterfowl. Tree rows, wetlands, and grasslands areas scattered throughout the OGWFRA may provide stopover habitat for migrants or individuals during post-breeding dispersal. Harvested

grain crops that were observed during the site visit could serve as feeding areas for migrating and wintering waterfowl. These types of habitats are found throughout the region and therefore their presence in the OGWFRA should not concentrate bird use as compared to adjacent areas.

Displacement of grassland nesting birds is often one of the primary concerns wildlife agencies express regarding the placement of wind facilities in and near grassland areas. The proposed OGWFRA contains grasslands, some of which may be native grasslands, and some species of sensitive grassland passerines are known to be present in the OGWFRA. Results of the Natural Heritage Information System search included records for the Henslow's sparrow, red-necked grebe and sandhill crane. The red-necked grebe, although not a state-listed species, is a Species of Greatest Conservation Need in Minnesota, and is known to breed colonially in nearby Oak Glen Lake. Sandhill crane adults and juveniles were observed feeding adjacent to the Aurora Wildlife Management Area. The sandhill crane is not a state-listed species but was identified in the state's response as a bird of interest.

The nearest Breeding Bird Survey route is the Austin Route. In 2008, 1,190 individuals of 65 species were observed. The five most abundant species observed were the red-winged blackbird, common grackle, European starling, house sparrow, and American robin. In 2007, 1,199 individuals of 57 species were observed with the five most commonly observed species being the red-winged blackbird, common grackle, European starling, American robin, and Canada goose.

There are several species of bats that could be found in the OGWFRA, including the big brown bat, hoary bat, eastern red bat, little brown myotis, northern myotis (species of concern in Minnesota), silver-haired bat, and tri-colored bat. Potential roosting habitat within the OGWFRA is found in the form of trees and buildings; no caves were observed during the site visit. Bats generally forage over water and open spaces such as agricultural fields, grasslands, streams, and wetlands/ponds. Bats may prey on insects that are likely to concentrate over water in wetlands and streams and these types of areas found in the OGWFRA are most likely to attract foraging bats. Based on bat use and bat fatalities studies from other parts of the country, including Minnesota (Table 6), it would be expected that bat impacts would be similar to other open grassland/agricultural landscapes. However, the exact magnitude of these fatalities and the degree to which bat species will be affected is difficult to determine.

Table E-1. Site Characterization Summary.

Resource	Project Considerations	Potential Future Studies	Timing of Potential Studies
Vegetation			
Wetlands and Waters of the US	Wetlands and Waters of the US occupy a portion of the project area. Site away from wetland areas to minimize wildlife impacts	Conduct a wetland delineation once the facility design has been determined but prior to finalizing the layout. Micro-site facilities when possible to avoid or minimize impacts to wetlands/waters	Summer
Native Grasslands	Native grassland remnants may be in the project area. Site away from native grassland areas to minimize impacts.	Updated vegetation map of selected regions to help micro-site facility to minimize impacts to native grasslands.	Update current mapping during snow free period if needed.
Wildlife			
State and Federal Species of Concern.	Several federal and state species of concern could occur in the project area.	Surveys for Henslow's sparrow and loggerhead shrike.	Summer/breeding season
Nesting Raptors	Tree rows, woodlands, and riparian zones in the area provide nesting habitat for raptors.	Survey suitable habitat for nests.	Spring, before leaf-out
Migratory Birds	Migrating birds likely pass over the project area and could utilize the area.	Fixed-point bird use surveys.	Spring, summer, and fall
Bats	Habitats suitable for bat roosting and foraging occur.	Acoustic bat surveys.	Summer and fall

INTRODUCTION

Knowledge of biological resource issues early in the development phase of wind energy facilities helps the industry identify, avoid, and minimize future problems. This report describes biological resources present within a potential wind resource area and evaluates these general characteristics as related to potential or known impacts on the resources from wind energy facilities.

The proposed Oak Glen Wind Resource Area (OGWFRA) consists of five non-contiguous blocks and is located in Steele County, Minnesota (Figure 1), near the city of Bixby. Avant Energy Services is proposing to construct approximately 30 turbines within the project area. The purpose of this report is to characterize biological resources in the proposed overall project area, determine if additional biological surveys are warranted, and to identify the timing of recommended future studies.

STUDY AREA

The OGWFRA, currently about 4093 acres (1,656 hectares; ha), is located in southeast Steele County in southern Minnesota (Figure 1). The proposed OGWFRA is located entirely within the Oak Savanna ecological subsection of the Eastern Broadleaf Forest ecological province (MnDNR ECS website). The subsection is mostly loess plain over bedrock or till with few lakes. The subsection was historically bur oak (*Quercus macrocarpa*) savanna with areas of tallgrass prairie and maple-basswood (*Acer-Tilia* spp.) forests. Most of the subsection is now farmed. The OGWFRA soils are mostly Hayden loams, Bixby clay loams, and Webster clay loams (Soil Survey of Steele County, Minnesota 1973). Hayden loams and Bixby clay loams are well-drained while Webster clay loams are not. Hayden loams are usually located on knolls and hillsides. Bixby clay loams are found on circular hills, broad gently rolling outwash plains, and on the sides of hills. Webster clay loams are found in broad tracts in areas with little slope. The landscape within the project area has a limited number of wetlands (Figure 2). Topography is gently rolling, with elevations ranging from 1,240 to 1,342 feet (ft; 378 to 409 meters [m]) above sea level (Figure 3). Ownership within the OGWFRA is private. However, there are three state areas, Aurora Wildlife Management Area (WMA), Oak Glen WMA, and Pogones WMA located near the project area (Figure 4). There is also a US Fish and Wildlife Service (USFWS) Waterfowl Production Area along the southwest boundary of the project area.

METHODS

Biological resources within the OGWFRA were evaluated through a search of existing data and a site visit. The site visit entailed an examination of the OGWFRA from public roads on April 1, 2009. The site visit was completed for an earlier version of the project boundary which is slightly smaller than the current project boundary (Figure 1), but with similar biological characteristics. During the site visit, biological features and potential wildlife habitat, including plant communities, topography features, and potential raptor nesting habitat and prey

populations, were identified. All wildlife species observed during the site visit were recorded and photographs were taken of the OGWFRA (Appendix A).

Several sources of available data were used to identify biological resources within the OGWFRA including published literature, field guides, and public data sets. Information about sensitive species presence and locations was requested from the Minnesota Department of Natural Resources (MNDNR) and USFWS by Avant Energy Services. The requests for information were made for the smaller project area as explained in the previous paragraph. The responses from the MNDNR and USFWS were received and are included in Appendix B.

LAND COVER

About 75% of the OGWFRA is cropland with the next most common land use being grassland (23.8%; Table 1; Figure 5). The land classification that WEST obtained from Minnesota Gap Analysis grouped native grass, pasture, planted cover, and hayland into one category called “grassland” and the site visit was not a formal habitat mapping attempt. Therefore, we have only general information about the amount of native grasslands in the project area. During the site visit, very few areas were observed that were obviously native grasslands. All other land use types accounted for less than 1% of the area individually.

Table 1. Land use types present within the OGWFRA (Minnesota Gap Analysis).

Land Use	Acres	Percent
Cropland	3051.9	74.6
Grassland	972.5	23.8
Lowland Deciduous Shrub	19.8	0.5
Transportation	17.8	0.4
Sedge Meadow	13.0	0.3
Bur/White Oak	10.8	0.3
Red Oak	3.1	<0.1
Lowland Deciduous	2.6	<0.1
Maple/Basswood	1.1	<0.1
Water	0.1	<0.1
Total	4,092.8	100.0

Sensitive and Special Status Plant Species

No federally-listed endangered, threatened, or candidate plant species or critical habitats are known to occur in the OGWFRA (Appendix B). The MNDNR completed a search of the Minnesota Natural Heritage Information System (NHIS) for rare plant species known to occur within an approximate 1-mile radius of the project area, which would encompass the current project boundary (Appendix B). Results of the search included plains wild indigo (*Baptisia bracteata* var. *leucophaea*) and rattlesnake-master (*Eryngium yuccifolium* Michx.).

Plains Wild Indigo

The plains wild indigo is a native plant that inhabits sandy or rocky prairies, pastures and roadsides (Haddock 2009). This plant was observed on the shore of Oak Glen Lake in 1951, the only recorded instance of this plant within or near the project boundary according to the NHIS. Oak Glen Lake is not included in the project boundary (Figure 6). Based on the time since this species was observed and the general lack of lakes within the project boundary it is unlikely that this species would be found within the OGWFRA.

Rattlesnake-Master

Rattlesnake-master is a tallgrass prairie native that was once thought to be a cure for rattlesnake venom. This plant is found in prairies and open woodlands. Rattlesnake-master was recorded in several areas proximal to the project area during a 1997-98 railroad right-of-way (ROW) prairie survey (Appendix B). More current surveys have occurred, but those data are not yet available. It is probably that this species remains within the native parcels in or near the project area.

Sensitive Habitats

The presence of wind turbines may alter the landscape so that wildlife habitat use patterns are altered, possibly displacing wildlife from the OGWFRA. The greatest concern with displacement impacts are for wind-energy facilities that are placed in native grasslands and other native habitats. The OGWFRA project area includes grasslands, so it is probable that some grassland-dependent species will be displaced (see the Breeding Bird section for more discussion on bird displacement). Siting the project away from native grasslands would lessen any potential impacts.

Prairie Remnants

Prairie remnants have been identified in railroad ROWs near the project area (Minnesota County Biological Survey; Figure 5). More than 99% of the prairie in Minnesota has been converted making even small remnants important to the many prairie-dependent wildlife and plant species (Appendix B).

Calcareous Fen

According the NHIS database search results, a calcareous fen is located on Pogones Wildlife Management Area (Figure 4). Calcareous fens are a rare and distinctive wetland that are dependent on groundwater that is cold, oxygen-poor, rich in calcium and magnesium bicarbonates (MNDNR 2008). Many of the plants that are found only in fens are also rare. Fens are very susceptible to disturbances such as reduction or change in water supply and quality, human and animal disruption, flooding, and water run-off into fens. The WMA is less than 1 mile from the southern boundary of the project area.

Wetlands and Riparian Areas

Formal wetland delineations for the OGWFRA have not been completed. Based on National Wetland Inventory (NWI) polygon data (USFWS NWI 2007), there are approximately 28 acres of wetlands, not including streams and rivers, found within the OGWFRA boundary (Table 2;

Figure 6). Less than 1% of the total OGWFRA is wetlands, excluding rivers and streams. The highest percentage (78%) of wetlands is freshwater emergent wetlands (Table 2). Freshwater forested/shrub wetland (about 17%), freshwater ponds (about 5%), and lakes (less than 1 acre) account for the remainder of the wetlands. Additional wetlands are found in the WMA's and WPA adjacent to the project boundaries, it is possible that wildlife move through the project boundary while traversing between the wildlife areas.

Table 2. Wetland water regimes present within the Oak Glen Wind Resource Area (NWI wetland polygons; USGS NWI 2007).

Wetland Water Regime	Acres	Percent
Freshwater Emergent Wetland	21.6	78.3
Freshwater Forested/Shrub Wetland	4.7	17.1
Freshwater Pond	1.3	4.6
Lake	<0.1	<0.1
Total	27.6	100

A tributary of Turtle Creek drains the northwestern portion of the OGWFRA to the north while the rest of the project area drains to the southwest to the Straight River via several tributaries (Figure 6). Oak Glen Lake is located adjacent to the most eastern block of the project area. An unnamed lake, located on the Aurora State WMA, is found along the northern boundary of the project area. Rickert Lake is located southeast of the project area.

There are no known USFWS wetland easements in the project area, but this should be confirmed through a county file search or coordination with the USFWS.

Calcareous Fen

Please see the discussion of calcareous fens under the Sensitive Habitats section.

WILDLIFE

Wildlife species associated with agricultural landscapes, grasslands, and deciduous treed areas are expected to be the most common species at the OGWFRA. A list of species observed during the site visit is provided in Table 3.

Table 3. Wildlife species observed at the Oak Glen Wind Resource Area during the site visit, April 1, 2009.

Species	Scientific Name
American crow	<i>Corvus brachyrhynchos</i>
American kestrel	<i>Falco sparverius</i>
American robin	<i>Turdus migratorius</i>
California gull	<i>Larus californicus</i>
Canada goose	<i>Branta canadensis</i>

Table 3. Wildlife species observed at the Oak Glen Wind Resource Area during the site visit, April 1, 2009.

Species	Scientific Name
common grackle	<i>Quiscalus quiscula</i>
Cooper's hawk	<i>Accipiter cooperii</i>
European starling	<i>Sturnus vulgaris</i>
horned lark	<i>Eremophila alpestris</i>
killdeer	<i>Charadrius vociferus</i>
mallard	<i>Anas platyrhynchos</i>
northern flicker	<i>Colaptes auratus</i>
red-tailed hawk	<i>Buteo jamaicensis</i>
red-winged blackbird	<i>Agelaius phoeniceus</i>
ring-necked pheasant	<i>Phasianus colchicus</i>
rock pigeon	<i>Columba livia</i>
western meadowlark	<i>Sturnella neglecta</i>
wild turkey	<i>Meleagris gallopavo</i>

Federal Listed Species

No federally-listed endangered, threatened, or candidate wildlife species are known to occur in the OGWFRA according to the response from the USFWS (Appendix B).

State Species of Concern

The MNDNR completed a search of the Minnesota NHIS for rare wildlife species known to occur within an approximate 1-mile radius of the project area (Appendix B). Results of the search included records for the Henslow's sparrow (*Ammodramus henslowii*), loggerhead shrike (*Lanius ludovicianus*), and Blanding's turtle (*Emydoidea blandingii*).

Henslow's Sparrow

Adult and juvenile Henslow's sparrows were observed in 2008 within the project area (Appendix B). The Henslow's sparrow is a Minnesota endangered species that requires uncultivated grasslands, old fields with standing, dead vegetation, and a litter layer (MNDNR Species Profiles website). Populations of the sparrow have declined drastically, probably due to habitat loss and the species' very specific habitat requirements. The MNDNR recommends avoiding the area where the sparrows were observed or carrying out construction during the non-breeding season. Surveys for Henslow's sparrows were conducted within the OGWFRA in 2009.

Loggerhead Shrike

The loggerhead shrike is a Minnesota threatened species that has been documented multiple times in 1996 and once in 2007 in the vicinity of the project area (Appendix B). This species also requires a very specific habitat which is large areas of open grassland interspersed with hedgerows, shrubs, and small trees (MNDNR Species Profiles website). Loggerhead shrike populations are declining, probably due to habitat conversion, tree encroachment on grasslands,

farming practices that remove trees, shrubs, and hedgerows, and environmental contamination of their food supply. Surveys for loggerhead shrikes were conducted within the OGWFRA in 2009.

Blanding's Turtle

The Blanding's turtle is a Minnesota threatened species that was observed over 50 years ago near the southwestern boundary of the project area (Appendix B). Habitat requirements for the turtle include wetland complexes with plentiful vegetation and adjacent well-drained uplands (MNDNR Species Profiles website). Nesting occurs in dry uplands with sparse vegetation, such as agriculture fields. Habitat loss or change, mortality on roads, and negative impact of farming practices on nests and young are some reasons for the population decline. Given the predominance of cultivated agriculture and limited wetlands in the project area, occurrence of this species within the OGWFRA is doubtful.

Raptors and Other Large Birds

Species Likely To Occur In the Area

The following raptor species could occur in or near the project area during some portion of the year (MOU website): bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), broad-winged hawk (*Buteo platypterus*), red-shouldered hawk (*B. lineatus*), Swainson's hawk (*B. swainsoni*), red-tailed hawk, rough-legged hawk (*B. lagopus*), American kestrel, peregrine falcon (*Falco peregrinus*), merlin (*F. columbarius*), and osprey (*Pandion haliaetus*).

Other species often grouped with raptors that could be found in the project area include the great-horned owl (*Bubo virginianus*), eastern screech owl (*Otus asio*), snowy owl (*Nyctea scandiaca*), barred owl (*Strix varia*), long-eared owl (*Asio otus*), short-eared owl (*Asio flammeus*), and turkey vulture (*Cathartes aura*).

Of these, the Cooper's hawk, Swainson's hawk, red-tailed hawk, American kestrel, red-shouldered hawk, great-horned owl, eastern screech owl, barred owl, and long-eared owl are most likely to be nest in the vicinity of the project area (MOU website). During the site visit, red-tailed hawk, Cooper's hawk, and American kestrel were observed in the project area (Table 3).

Potential Raptor Nesting Habitat

No raptor nests were observed during the site visit. Potential nest structures for above ground nesting species were present in the form of living and dead trees scattered throughout the project area (Figure 7). Farmsteads observed during the site visit generally had tree rows or woodlots associated with them. Grassland areas in and adjacent to the project could provide nesting habitats for ground-nesting raptors.

Potential for Prey/Forage Concentrations

No signs of colonial rodents were observed during the site visit; these types of areas are known to attract feeding raptors. However, it is possible that small mammal colonies, such as ground squirrels, are present within the OGWFRA, but were not visible from public roads. Potential

raptor prey sources include rodents, rabbits, and waterfowl; all consistent with a cultivated agriculture and grassland region.

Overall, it is very difficult to assess potential prey densities during individual site visit from public access roads and prey densities can fluctuate rapidly based on habitat and climatic factors. However, overall prey densities are not expected to be significantly different than areas outside of the proposed OGWFRA, with the exception of the Steele County Landfill (Figure 4). With roost sites and food available, it is likely that raptors will use the area but not to a greater degree than the surrounding areas with similar habitat.

The Steele County landfill is located about 1 mile northwest of Bixby, Minnesota, within the project boundary (Figure 4). During the site visit, numerous gulls and American crows (*Corvus brachyrhynchos*) were observed in the landfill. While not necessary attracting feeding raptors, this area does constitute a forage concentration area the gulls and crows that could be at risk of turbine strike. The USFWS Interim Guidelines (2003) recommends avoiding turbine placement in areas where birds will be concentrated, such as a landfill.

Topography and Raptor Use

Topography in the OGWFRA is gently rolling to rolling. There are no big hills, steep ridges, or other topographical features that might cause bottlenecks or significant updrafts where raptors might concentrate (Figure 2). At other wind-energy facilities located on prominent ridges with defined edges (e.g., rims of canyons, steep slopes), raptors often fly along the rim edges, using updrafts to maintain altitude while hunting, migrating or soaring (Johnson et al. 2000b; Hoover and Morrison 2005). In Wyoming, raptors most often used areas within 164 ft (50 m) of the rim edge (Johnson et al. 2000b). It is not anticipated that topography will increase the potential for raptor use in the OGWFRA.

Bird Migration

Most species of birds are protected by the Migratory Bird Treaty Act (MBTA 1918). Although many species of passerines migrate at night and may collide with tall man-made structures, no large mortality events on the same scale as those seen at communication towers have been documented at wind-energy facilities in North America (NWCC 2004). Large numbers of passerines have collided with lighted communication towers and buildings when foggy conditions occur during spring or fall migration. Birds appear to become confused by the lights during foggy or low cloud ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001). Most collisions at communication towers are attributed to the guy wires on these structures, which wind turbines do not have. Additionally, the large mortality events observed at communication towers have occurred at structures greater than 500 ft (152 m) in height (Erickson et al. 2001), likely because most small birds migrate at elevations of 500 to 1,000 ft (152 to 305 m) above the ground (USFWS 1998), which is higher than most of the modern turbines. Migrating passerines are likely more at risk of turbine collision when ascending and descending from stopover habitats.

It is likely that birds migrate through the proposed OGWFRA, including passerines, raptors, and waterfowl. Tree-rows, wetlands, and grasslands areas scattered throughout the OGWFRA may

provide stopover habitat for migrants or individuals during post-breeding dispersal (Figure 7). Harvested grain crops, such as corn fields that were observed during the site visit, could serve as feeding areas that might attract migrating and wintering waterfowl. These types of habitats are found throughout the region and therefore their presence in the OGWFA should not concentrate bird use as compared to adjacent areas.

Breeding Birds

The nearest US Geological Survey (USGS) Breeding Bird Survey (BBS) route is the Austin Route (Figure 8; National Atlas of the United States 2009). Each BBS route is 24.5 mi (39.4 km) long, and all birds seen or heard are tallied for a three-minute period every half mile (0.8 km) along the route. In 2008, 1,190 individuals of 65 species were observed on the Austin Route (Sauer et al. 2008). The five most abundant species observed were the red-winged blackbird, common grackle, European starling, house sparrow (*Passer domesticus*), and American robin. In 2007, 1,199 individuals of 57 species were observed with the five most commonly observed species being the red-winged blackbird, common grackle, European starling, American robin, and Canada goose.

Displacement of grassland nesting birds is often one of the primary concerns wildlife agencies express regarding the placement of wind facilities in and near grassland areas. Recent research has focused on the potential displacement of grassland passerines at wind-energy facilities, and some uncertainty currently exists over the effects of wind-energy facilities on the breeding success of these birds. In Minnesota, researchers have found that breeding passerine density on Conservation Reserve Program grasslands was reduced in the immediate vicinity of turbines (Leddy et al. 1999), but changes in density at broader scales was not detectable (Johnson et al. 2000a). Erickson et al. (2004) documented a decrease in density of some native grassland passerines, such as grasshopper sparrow (*Ammodramus savannarum*), near turbines in Washington; however, they could not determine if a decrease in post-construction density was the result of behavioral disturbance or a loss of habitat. Piorkowski (2006) conducted a displacement study at a wind-energy facility in Oklahoma where, of the grassland species present on the site, only the western meadowlark showed significantly lower densities near turbines. Piorkowski (2006) suggested that habitat characteristics were more important to determining passerine breeding densities than the presence of wind turbines. Shaffer and Johnson (2007) documented avoidance by grasshopper sparrows out to 492 ft (150 m) at a wind-energy facility in northern South Dakota. The proposed OGWFA contains grasslands, some of which may be native grasslands, and some species of sensitive grassland passerines are likely to be present in the OGWFA and displaced in the areas around turbines, if they are constructed in or near grasslands. As more research is published from around the region and country, the potential impacts of wind turbines on breeding passerines can be better defined.

State Species of Concern

The MNDNR completed a search of the NHIS for rare wildlife species known to breed in the vicinity of the project area (Appendix B). Results of the search included records for the Henslow's sparrow, red-necked grebe (*Podiceps grisegena*), and sandhill crane (*Grus canadensis*).

Henslow's Sparrow

Adult and juvenile Henslow's sparrows, a Minnesota endangered species, were observed in 2008 within the project area (Appendix B). Please see a discussion of this species in the section "State Species of Concern".

Red-Necked Grebe

The red-necked grebe, a Species of Greatest Conservation Need in Minnesota, is known to breed colonially in nearby Oak Glen Lake (Appendix B). The grebe is not a state-listed species but was identified in the MNDNR's response as a bird of interest. The breeding colony could also attract raptors. Grebes, rails, and similar species have been found as fatalities at other wind facilities.

Sandhill Crane

Sandhill crane adults and juveniles were reported by the MNDNR as being observed feeding adjacent to the Aurora WMA, which along the northern boundary of the project area (Appendix B). The sandhill crane is not a state-listed species but was identified in the MNDNR's response as a bird of interest (MNDNR Nature Snapshots website). Sandhill cranes have not been documented as fatalities at wind facilities (NWCC 2004).

Bats

There are several species of bats that could be found in the OGWFRA, including the big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*), little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), silver-haired bat (*Lasionycteris noctivagans*), and tri-colored bat (*Perimyotis subflavus*); BCI website).

The northern myotis is a species of special concern in Minnesota but the state does not have a record of the bat occurring in Steele County (MNDNR Species Profiles website). The USFWS had formerly listed the long-eared bat (*Myotis evotis*), Townsend's big-eared bat (*Corynorhinus townsendii*), long-legged bat (*Myotis volans*), and small-footed myotis (*Myotis leibii*) as candidate species. Based on information from Bat Conservation International, none of the former candidate species occur in the OGWFRA (BCI website). No state or federally listed bat species are known or believed to occur in the OGWFRA.

Potential roosting habitat within the OGWFRA is found in the form of trees and buildings; no caves were observed during the site visit. Bats generally forage over water and open spaces such as agricultural fields, grasslands, streams, and wetlands/ponds adjacent to or within wooded areas. Bats may prey on insects that are likely to concentrate over water in wetlands and streams and these types of areas are most likely to attract foraging bats. Bats probably forage over the entire OGWFRA at some level given the scattering of trees and open fields, although the extent and location of use is not known. Higher foraging/use rates are likely to be found over the few wetlands in the project area as well as the lakes and wetlands outside of the project boundary.

Bat casualties have been reported from most wind-energy facilities where post-construction fatality data are publicly available. Reported estimates of bat mortality at wind-energy facilities have ranged from 0.01 – 47.5 fatalities per turbine per year (0.9 – 43.2 bats / MW / Year) in the United States, with an average of 3.4 per turbine or 4.6 per MW (NWCC 2004). Most of the bat

casualties at wind-energy facilities to date are migratory species which conduct long migrations between summer roosts and winter areas. The species most commonly found as fatalities at wind-energy facilities include hoary bats, silver-haired bats and eastern red bats (Table 5). The highest numbers of bat fatalities found at wind-energy facilities to date have occurred in eastern North America on ridge tops dominated by deciduous forest and where documented use rates have been high (NWCC 2004; Table 6). However, Barclay et al. (2007) recently reported relatively high fatality rates from a facility in Canada located in grassland and agricultural habitats. A site in northern Iowa near Clear Lake also was found to have relative high fatality rates (Kunz et al. 2007; Table 6). Unlike the eastern US wind-energy facilities with high bat mortality, the Alberta facility is in open grasslands and crop fields, although it is adjacent to foothills along the Rocky Mountains and may lie within a bat migration corridor. The Iowa facility is also in an agriculturally dominated area and it is unclear why there were elevated fatalities.

Besides information from the Buffalo Ridge Project in Southwest Minnesota, there has been limited, publically-available, quantitative bat use surveys conducted in Minnesota. Based on bat use and bat fatalities studies from other parts of the country, including Minnesota (Table 6), it would be expected that bat impacts would be similar to other open grassland/agricultural landscapes. However, the exact magnitude of these fatalities and the degree to which bat species will be affected is difficult to determine.

Table 5. Species composition of bat fatalities from wind-energy facilities in the US (Adapted from NRC 2007, p. 65).

Common Name	Scientific Name	Total (number and percentage)	
hoary bat	<i>Lasiurus cinereus</i>	1,023	41
eastern red bat	<i>Lasiurus borealis</i>	580	23
tri-colored bat	<i>Perimyotis subflavus</i>	261	11
silver-haired bat	<i>Lasionycteris noctivagans</i>	209	8.4
little brown myotis	<i>Myotis lucifugus</i>	145	5.8
Brazilian (or Mexican) free-tailed bat	<i>Tadarida brasiliensis</i>	143	5.7
big brown bat	<i>Eptesicus fuscus</i>	59	2.4
northern long-eared myotis	<i>Myotis septentrionalis</i>	8	0.4
western red bat	<i>Lasiurus blossomilli</i>	4	0.2
Seminole bat	<i>Lasiurus seminolus</i>	1	0.1
unknown	-	53	2.1
Total	10 species	2,486	100

Table 6. Wind-energy facilities in the US with both pre-construction AnaBat sampling data and post-construction mortality data for bat species (adapted from Kunz et al. 2007).

Wind-Energy Facility	Activity (#/detector night)	Mortality (bats/turbine/year)
Foote Creek Rim, WY	2.2	1.3
Buffalo Ridge, MN	2.1	2.2
Buffalo Mountain, TN	23.7	20.8
Top of Iowa, IA	34.9	10.2
Mountaineer, WV	38.3	38

CONCLUSIONS

A summary of the potential for wildlife and habitat conflicts in the proposed wind-energy facility development area is presented in Table 7. No federally-listed endangered, threatened, or candidate plant species or critical habitats are known to occur in the OGWFERA. The search of the Minnesota NHIS for rare plant species found observations of the plains wild indigo and rattlesnake-master. The plains wild indigo was observed along Oak Glen Lake in 1951; the plant is not likely to be found on the project area, based on the length of time since an observation. Rattlesnake-master was recorded in several areas adjacent to the project area during a 1997-98 railroad ROW prairie survey. This plant species is probably still present within or in proximity to the project area.

Although there are few wetlands in the project area, and additional wetlands and lakes in the vicinity. There is also a rare calcareous fen to south of the project area that is very sensitive to disturbance. It is likely that birds will move between these wetlands, thus crossing over the project area.

There are grasslands, some of them likely native prairie, located within and adjacent to the project area. In general, remaining native land cover in this portion of Minnesota, including native grasslands and wetlands, are considered very important to native wildlife. On a local scale it is likely that these native areas will attract wildlife. Project developments in the areas with less wetlands and native grasslands would likely have lower impacts (i.e., displacement) to wildlife, particularly grassland bird species and bats.

There are no federal or state areas within the project but there are several nearby; these areas are found to the north, south, and east of the project area. These areas could provide attractive habitat for breeding and migrating birds. Birds will likely move between these areas, resulting in birds moving through project area.

No rare or sensitive wildlife species were observed during the site visit. However, the Minnesota NHIS search results included records for the Henslow's sparrow, loggerhead shrike, and Blanding's turtle. Adult and juvenile Henslow's sparrows, a Minnesota endangered species, were

observed in 2008 within the project area. It seems possible that the sparrow will utilize the area again. The loggerhead shrike, a Minnesota threatened species, has been documented multiple times in two years in the vicinity of the project area. It is likely that shrikes will utilize the OGWFRA. Surveys are ongoing to determine the presence of these species. The Blanding's turtle, a Minnesota threatened species, was observed over 50 years ago near the project area; this turtle species probably is no longer found in the area based on the number of years since its last observation. There is also a known red-necked grebe breeding colony located adjacent to the project area.

Many species of raptors could be found in or near the project area based on ranges and observations made during the site visit. Nesting sites are available in, and adjacent to, the project area. No topographical features were observed during the site visit that might concentrate raptor use. No colonial mammals, which could serve as prey for raptors, were observed during the site visit but they could exist on the project area. The Steel County landfill appears to concentrate gull and crow use in the area. Care should be taken in placing turbines in close proximity to the landfill due to this concentration of birds.

Several species of bats could utilize the project area based on their ranges, but the extent of their use (species, numbers of bats) is unknown. Deciduous trees and buildings in the area provide potential roosting habitat and hibernacula for bats. Research to date on the impacts of wind-energy facilities on bats has shown that species that conduct long distance migrations usually make up the vast majority of bat fatalities at wind-energy facilities. Additionally, the timing of bat fatalities at wind-energy facilities indicates that most bats are killed by turbines during the migration season. Few bat fatalities have been recorded at wind-energy facilities during spring or summer, although bat use at wind-energy facilities has been recorded during those seasons. Migrating bats appear to be at much higher risk of collision than resident bat species that may breed near wind-energy facilities. Maximizing distances from open water and wetlands should decrease the potential impacts to bats.

As the proposed OGWFRA moves forward, further wildlife and habitat surveys may be warranted on specific site(s), such as grasslands, and these studies are ongoing. The results can be used to identify areas of high wildlife use and sensitive habitats to assist with turbine siting and to compare with post-construction data collection. These surveys are likely to include:

- Jurisdictional wetlands and waters of the US are present in the OGWFRA. A formal delineation should be performed prior to construction.
- Update of vegetation community mapping in selected areas of the OGWFRA to assist in micro-siting away from grassland areas.
- Surveys for nesting raptors should be conducted to determine breeding raptor use of the OGWFRA and to avoid nesting areas during construction.
- Fixed-point bird use surveys could be conducted to help evaluate the project area use levels in comparison to other WRAs in the region and nationally. By comparing use rates

and fatality rates at existing WRA's to use rates at proposed development locations, it may be possible to estimate potential direct impacts levels (e.g., low, moderate, or high).

- There is little information on bat migration routes in the Midwest and potential impacts of wind-energy development on bats are of concern. Although there is no evidence that significant numbers of bats would migrate through the OGWFRA, acoustic bat surveys could help predict possible levels of impact.
- Species-specific surveys for federal or state species of concern likely to be impacted by the OGWFRA will be conducted once construction plans are finalized and it is known if the layout will impact potential habitat (e.g., Henslow's sparrow, loggerhead shrike). This could include both habitat and species surveys as appropriate.
- Post-construction bird and bat mortality monitoring to estimate fatality rates are recommended and at least one year post-construction surveys for breeding birds, bats, and bird use surveys to compare to pre-construction survey information.

Table 7. A summary of the potential for wildlife and habitat conflicts in the Oak Glen Wind Resource Area.

VH = Very High, H = High, M = Medium, and L = Low.					
Issue	VH	H	M	L	Notes
Potential for raptor nest sites			✓		Several tree rows and woodlots
Concentrated raptor flight potential				✓	The project area has no topography or other prominent features likely to concentrate raptor use.
Potential for migratory pathway				✓	The project area has no topography or other prominent features likely to concentrate birds during migration.
Potential for raptor prey species			✓		Suitable habitat for small mammals and birds.
Potential for protected species to occur	✓				State listed species (e.g., Henslow's sparrow, loggerhead shrike) have been documented recently within and/or adjacent to the project area in recent years.
Potential for State Issues		✓			Protection of habitats required by protected bird species.
Uniqueness of habitat at wind-energy facility			✓		The overall habitat in the OGWFRA is not unique compared to the surrounding landscape, but there are areas of native grassland within and adjacent to the project area as well as state and federal wildlife areas.
Potential for rare plants to occur		✓			No federally-listed plants known to occur in project area. Potential for state species to occur.
Potential for use by bats		✓			The site has scattered trees and buildings, and wetlands in the vicinity.

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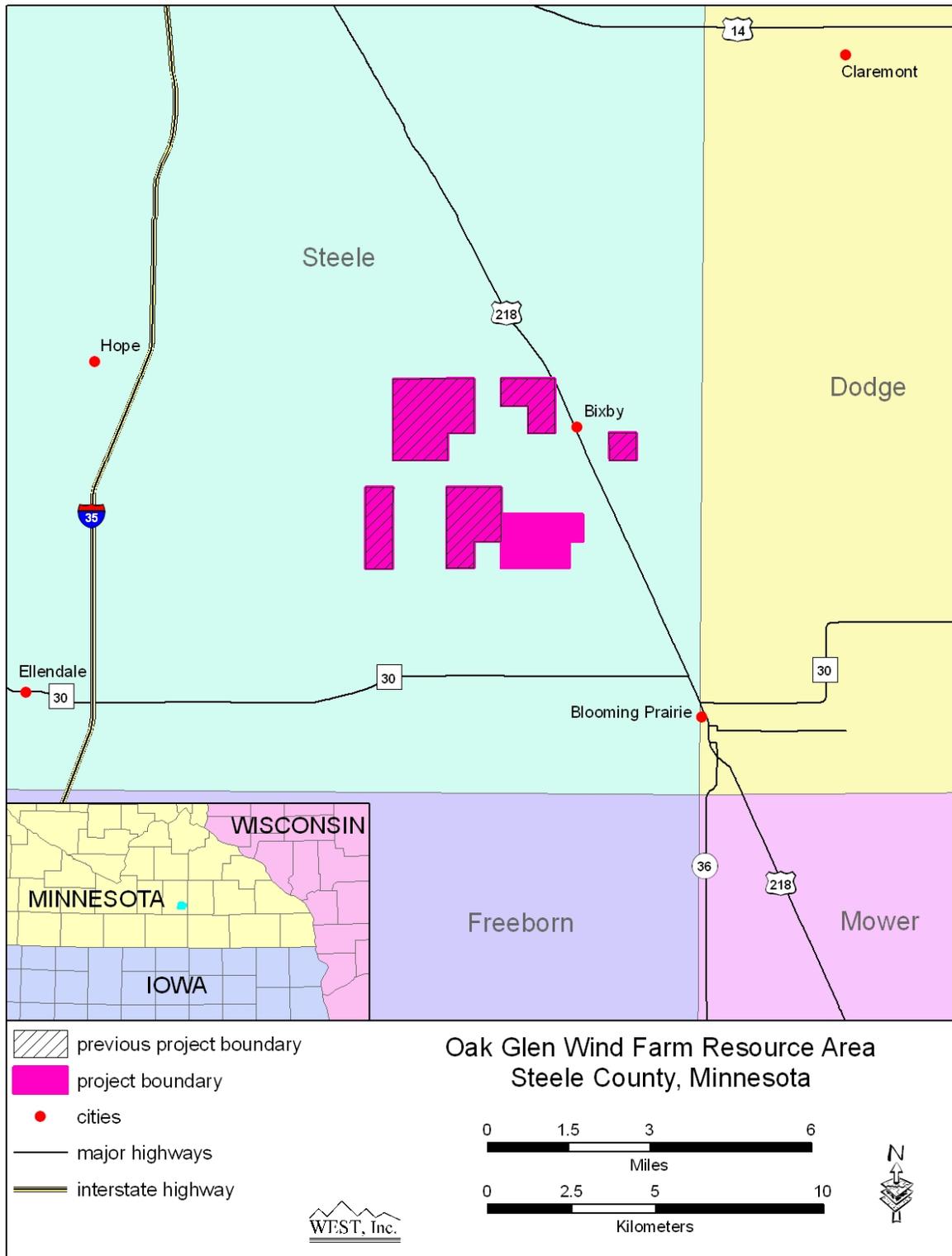


Figure 1. Location of the Oak Glen Wind Farm Resource Area.

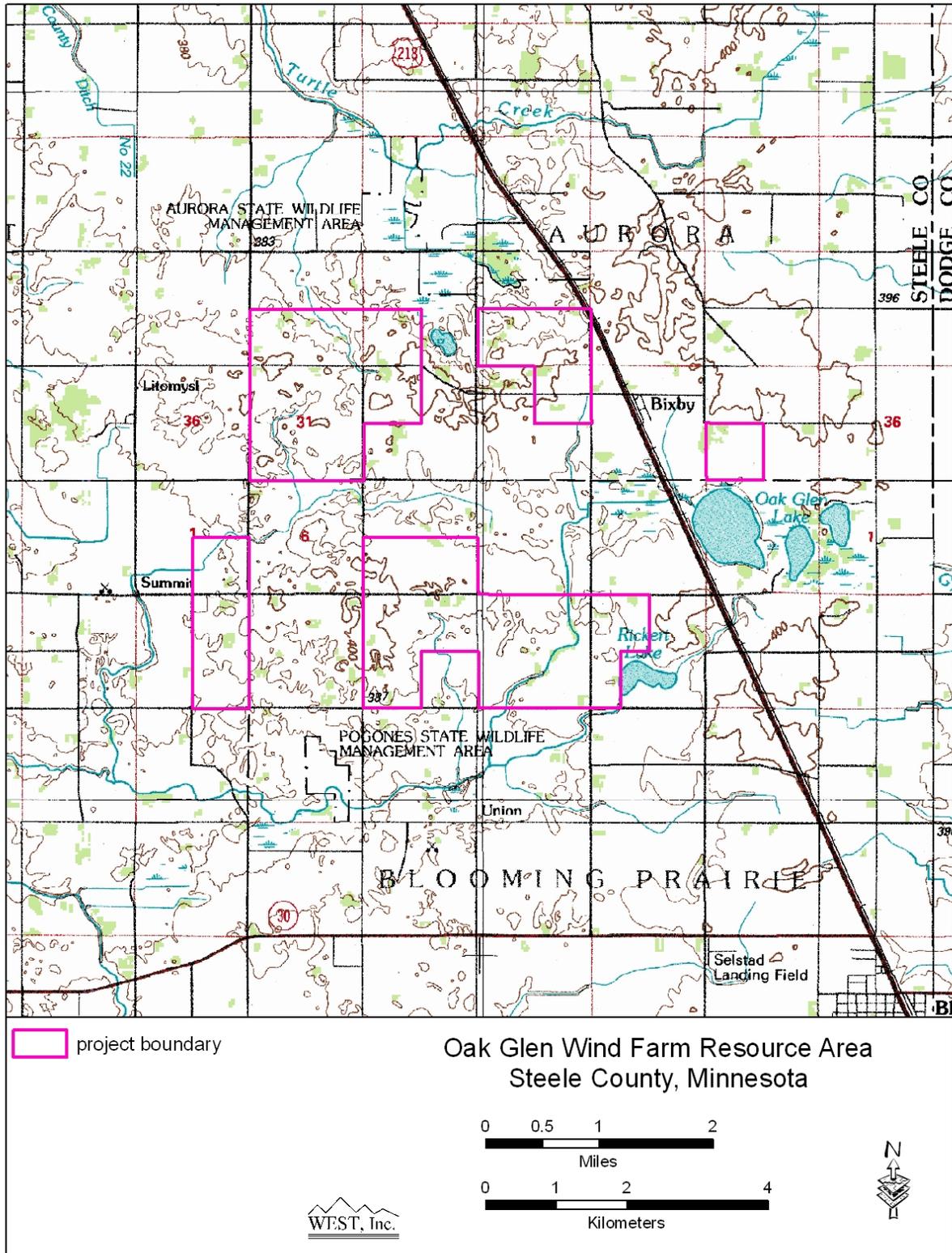


Figure 2. Topographic map of the Oak Glen Wind Farm Resource Area.

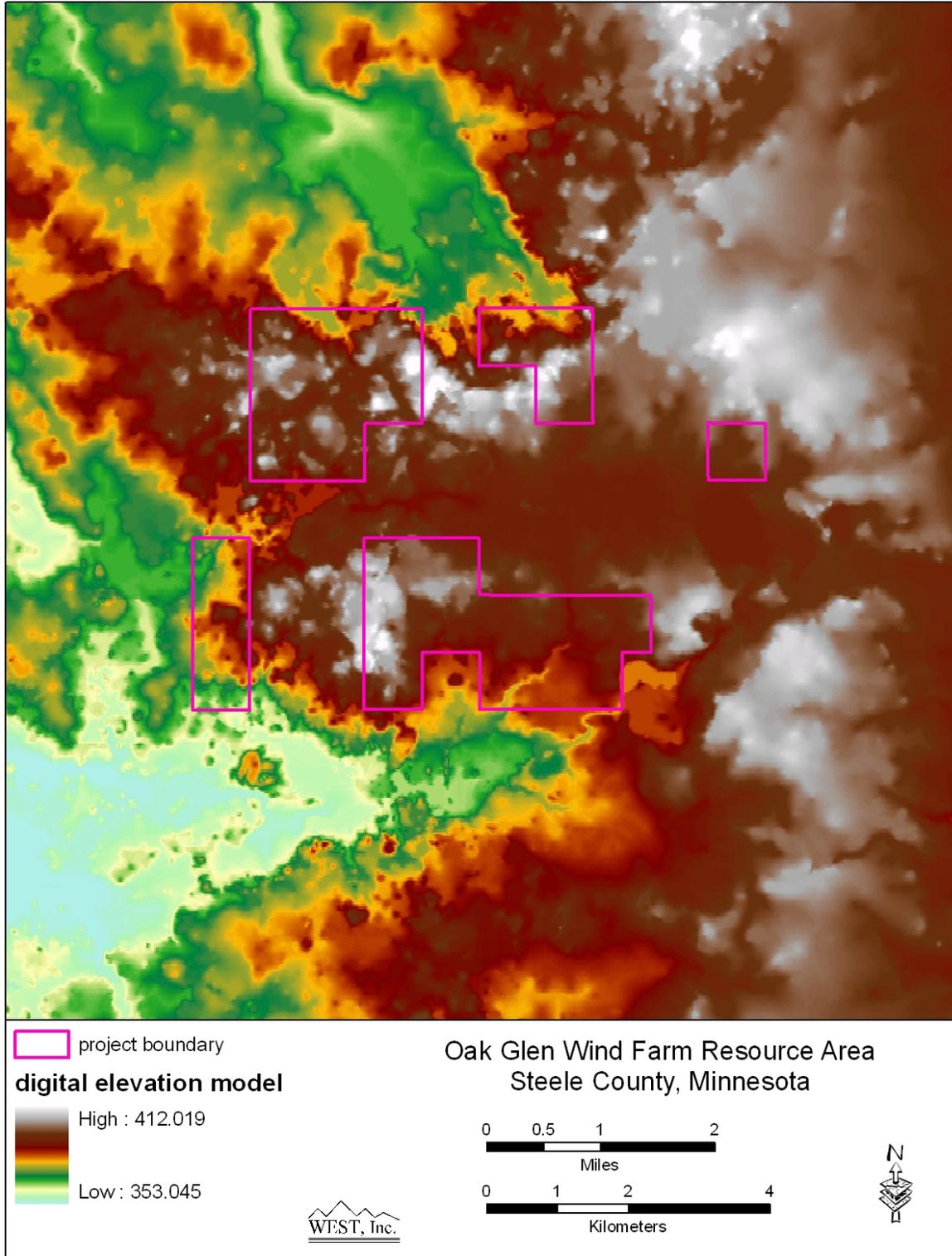


Figure 3. Digital elevation model of the Oak Glen Wind Farm Resource Area.

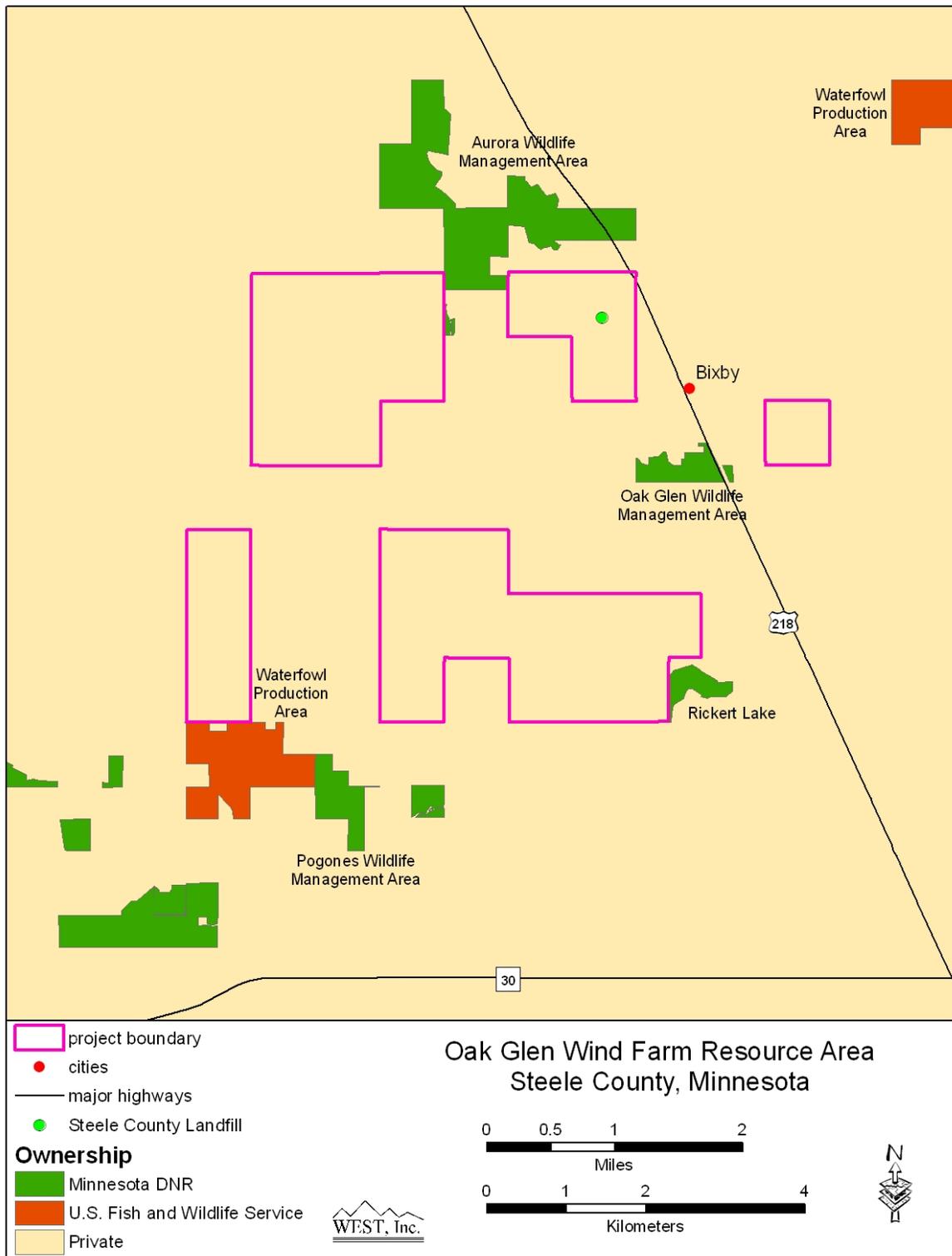


Figure 4. Ownership of the Oak Glen Wind Farm Resource Area.

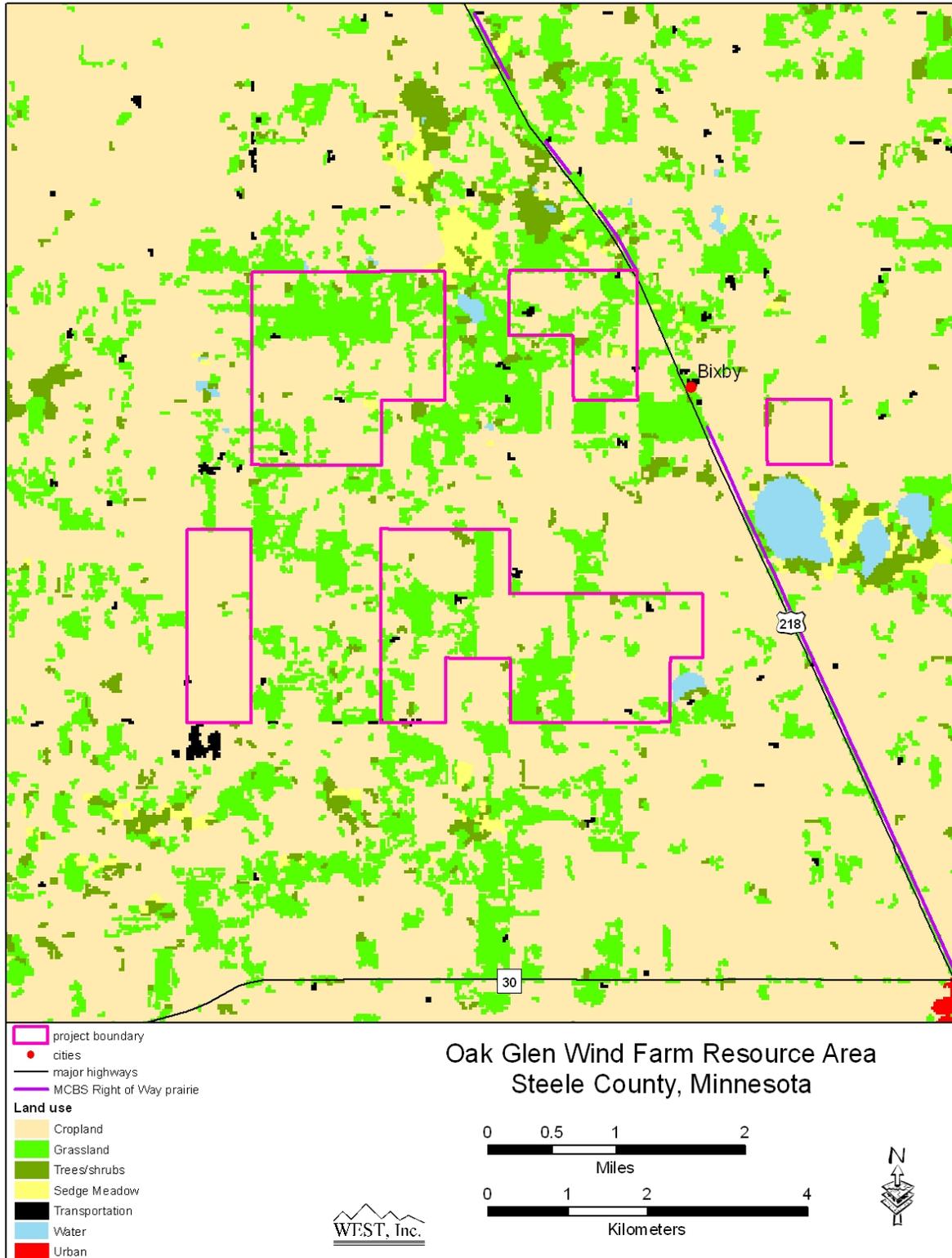


Figure 5. Land use/land cover map of the Oak Glen Wind Farm Resource Area.

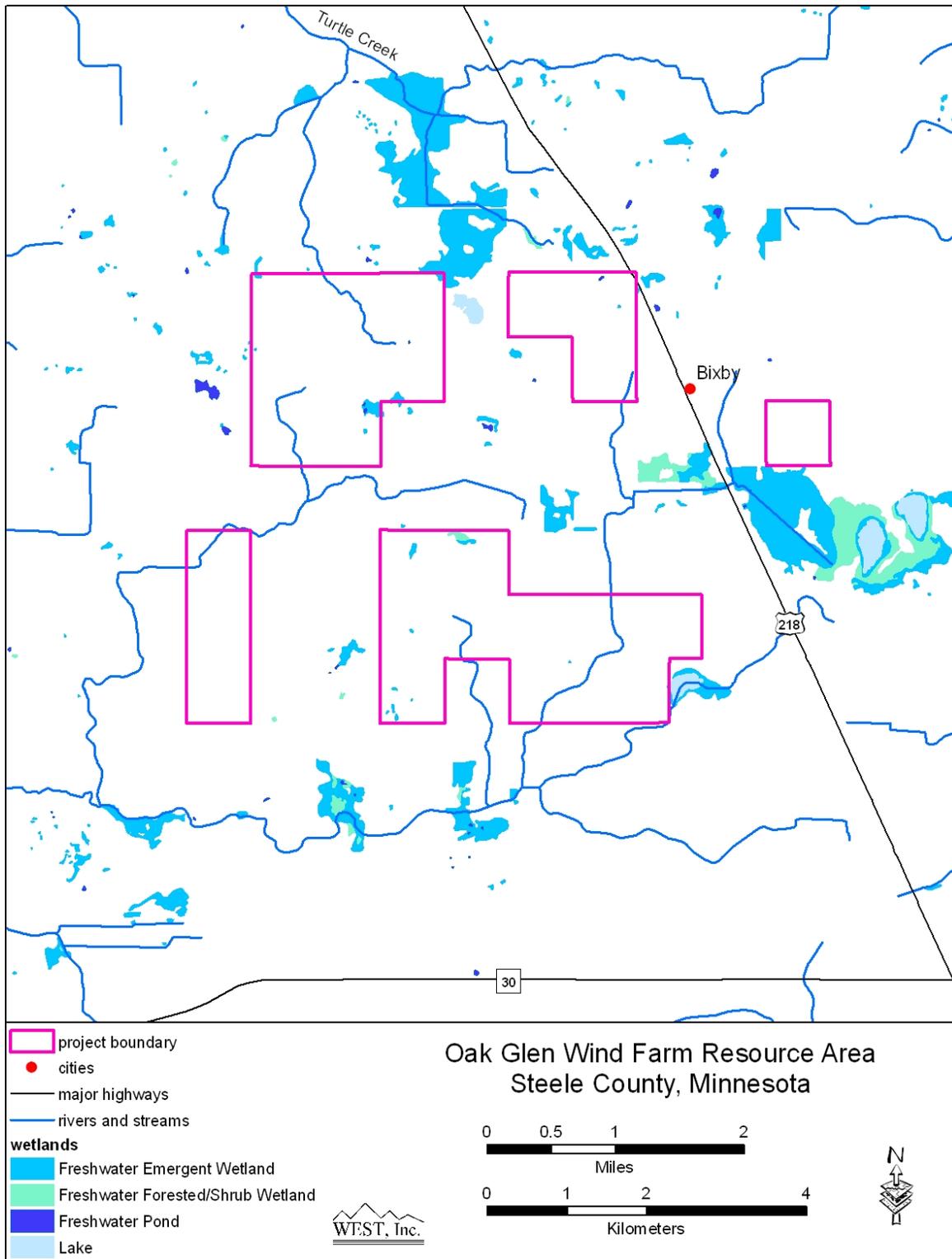


Figure 6. NWI wetland and rivers map of the Oak Glen Wind Farm Resource Area.

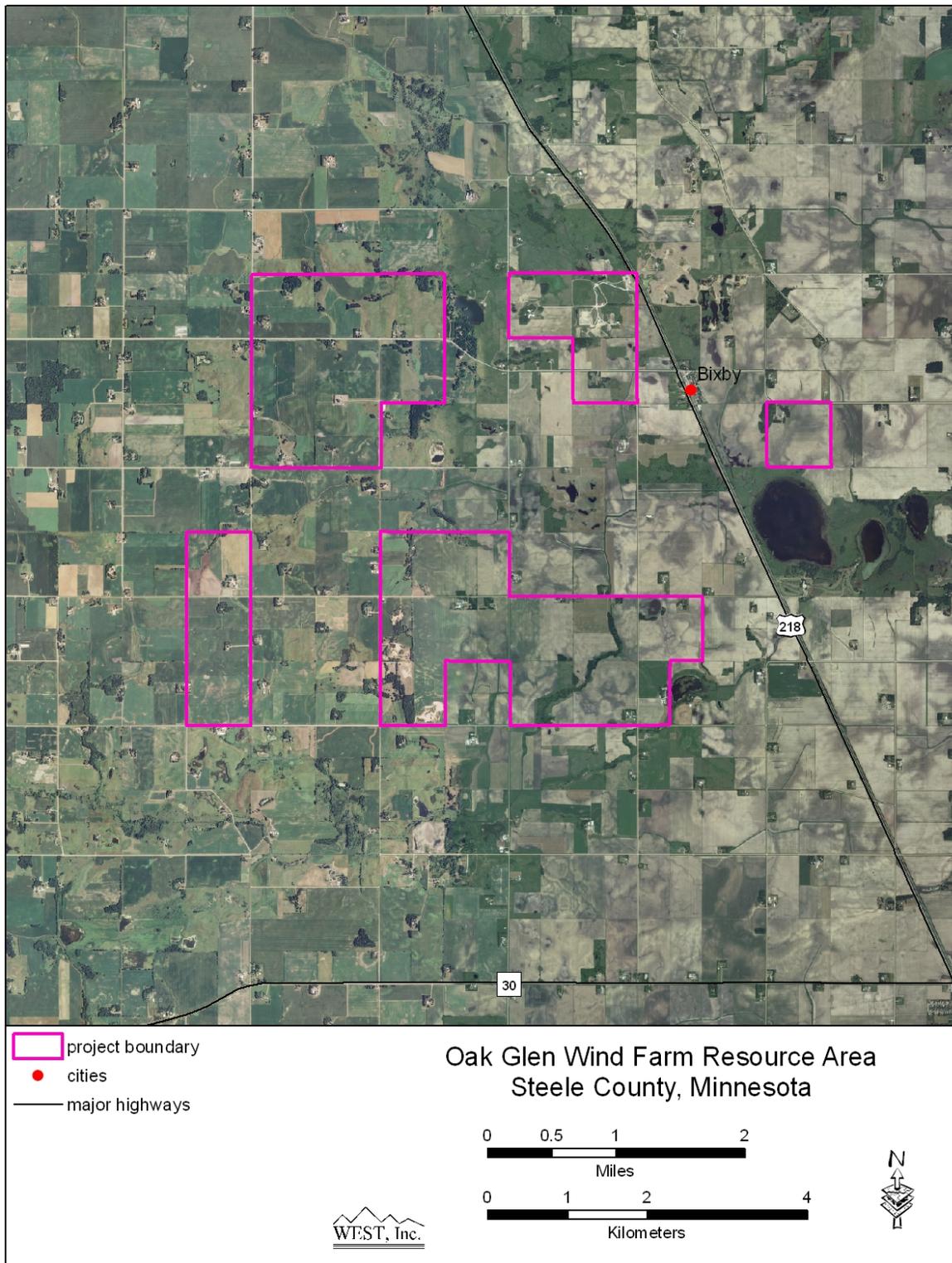


Figure 7. Aerial photograph of the Oak Glen Wind Farm Resource Area.

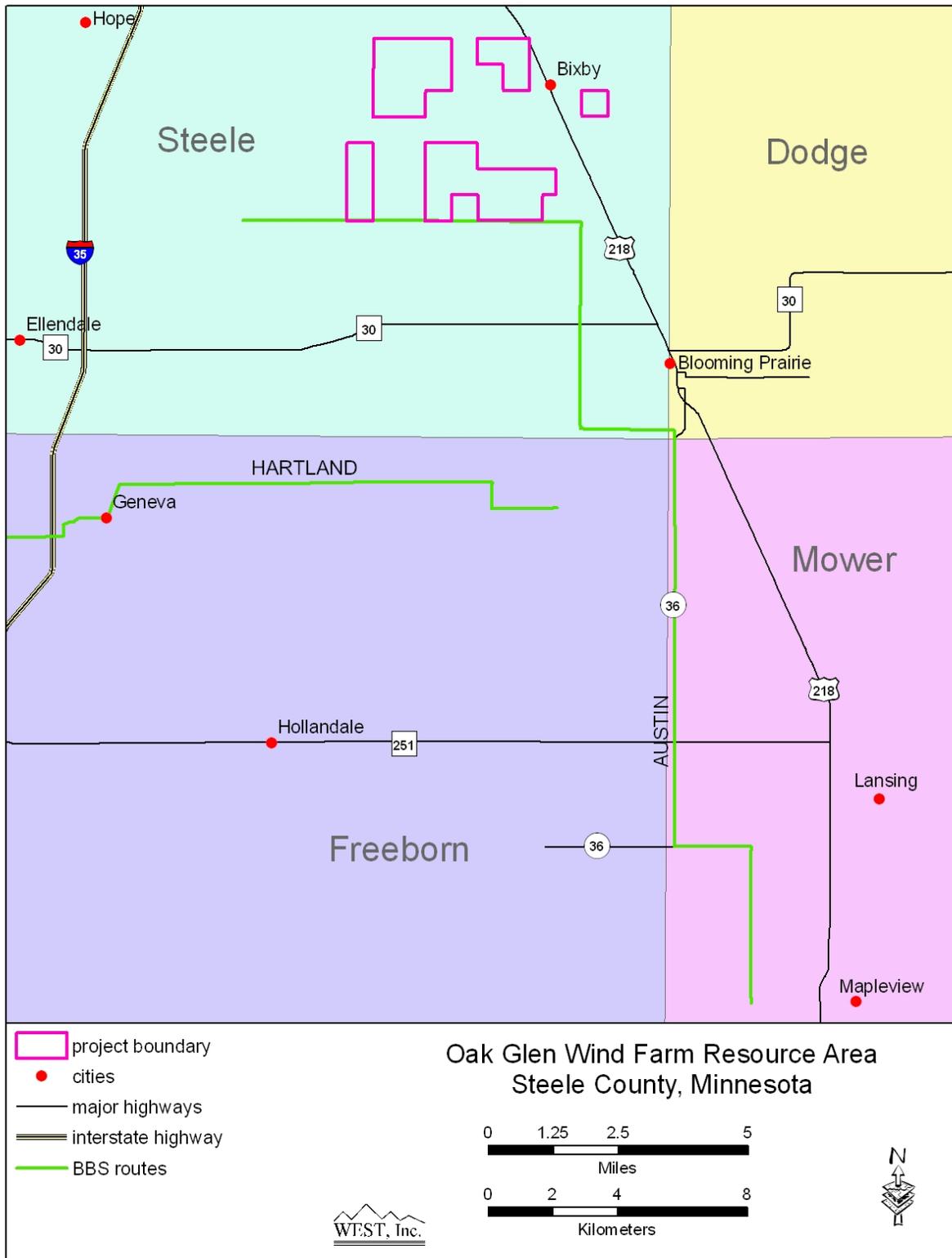


Figure 8. Breeding Bird Survey route nearest the Oak Glen Wind Farm Resource Area.

Appendix A: Photographs from the Oak Glen Wind Farm Resource Area site visit on April 1, 2009.



Photo 1. Northeast portion of project area, looking north.



Photo 2. North central portion of project area, looking northwest.



Photo 3. Southeast portion of project area.



Photo 4. Southwest portion of project area.



Photo 5. Southwest portion of project area.



Photo 6. Southwest portion of project area.