

**Avian Use Study
Aurora Wind Energy Project
Williams County, North Dakota**

**Final Draft Report
August 2017 – July 2018**

**Prepared for:
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January 9, 2019



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REPORT REFERENCE

Derby, C., K. Moratz, and S. Agudelo. 2018. Avian Use Study, Aurora Wind Energy Project, Williams County, North Dakota. Final Report: August 2017 – July 2017. Prepared for Aurora Wind Project, LLC, Lenexa, Kansas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. January 9, 2019.

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1 INTRODUCTION

Aurora Wind Project, LLC (Aurora) is considering the development of the Aurora Wind Energy Project (Project) in Williams County, North Dakota (Figure 1). To support development of the Project, Aurora contracted Western EcoSystems Technology, Inc. (WEST) to conduct pre-construction baseline avian use surveys within the Aurora Avian Use Study Area (Study Area) to estimate temporal and spatial bird use, using methods consistent with the US Fish and Wildlife Service's (USFWS) *Eagle Conservation Plan Guidance, Module 1 – Land-Based Wind Energy, Version 2* (ECPG; USFWS 2013) and *Final Land-Based Wind Energy Guidelines* (WEG; USFWS 2012).

The objectives of the fixed-point avian use surveys were to: 1) assess the relative abundance and spatial and temporal distribution of avian species within the Study Area, and 2) identify and assess the potential risk of adverse impacts to avian species or groups, especially eagles and federally-listed and sensitive avian species. This report describes the results of the second year (Year 2) of fixed-point avian use surveys conducted within the Study Area from August 11, 2017 – July 26, 2018; the first year of fixed-point avian use surveys (Year 1) was conducted from May 24, 2016 – May 7, 2017 (Derby 2017).

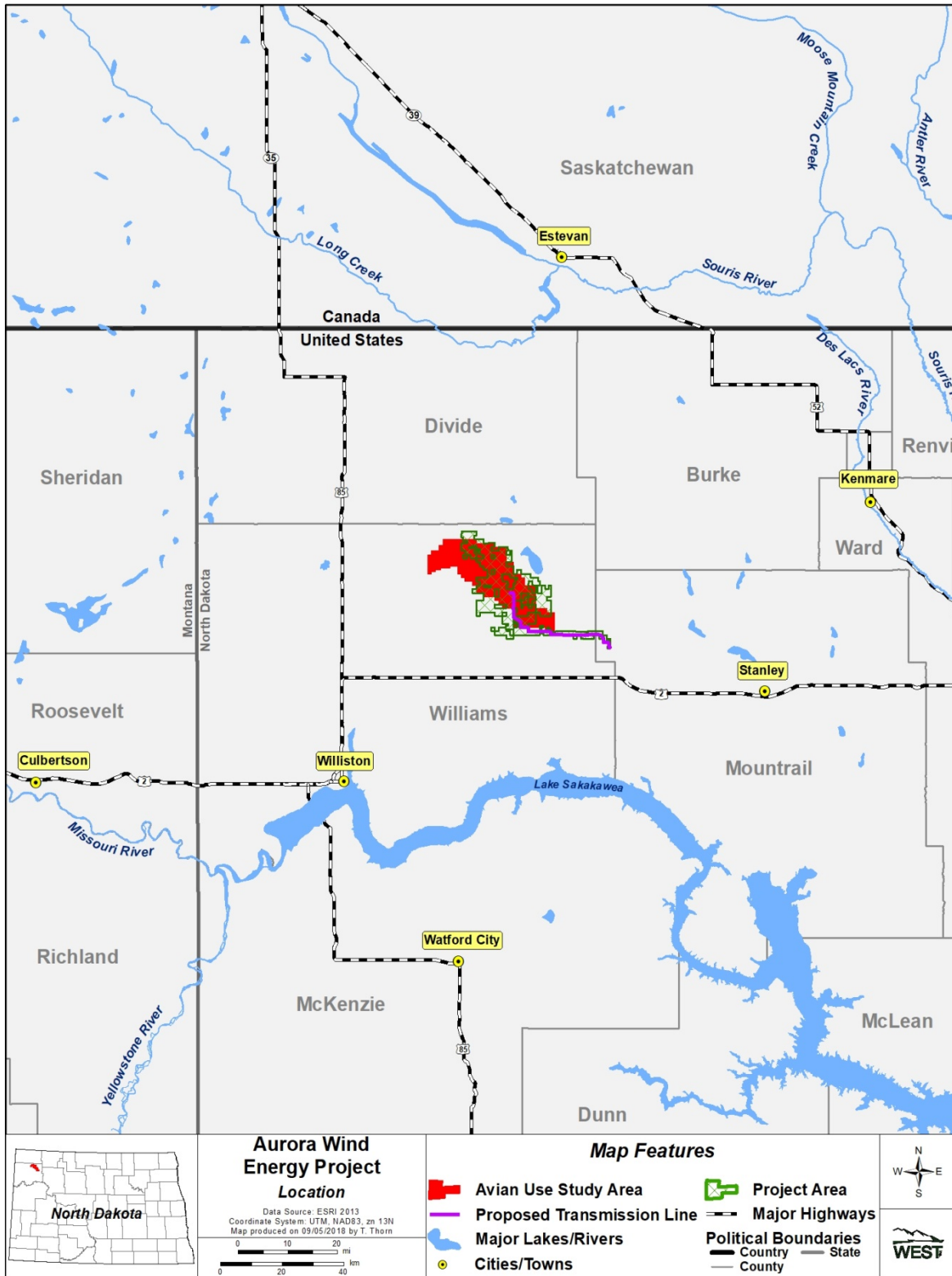


Figure 1. Location of the Aurora Wind Energy Project and Aurora Avian Use Study Area in Williams County, North Dakota.

2 STUDY AREA

The Project, located approximately 8 kilometers (5 miles) northwest of the city of Tioga in Williams County, North Dakota, falls within the Missouri Coteau Slope and River Breaks Level IV Ecoregions (US Environmental Protection Agency 2016), in an area of nearly flat to gently rolling topography previously dominated by short- and mixed-grass prairies (Bryce et al. 1996). Land conversion to agricultural crops in flat areas and livestock production on steeper lands along drainages has been extensive; oil and gas extraction are also major activities in the general region (Bryce et al. 1996, Wang et al. 2018).

The Study Area where avian surveys were conducted remained the same in Year 2 as Year 1; however, the total Project area decreased from approximately 21,982 hectares (ha; 54,318 acres [ac]) in Year 1 to 19,462 ha (48,092 ac) in Year 2, which includes a proposed transmission line to the east (Figure 1). According to the US Geological Survey (USGS) National Land Cover Database (NLCD; USGS NLCD 2011, Homer et al. 2015), cultivated crops composed the majority of lands within the Study Area (86.7%); grassland/herbaceous (6.6%), developed (3.8%), and water/wetlands (2.5%) were the next most common land types, while shrub/scrub, forest, and pasture/hay made up less than 1.0% of the total Project area (Table 1, Figure 2).

Table 1. US Geological Survey (USGS) National Land Cover Database (NLCD) land cover/land use types, acreage, and percent (%) composition within the Aurora Wind Avian Study Area in Williams County, North Dakota.

Land Cover/Land Use Type	Acres	% Composition
Cultivated Crops	47,091.1	86.7
Grassland/Herbaceous	3,564.8	6.6
Developed	2,074.4	3.8
Water/Wetlands	1,352.7	2.5
Shrub/Scrub	214.1	0.4
Forest	20.9	<0.1
Total	54,318.0	100

Sources: USGS NLCD 2011, Homer et al. 2015.

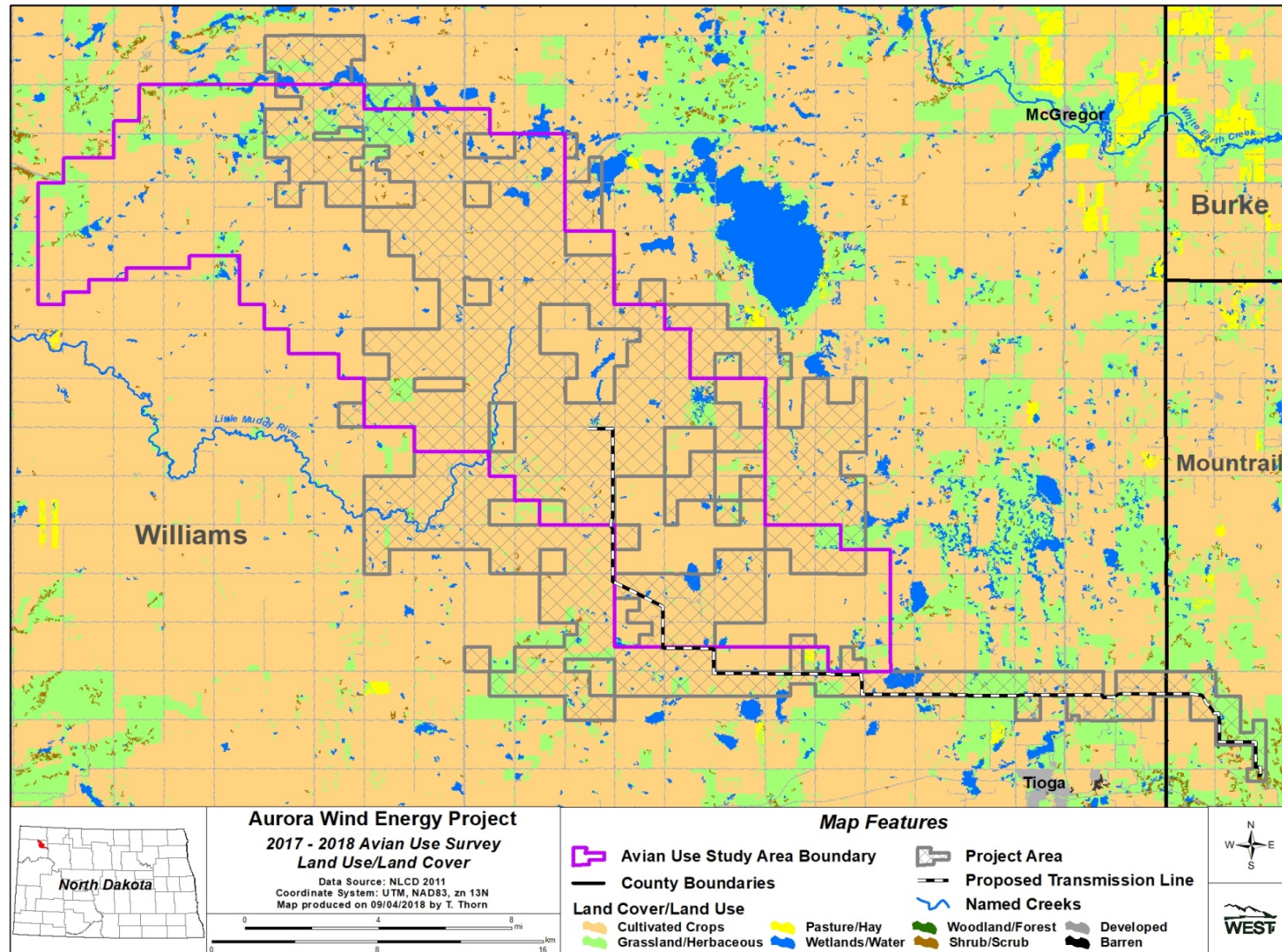


Figure 2. US Geological Survey (USGS) National Land Cover Database (NLCD) land cover types within and adjacent to the Aurora Wind Energy Project and Aurora Avian Use Study Area in Williams County, North Dakota (Sources: USGS NLCD 2011, Homer et al. 2015).

3 METHODS

3.1 Field Surveys

3.1.1 Fixed-Point Avian Use Surveys

Avian use surveys were conducted using methods described by Reynolds et al. (1980). Thirty-three fixed-point count locations consisting of 800-meter (m; 2,625-foot [ft]) radius circular plots were selected for avian use surveys conducted in Year 2 within the Survey Area; these points were also surveyed during Year 1 (Figure 3). Observation points (the center of the 800-m plot) were separated by at least 1,600 m (5,249 ft) to avoid overlap and were located along public roads using a systematic sampling scheme with a random start in ArcGIS (a Geographic Information System software program).

Each of the 33 fixed-point count locations were surveyed once per month, with odd points generally visited one week and even points visited approximately two weeks later so that the biologist was on site during multiple weeks each month. Surveys were conducted during daylight hours; survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each fixed-point count location was surveyed roughly the same number of times, but some were missed due to weather and road conditions.

Fixed-point count surveys were conducted for 60 minutes (min), with all small and large birds recorded for the first 10 min, then only large birds being recorded for the remaining 50 min of each 60-min survey (small birds within 100-m [328-ft] radius, large birds within 800-m radius). All large and small birds seen during each fixed-point count survey were recorded using a unique observation number; however, in some cases, the same observations may represent repeated sightings of the same individual.

Observations of large birds outside the 800-m radius plot were recorded and included in the development of species composition, relative abundance, and species diversity metrics, but were not included in analyses of avian use and flight heights. Large birds included waterbirds, waterfowl, shorebirds, rails and coots, grebes and loons, gulls and terns, diurnal raptors (kites, hawks, accipiters, eagles, falcons, northern harrier [*Circus cyaneus*], and osprey [*Pandion haliaetus*]), owls, vultures, upland game birds, doves/pigeons, some cuckoos, large corvids (e.g., ravens, magpies, and crows), and goatsuckers. Small birds included passerines (excluding large corvids), most cuckoos, swifts and hummingbirds, woodpeckers, and kingfishers.

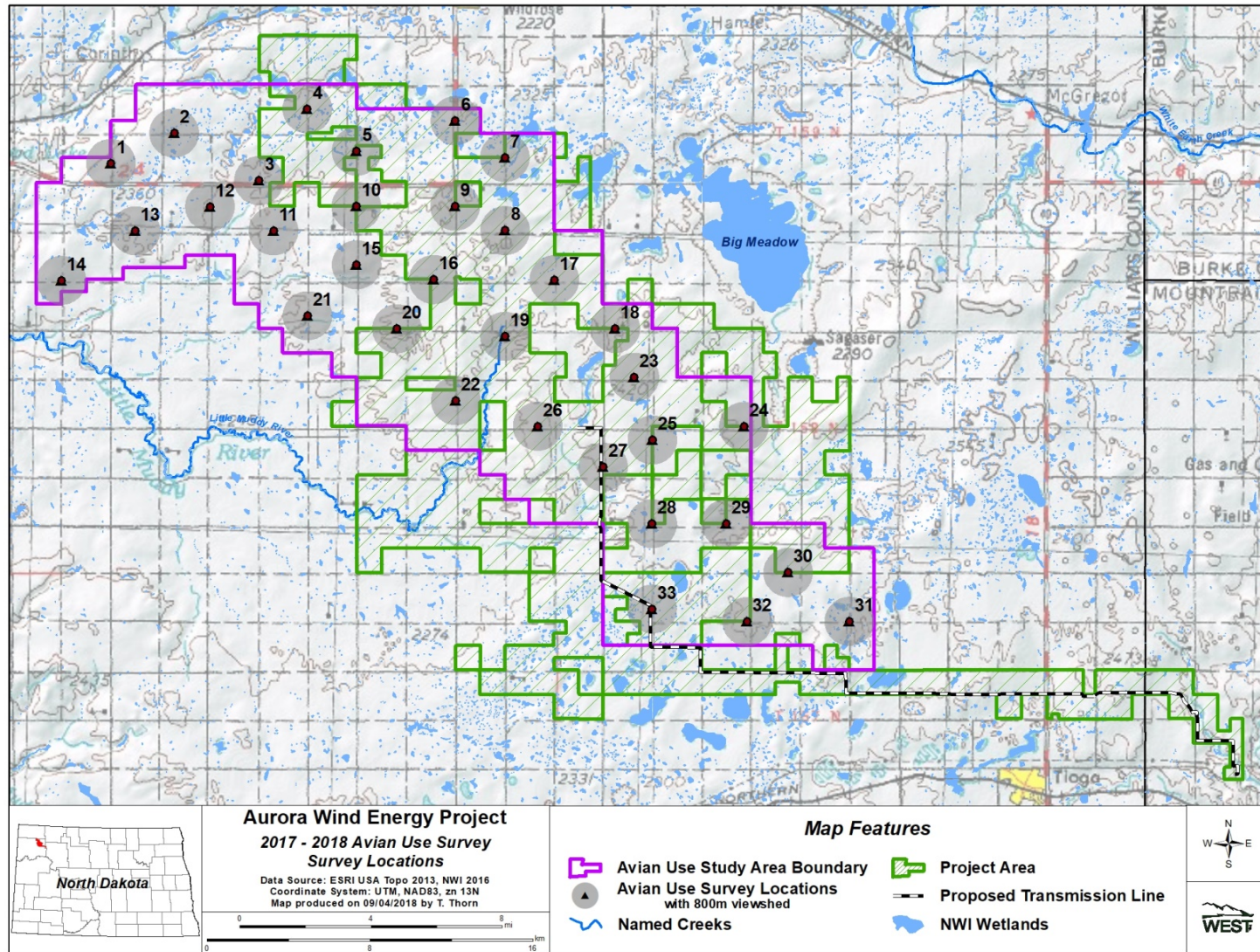


Figure 3. Fixed-point count locations and circular survey plots selected for surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

The following information was recorded during each fixed-point avian use survey: date, start and end time, and weather information (i.e., temperature, wind speed, wind direction, precipitation, and cloud cover). Additionally, the following data were recorded for each observation:

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex/Age class (to the extent possible)
- Distance from plot center when first observed
- Closest distance observed
- Flight height above ground level (AGL)
- Flight direction
- Activity (flying compared to perched)
- Approximate flight direction

For bald (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) observations, flight height, distance, and activity (i.e., flying or perched) were recorded during each 1-min interval, per the ECPG. The perch locations and flight paths of eagles were mapped to qualitatively assess areas of eagle use within the Study Area.

3.1.2 Incidental Wildlife Observations

Incidental wildlife observations provide records of wildlife seen outside of the standardized surveys. In addition to large bird species (especially raptors), biologists recorded endangered and threatened species, species of concern, and rare or unusual species. Incidental observations were recorded in a similar fashion to standardized surveys, where the date, time, observation number, species, number of individuals, sex/age class, distance from observer, flight height AGL (for bird species), flight direction, and activity, were recorded. Biologists recorded the location of sensitive species by Universal Transverse Mercator (commonly, UTM) coordinates using a hand-held Global Positioning System (commonly, GPS) unit.

3.1.3 Sensitive Species Observations

Sensitive species observed during large bird use surveys and incidentally were recorded. Sensitive species included federally protected species (i.e., protected under the Endangered Species Act [ESA; Public Law 93-205 1973] and the Bald and Golden Eagle Protection Act [BGEPA; 16 United States Code §§ 668–668d 1940]), as well as North Dakota Species of Conservation Priority (SCP; Dyke et al. 2015). North Dakota does not have an endangered or threatened species list but rather a list of SCP which includes mammals, reptiles, amphibians, fish, and freshwater mussels. Species designated as a SCP by North Dakota Game and Fish Department are placed in one of three levels used to prioritize funding for State Wildlife Grant (SWG) projects: Level I (LI) SCP includes species in decline in North Dakota or across their range, or species with core breeding range within North Dakota; Level II (LII) SCP includes

species of moderate conservation priority or species with high level of conservation priority but with substantial non-SWG funding available; Level III (LIII) SCP includes species of moderate conservation priority that do not breed in North Dakota. In North Dakota, SCP are wildlife species, including low and declining populations, that are indicative of the diversity and health of the state's wildlife. SCP are not afforded additional protections under existing state or federal law; however, SCP may include current federally threatened or endangered species.

3.2 Quality Assurance and Quality Control

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

A Microsoft® MSSQL Server database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference. QA/QC measures implemented for report writing included review of the final document by a technical editor, statistician, peer (research biologist), project manager, and senior manager.

3.3 Data Analysis

3.3.1 Species Composition, Relative Abundance, Diversity, and Richness

Species composition (i.e., species and bird types observed during the surveys), relative abundance (i.e., number of observations and groups of each species and bird type by season), and diversity (i.e., total number of unique species observed within each season) were compiled for all birds observed during the bird use surveys, irrespective of distance from observer. Species richness by season was calculated by averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. In addition, species composition for each bird type, regardless of distance from observer, was calculated for major groups.

3.3.2 Avian Use, Percent of Use, and Frequency of Occurrence

Large bird use for fixed-point avian use surveys was calculated as the number of birds per 800-m plot per 60-min survey; small bird use was calculated as number of birds per 100-m plot per 10-min survey. Mean use was calculated by season by first summing the number of birds seen within each plot during a visit, then averaging across all plots within each visit, and finally by averaging across all visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of calendar days in each season (as defined by the following season dates: spring = March 1 – May 31; summer = June 1 – August 31; fall = September 1 – November 30, winter = December 1 – February 28). Percent of use was calculated as the proportion of large or small bird use that was attributable to a particular bird

type or species, and frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed.

3.3.3 *Eagle Minutes*

Total eagle minutes were defined as the total minutes an eagle was observed during a scheduled avian use survey, regardless of distance, activity, or flight height AGL. Following survey protocols described in the ECPG, eagle risk minutes were defined as the number of minutes an eagle was observed flying within three-dimensional plots (i.e., cylinders) that included the area within the 800-m radius survey plots and up to 200 m (656 ft) AGL during the 60-min survey periods. Therefore, observations of perched eagles or of eagles flying beyond the cylinder did not apply to eagle risk minutes, but did apply to total eagle minutes.

3.3.4 *Flight Height*

Flight height data were used to estimate bird use within a rotor-swept height (RSH) of 25 – 150 m (82 – 492 ft) AGL. Flight heights (a single bird or a flock of two or more) when first observed were used to calculate the percentage of groups flying at different height categories: below the RSH (0–25 m [0–82 ft] AGL), at RSH (25–150 m [82–492 ft] AGL), and greater than the RSH (above 150 m [492 ft] AGL).

3.3.5 *Spatial Use*

Large and small bird spatial use was evaluated by comparing bird mean use among survey plots for each bird type. In addition, eagle flight paths were mapped to qualitatively identify areas of concentrated use and/or consistent flight patterns.

3.3.6 *Visits*

For analysis purposes, a visit was defined as the required length of time, in days, to survey all of the plots once within the Study Area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season, and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits. Under certain circumstances, such as extreme weather conditions, plots were not surveyed during some visits. In these cases, a visit might not have constituted a survey of all plots.

4 RESULTS

4.1 Fixed-Point Avian Use Surveys

4.1.1 Species Composition, Relative Abundance, Diversity, and Richness

A total of 355 60-min fixed-point avian use surveys were conducted within the Study Area from August 11, 2017 – July 26, 2018 (Table 2). A total of 9,313 bird observations within 1,479 separate groups (defined as one or more individual birds) were recorded during the fixed-point avian use surveys (Appendix A). The most commonly recorded bird type was passerines, which composed 31.8% of all observations throughout all seasons, with horned larks (*Eremophila alpestris*) composing the majority (1,199 observations in 129 groups) of those observations

(Appendix A). Waterfowl were the second most abundant bird type observed, accounting for 24.4% of all observations throughout the study (2,277 observations in 207 groups; Appendix A).

Nine unique diurnal raptor species and one unidentified raptor species, totaling 180 observations in 138 groups, were observed during surveys (Appendix A). Diurnal raptors accounted for 1.9% of all bird observations, with northern harrier being the most commonly recorded diurnal raptor species (42.8% of diurnal raptor observations). Three bald eagles were recorded in three separate groups in the fall of 2017 (1.7% of diurnal raptor observations; Appendix A).

During fixed-point avian use surveys, 95 unique bird species were recorded; species diversity was lowest in winter (nine unique species) compared to all other seasons (Table 2). Species richness for large birds was highest during summer (2.63 species/800-m plot/60-min survey), followed by spring (2.47), fall (1.59), and winter (0.14; Table 2). Small bird richness was highest during summer (2.63 species/100-m plot/10-min survey), followed by spring (1.43), fall (0.61), and winter (0.56; Table 2).

Table 2. Summary of sample size (number of visits and surveys conducted), species richness (number unique species/plot^a/survey^b), and diversity (number of unique species), by season and overall during the fixed-point avian use surveys^c conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Season	Number of Visits	Number Surveys Conducted	Number Unique Species	Species Richness ^c	
				Large Birds	Small Birds
Summer	3	98	63	2.63	2.63
Fall	3	99	51	1.59	0.61
Winter	3	79	9	0.14	0.56
Spring	3	79	48	2.47	1.43
Overall	12	355	95	1.72	1.31

^a 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

^b Per 60-minute (min) survey for large birds; per 10-min survey for small birds.

^c Small bird surveys used smaller viewsheds and shorter survey periods than those used for large bird surveys; direct comparison between large and small bird metrics is not possible.

4.1.2 Avian Use, Percent of Use, and Frequency of Occurrence

Large bird use, as determined by the number of birds/800-m plot/60-min survey, was higher during fall (25.04) and spring (20.37) compared to summer (9.43) and winter (1.39; Table 3, Appendix B1). Small bird use, as determined by the number of birds/100-m plot/10-min survey, was highest in fall (11.63) compared to spring (7.01), winter (6.16), and summer (5.67; Table 3, Appendix B2).

Table 3. Mean bird use, percent of total use, and frequency of occurrence for each bird type and raptor subtype by season during the fixed-point avian use surveys conducted within the Aurora Avian Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Raptor Subtype	Mean Use (number of birds/plot ^a /survey ^b)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Waterbirds	0.17	5.91	0	3.82	1.8	23.6	0	18.8	9.2	6.1	0	6.3
Waterfowl	2.16	10.11	0	10.76	22.9	40.4	0	52.8	24.7	21.2	0	38.5
Shorebirds	0.86	0.51	0	1.01	9.1	2.0	0	5.0	29.7	5.1	0	38.6
Gulls/Terns	3.71	3.17	0	3.78	39.3	12.7	0	18.6	49.1	11.1	0	34.5
Rails/Coots	0.08	1.95	0	0	0.9	7.8	0	0	3.1	6.1	0	0
Diurnal Raptors	0.54	0.65	0	0.30	5.7	2.6	0	1.5	38.6	42.4	0	24.4
<i>Accipiters</i>	0.01	0	0	0	0.1	0	0	0	1.0	0	0	0
<i>Buteos</i>	0.36	0.42	0	0.13	3.9	1.7	0	0.6	28.4	32.3	0	11.4
<i>Northern Harrier</i>	0.16	0.12	0	0.16	1.7	0.5	0	0.8	15.3	11.1	0	14.3
<i>Eagles</i>	0	0.03	0	0	0	0.1	0	0	0	2.0	0	0
<i>Falcons</i>	0	0.07	0	0.01	0	0.3	0	<0.1	0	5.1	0	1.0
Owls	0.01	0.02	0.01	0	0.1	<0.1	1.0	0	1.0	2.0	1.3	0
Vultures	0.06	0.01	0	0.01	0.6	<0.1	0	<0.1	2.0	1.0	0	1.0
Upland Game Birds	0.23	0.45	1.32	0.19	2.4	1.8	94.7	0.9	17.5	8.1	9.0	12.8
Doves/Pigeons	1.05	2.17	0.04	0.11	11.2	8.7	2.6	0.5	23.4	22.2	1.2	4.0
Large Corvids	0.56	0.09	0.03	0.38	5.9	0.4	1.8	1.9	3.1	5.1	2.5	10.3
Overall Large Birds	9.43	25.04	1.39	20.37	100	100	100	100				
Passerines	5.65	11.57	6.16	6.99	99.6	99.5	100	99.7	84.8	40.4	44.8	79.4
Woodpeckers	0.02	0.01	0	0.01	0.4	<0.1	0	0.1	2.0	1.0	0	1.0
Unidentified Birds	0	0.05	0	0.01	0	0.4	0	0.1	0	4.0	0	1.0
Overall Small Birds	5.67	11.63	6.16	7.01	100	100	100	100				

^a 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

^b Per 60-minute (min) survey for large birds; per 10-min survey for small birds.

Waterbirds

Waterbird use was highest during fall (5.91 birds/800-m plot/60-min survey) and spring (3.82), due mostly to use by sandhill cranes (*Antigone canadensis*), compared to other times of the year (summer 0.17 and winter 0; Table 3, Appendix B1). Whooping crane (*Grus americana*) use was only observed during the spring (0.16; Appendix B1). Waterbirds accounted for 23.6% of the overall large bird use during fall, 18.8% during spring, 1.8% during summer, and 0% during winter. Waterbirds were observed during 9.2% of summer surveys, 6.3% of spring surveys, 6.1% of fall surveys, and 0% of winter surveys (Table 3, Appendix B1).

Waterfowl

Waterfowl had the highest use during the spring (10.76 birds/800-m plot/60-min survey) and fall (10.11), compared to other times of the year (summer 2.16 and winter 0) due mostly to use by Canada geese (*Branta canadensis*; Table 3, Appendix B1). Waterfowl accounted for 52.8% of large bird use in the spring, followed by fall (40.4%), summer (22.9%), and winter (0%). Waterfowl were observed most frequently during the spring surveys (38.5%), followed by summer (24.7%), fall (21.2%), and winter (0%; Table 3, Appendix B1).

Shorebirds

Shorebirds had the highest use during spring (1.01 birds/800-m plot/60-min survey) compared to other times of the year (summer 0.86, fall 0.51, and winter 0; Table 3, Appendix B1). Shorebirds accounted for 9.1% of large bird use during summer, 5.0% during spring, 2.0% during fall, and 0% during winter. Shorebirds were observed during 38.6% of spring surveys, 29.7% of summer surveys, 5.1% of fall surveys, and 0% of winter surveys (Table 3, Appendix B1).

Gulls/Terns

Mean use of the by gulls/terns over the study period was highest during spring (3.78 birds/800-m plot/60-min survey), compared to summer (3.71), fall (3.17), and winter (0), due mostly to use by Franklin's gull (*Leucophaeus pipixcan*; Table 3; Appendix B1). Gulls/terns accounted for 39.3% of large bird use in summer, 18.6% in spring, 12.7% in fall, and 0% in winter (Table 3, Appendix B1). Gulls/terns were observed during 49.1% of summer surveys, 34.5% of spring surveys, 11.1% of fall surveys, and 0% of winter surveys (Table 3; Appendix B1).

Rails/Coots

Rails/coots had the highest mean use during fall (1.95 birds/800-m plot/60-min survey) compared to summer (0.08), fall (0), and winter (0; Table 3; Appendix B1). Rails/coots accounted for 7.8% of large bird use in fall, 0.9% in summer, and 0% in winter and spring (Table 3, Appendix B1). Rails/coots were observed during 6.1% of fall surveys, 3.1% of summer surveys, and 0% of winter and spring surveys (Table 3; Appendix B1).

Diurnal Raptors

Mean diurnal raptor use was highest during the fall (0.65 birds/800-m plot/60-min survey), followed by summer (0.54) and spring (0.30); no diurnal raptor use was recorded in the winter (Table 3, Appendix B1). Buteos and northern harriers had the highest use of diurnal raptor

subtypes across the three seasons in which diurnal raptors were observed (fall 0.42, summer 0.36, and spring 0.13 for buteos; summer and spring 0.16 and fall 0.12 for northern harrier; Table 3, Appendix B1). Red-tailed (*Buteo jamaicensis*) and Swainson's (*Buteo swainsoni*) hawks contributed the most to buteo use across seasons (Appendix B1); however, other buteos (i.e., ferruginous hawk [*Buteo regalis*] and rough-legged hawk [*Buteo lagopus*]), were also observed. Other diurnal raptor species observed during scheduled surveys included Cooper's hawk (*Accipiter cooperi*), bald eagles, American kestrel (*Falco sparverius*) and prairie falcon (*Falco mexicanus*). Diurnal raptors accounted for 5.7% of overall large bird use during summer, 2.6% during fall, and 1.5% in spring. Diurnal raptors were observed during 42.4% of fall surveys, 38.6% of summer surveys, and 24.4% of spring surveys (Table 3, Appendix B1).

The bald eagle was the only eagle species observed during surveys and use was restricted to fall (0.03 birds/800-m plot/60-min survey; Table 3, Appendix B1). Bald eagles accounted for 0.1% of large bird use during fall and were observed during 2.0% of fall surveys (Table 3, Appendix B1).

Owls

Mean use by owls was low, with 0.01 birds/800-m plot/60-min survey during summer and winter, 0.02 in fall, and no owl use during spring (Table 3, Appendix B1); great horned owls (*Bubo virginianus*) were observed in summer and fall, while snowy owls (*Bubo scandiacus*) were only observed during winter (Appendix B1). Owls accounted for 1.0% of large bird use during winter, 0.1% of use during summer, and less than 0.1% of use in the fall (Table 3, Appendix B1). Owls were observed during 2.0% of fall surveys, 1.3% of winter surveys, and 1.0% of summer surveys (Table 3, Appendix B1).

Vultures

Turkey vulture (*Cathartes aura*) use over the study period was low, with the highest use during summer (0.06 birds/800-m plot/60-min survey) compared to fall and spring (0.01; Table 3, Appendix B1). No vultures were observed in winter. Vultures accounted for 0.6% of large bird use in summer and less than 0.1% in fall and spring (Table 3, Appendix B1). Vultures were observed during 2.0% of summer surveys and 1.0% of fall and spring surveys (Table 3, Appendix B1).

Upland Game Birds

Upland game birds had the highest mean use during the winter (1.32 birds/800-m plot/60-min survey) compared to any other season (0.45 in fall, 0.23 in summer, and 0.19 in spring; Table 3, Appendix B1), with the majority of summer, winter, and spring use attributable to ring-necked pheasants (*Phasianus colchicus*; Appendix B1). Gray partridge (*Perdix perdix*) had the highest use during fall (0.23; Appendix B1). Upland game birds composed 94.7% of overall large bird use during winter, 2.4% of use during summer, 1.8% during fall, and 0.9% during spring (Table 3, Appendix B1). Upland game birds were observed during 17.5% of summer surveys, 12.8% of spring surveys, 9.0% of winter surveys, and 8.1% of fall surveys (Table 3, Appendix B1).

Doves/Pigeons

Mean use by doves/pigeons was the highest in fall (2.17 birds/800-m plot/60-min survey) compared to summer (1.05), spring (0.11), and winter (0.04; Table 3, Appendix B1). Doves/pigeons composed 11.2% of large bird use in summer, 8.7% in fall, 2.6% in winter, and 0.5% in spring (Table 3, Appendix B1). Doves/pigeons were observed during 23.4% of summer surveys, 22.2% of fall surveys, 4.0% of spring surveys, and 1.2% of winter surveys (Table 3, Appendix B1).

Large Corvids

Mean use by large corvids was highest in summer 0.56 birds/800-m plot/60-min survey compared to spring (0.38), fall (0.09), and winter (0.03; Table 3, Appendix B1). Large corvids composed 5.9% of use in summer compared to 1.9% of use in spring, 1.8% of use in winter, and 0.4% of use in fall (Table 3; Appendix B1). Large corvids were observed during 10.3% of spring surveys, 5.1% of fall surveys, 3.1% of summer surveys, and 2.5% of winter surveys (Table 3, Appendix B1).

Passerines

Passerine mean use was highest during the fall (11.57 birds/100-m plot/10-min survey), followed by spring (6.99), winter (6.16), and summer (5.65; Table 3, Appendix B2). Horned larks were the only passerine species observed in all seasons, and had the highest small bird mean use in fall, winter, and spring (Appendix B2). Brown-headed cowbirds (*Molothrus ater*) had the highest small bird mean use in summer (0.96; Appendix B2). Passerines composed 100% of small bird use in winter and greater than 99.0% of small bird use during the rest of the seasons (Table 3, Appendix B2). Passerines were observed most frequently during summer (84.8% of surveys), spring (79.4%), winter (44.8%), and fall (40.4%; Table 3, Appendix B2).

Woodpeckers

Woodpecker mean use was low during the survey period with use being highest in summer (0.02 birds/100-m plot/10-min survey), followed by fall and spring (0.01; Table 3, Appendix B2). No woodpeckers were observed in winter. Woodpeckers composed 0.4% of small bird use in summer, 0.1% in spring, and less than 0.1% in fall (Table 3, Appendix B2). Woodpeckers were observed most frequently during summer (2.0% of surveys) compared to fall and spring (1.0%; Table 3, Appendix B2).

4.1.3 Eagle Minutes

A total of three bald eagle observations were documented in the fall during the scheduled avian use surveys conducted within the Study Area, for a total of nine eagle minutes (i.e., regardless of distance from observer, activity, or flight height AGL). Six of the nine eagle minutes were also risk minutes (flying within 800 m of observer and below 200 m AGL). Two bald eagle observations were recorded on November 7, 2017 at Point 8, while the third eagle was observed on November 8, 2017 at Point 6.

4.1.4 Flight Height

A total of 661 groups of individual large birds were observed flying within the 800-m plot, totaling 3,909 individual observations, while 276 groups of small birds were observed flying within a 100-m plot, totaling 1,790 individual observations (Table 4). Overall, 42.7% of flying large birds and less than 0.1% of flying small birds were recorded within the RSH (25 - 150 m [82 – 492 ft] AGL).

Flying diurnal raptors were mostly (69.6%) observed below RSH compared to 27.7% within RSH; the accipiter subgroup had the highest (100%) percentage within the RSH, followed by buteos (43.5%). All other diurnal raptor species, including three eagle observations, were observed below RSH (Table 4).

Table 4. Flight height characteristics (meters [m]) by bird type and raptor subtype during the fixed-point^b avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Bird Type/Raptor Subtype	# Groups Flying	# Obs. Flying	Mean Flight Height (m)	% Obs Flying	% Within Flight Height Categories		
					0–25 m	25–150 m ^b	>150 m
Waterbirds	25	819	106.12	92.1	1.1	49.2	49.7
Waterfowl	155	1,389	16.54	66.9	35.2	64.8	0
Shorebirds	57	133	9.37	58.6	97.7	2.3	0
Gulls/Terns	235	943	18.46	91.5	70.4	29.2	0.4
Rails/Coots	1	59	8.00	29.4	100	0	0
Diurnal Raptors	106	112	28.91	78.3	69.6	27.7	2.7
<i>Accipiters</i>	1	1	40.00	100	0	100	0
<i>Buteos</i>	65	69	42.45	77.5	52.2	43.5	4.3
<i>Northern Harrier</i>	34	36	5.85	85.7	100	0	0
<i>Eagles</i>	3	3	9.67	100	100	0	0
<i>Falcons</i>	3	3	12.33	37.5	100	0	0
Owls	2	2	11.50	50.0	100	0	0
Vultures	4	8	28.75	100	25.0	75.0	0
Upland Game Birds	10	50	3.40	26.2	100	0	0
Doves/Pigeons	48	310	8.98	93.1	83.9	16.1	0
Large Corvids	18	84	9.94	88.4	98.8	1.2	0
Large Birds Overall	661	3,909	21.09	75.2	46.7	42.7	10.6
Passerines	273	1,786	5.10	66.1	100	0	0
Woodpeckers	1	1	1.00	25.0	100	0	0
Unidentified Birds	2	3	15.50	50.0	66.7	33.3	0
Small Birds Overall	276	1,790	5.16	66.0	99.9	<0.1	0

Obs = Observations.

^a 800-meter (m; 2,625-foot [ft]) radius plot and 60-minute (min) survey for large birds; 100-m (328-ft) radius plot and 10-min survey for small birds.

^b The likely “rotor-swept height” for potential collision with a turbine blade, or 25–150 m (82–492 ft) above ground level was used in the analysis and may not reflect the actual range of turbines eventually installed.

Large bird types that were most often recorded in the RSH were vultures (75.0%) and waterfowl (64.8%; Table 4). Waterbirds were recorded flying relatively within (49.2%) or below (49.7%) the RSH (Table 4). Sandhill cranes were observed flying 50.0% of the time within the RSH based on initial observations, while whooping cranes were not observed flying within the RSH

(Appendix C). Six large bird species (greater white-fronted geese [*Anser albifrons*], American white pelican [*Pelecanus erythrorhynchos*], cackling goose [*Branta hutchinsii*], snow goose [*Chen caerulescens*], Cooper's hawk (*Accipiter cooperii*), and ferruginous hawk (*Buteo regalis*) were observed flying 100% of the time within the RSH based on initial observations (Appendix C). The majority (99.9%) of small birds were observed flying below RSH, with only a small percentage (less than 0.1%) observed flying within RSH (Table 4, Appendix C).

4.1.5 Spatial Use

Large Birds

Large bird use was observed at all 33 survey points. For all large bird species combined, use was highest at Point 33 (57.83 birds/800-m plot/60-min survey), followed by Point 28 (42.75; Appendix D1). The rest of large bird use ranged from a mean of 2.33 at Point 3 to a mean of 36.67 at Point 15 (Appendix D1).

Waterbird use was limited to 12 survey points, while waterfowl, shorebirds, and gulls/terns were observed at a majority of survey points (Appendix D1). Waterbird use was the highest at Point 15 (18.92 birds/600-m plot/60-min survey) and ranged from 0.14–15.08 at all other survey points where waterbirds were observed (Appendix D1). On April 24, 2018, 12 whooping cranes were observed (two at Points 5 and 10 at Point 15); no additional whooping cranes were incidentally observed outside of the scheduled fixed-point use surveys.

Waterfowl were recorded at 32 of the 33 survey points, with use being highest at Point 28 (41.25 birds/800-m plot/60-min survey) and ranging from 0.14–39.42 at all other survey points where waterfowl were observed; shorebird use was observed at 30 of the 33 survey points, with shorebird use being highest at Point 25 (3.36) and ranging from 0.12–2.17 at all other survey points where shorebirds were observed; gulls/terns were recorded at all survey points, with use being highest at Point 8 (12.75) and ranging from 0.09–11.86 at all other survey points where gulls/terns were observed (Appendices D1 and D2).

Diurnal raptor use was recorded at all 33 survey points and ranged from 0.08–0.92 birds/800-m plot/60-min survey, with the lowest use at points 22 and 23 and the highest at Point 15 (Appendices D1 and D2). Buteos were observed at 30 of the 33 survey points and harriers were recorded at 26 survey points, the highest mean use for buteos (0.62) occurred at Point 13, while use by harriers was highest at Point 8 (0.50; Appendix D1). Eagles were observed at only two points during scheduled avian use surveys (points 6 and 8; Appendix D1). Eagle flight paths and incidental observations are shown in Figure 4.

Owl and vulture use was only documented at four survey points (Appendix D1). The highest mean use for owls was 0.14 /800-m plot/60-min survey at Point 11, ranging from 0.08–0.09 at all other survey points with owl observations, the highest mean use for vultures was 0.33 at Point 26, ranging from 0.08–0.25 at all other points where vulture use was observed (Appendix D1). The highest mean use for upland game birds occurred at Point 15 (8.25), with use ranging from 0.08–1.42 at the remaining survey points with upland gamebird observations; doves/pigeons use was highest at Point 23 (4.25), with use ranging from 0.08–3.33 at the

remaining points with doves/pigeons observations; large corvids use was highest at Point 14 (5.67), with use ranging from 0.08–1.00 at the remaining survey points with large corvids observations (Appendix D1).

Small Birds

Small birds use was observed at all 33 observation points, with use the highest mean use at Point 4 (65.08 birds/100-m plot/10-min survey; Appendix D1). Small bird use was largely due to use by passerines. Passerine mean use was highest at Point 4 (65.08) and ranged from 0.09–31.62 at the remaining survey points with passerine observations (Appendices D1 and D2; woodpeckers were observed at four points (0.08 bird/100-m plot/10-min survey at points 6, 23, 24, and 32; Appendix D1).

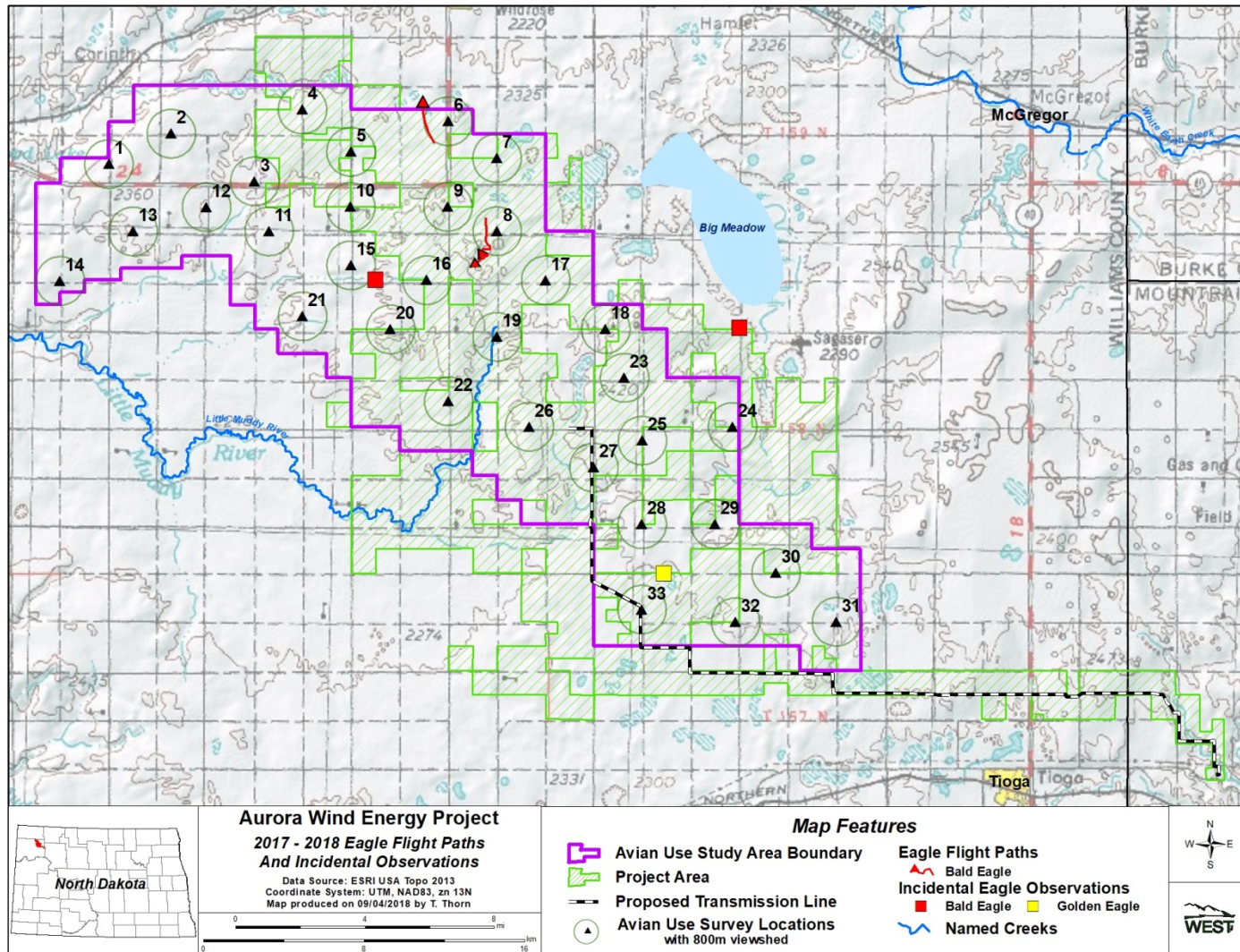


Figure 4. Eagle flight paths and locations recorded as incidental observations and during fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

4.2 Sensitive Species Observations

A total of 27 sensitive species in 389 groups totaling 1,438 individuals were observed during scheduled surveys and incidentally within the Study Area (Table 5). Twelve whooping cranes (federally endangered under the ESA and also a LIII SCP) were observed during scheduled avian use surveys. A total of five bald eagles and one golden eagle (federally protected under the BGEPA) were observed during fixed-point avian use surveys and incidentally. There were 10 LI SCP with Franklin's gulls making up the bulk of observations (599 individuals; Table 5). Sixteen LII SCP were recorded with western meadowlark (*Sturnella neglecta*) making up the majority of observations (140 individuals; Table 5). Unless further protected by federal regulations, SCP are not afforded additional protections under existing state or federal law.

Table 5. Summary of number of groups (# Grps) and observations (# Obs) of sensitive species observed during scheduled fixed-point avian use surveys (FP) and incidentally (Inc.) within the Aurora Avian Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Species	Scientific Name	Status ^a	FP		Inc.		Total	
			# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
American white pelican	<i>Pelecanus erythrorhynchos</i>	LII	1	5	0	0	1	5
whooping crane	<i>Grus americana</i>	LIII; E	2	12	0	0	2	12
canvasback	<i>Aythya valisineria</i>	LII	3	5	0	0	3	5
lesser scaup	<i>Aythya affinis</i>	LII	1	3	0	0	1	3
northern pintail	<i>Anas acuta</i>	LII	21	61	0	0	21	61
American avocet	<i>Recurvirostra americana</i>	LII	1	2	0	0	1	2
upland sandpiper	<i>Bartramia longicauda</i>	LII	51	61	0	0	51	61
Wilson's phalarope	<i>Phalaropus tricolor</i>	LI	0	0	2	256	2	256
marbled godwit	<i>Limosa fedoa</i>	LI	11	18	0	0	11	18
willet	<i>Tringa semipalmata</i>	LII	1	4	0	0	1	4
Franklin's gull	<i>Leucophaeus pipixcan</i>	LI	53	599	0	0	53	599
black tern	<i>Chlidonias niger</i>	LI	1	2	1	3	2	5
American kestrel	<i>Falco sparverius</i>	LII	4	5	1	1	5	6
prairie falcon	<i>Falco mexicanus</i>	LII	3	3	0	0	3	3
ferruginous hawk	<i>Buteo regalis</i>	LI	1	1	0	0	1	1
Swainson's hawk	<i>Buteo swainsoni</i>	LI	36	37	4	4	40	41
northern harrier	<i>Circus cyaneus</i>	LII	41	77	3	5	44	82
bald eagle	<i>Haliaeetus leucocephalus</i>	LII; BGEPA	3	3	2	2	5	5
golden eagle	<i>Aquila chrysaetos</i>	LII; BGEPA	0	0	1	1	1	1
sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	LII	1	1	3	17	4	18
bobolink	<i>Dolichonyx oryzivorus</i>	LII	6	8	0	0	6	8
chestnut-collared longspur	<i>Calcarius ornatus</i>	LI	4	62	0	0	4	62
grasshopper sparrow	<i>Ammodramus savannarum</i>	LI	31	33	1	1	32	34
lark bunting	<i>Calamospiza melanocorys</i>	LI	1	1	1	1	2	2

Table 5. Summary of number of groups (# Grps) and observations (# Obs) of sensitive species observed during scheduled fixed-point avian use surveys (FP) and incidentally (Inc.) within the Aurora Avian Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Species	Scientific Name	Status ^a	FP		Inc.		Total	
			# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
loggerhead shrike	<i>Lanius ludovicianus</i>	LII	1	1	1	1	2	2
Sprague's pipit	<i>Anthus spragueii</i>	LI	1	2	0	0	1	2
western meadowlark	<i>Sturnella neglecta</i>	LII	90	140	0	0	90	140
Overall	27 Species		369	1,146	20	292	389	1,438

^a LI, LII, LIII = Level I, Level II, and Level III North Dakota Species of Conservation Priority (Dyke et al. 2015); BGEPA = Bald and Golden Eagle Protection Act (1940); E = Federally Endangered (ESA 1973).

4.3 Incidental Wildlife Observations

Fifteen identified and one unidentified bird, and one mammal species were incidentally observed outside of the standardized fixed-point avian use surveys, totaling 380 observations within 35 groups (Table 6). Wilson's phalarope (*Phalaropus tricolor*) and made up the majority of the incidental observations (256 individuals), followed by sandhill crane (65 individuals).

Table 6. Incidental observations recorded within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Species	Scientific Name	# Groups	# Observations
Birds			
sandhill crane	<i>Antigone canadensis</i>	1	65
Wilson's phalarope	<i>Phalaropus tricolor</i>	2	256
black tern	<i>Chlidonias niger</i>	1	3
American kestrel	<i>Falco sparverius</i>	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	2	2
golden eagle	<i>Aquila chrysaetos</i>	1	1
northern harrier	<i>Circus cyaneus</i>	3	5
rough-legged hawk	<i>Buteo lagopus</i>	2	2
red-tailed hawk	<i>Buteo jamaicensis</i>	8	8
Swainson's hawk	<i>Buteo swainsoni</i>	4	4
snowy owl	<i>Bubo scandiacus</i>	1	1
unidentified grouse	N/A	1	3
sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	3	17
grasshopper sparrow	<i>Ammodramus savannarum</i>	1	1
lark bunting	<i>Calamospiza melanocorys</i>	1	1
loggerhead shrike	<i>Lanius ludovicianus</i>	1	1
Mammals			
moose	<i>Alces alces</i>	2	9
Overall		35	380

5 SUMMARY

The WEG use a tiered approach to assess impacts to species and their habitats. Tier 3 studies, as defined in the WEG, are designed to address questions regarding impact that cannot be

sufficiently addressed using available literature (i.e., Tiers 1 and 2 desktop analyses). Avian use surveys are one of a suite of Tier 3 studies used as part of risk analyses. These studies provide additional site-specific data that, when combined with available literature reviewed in previous Tiers, allow for a confident assessment of the risk of significant adverse impacts to species of concern; assist in identifying measures to mitigate significant adverse impacts, if necessary; and/or identify a need for more field studies.

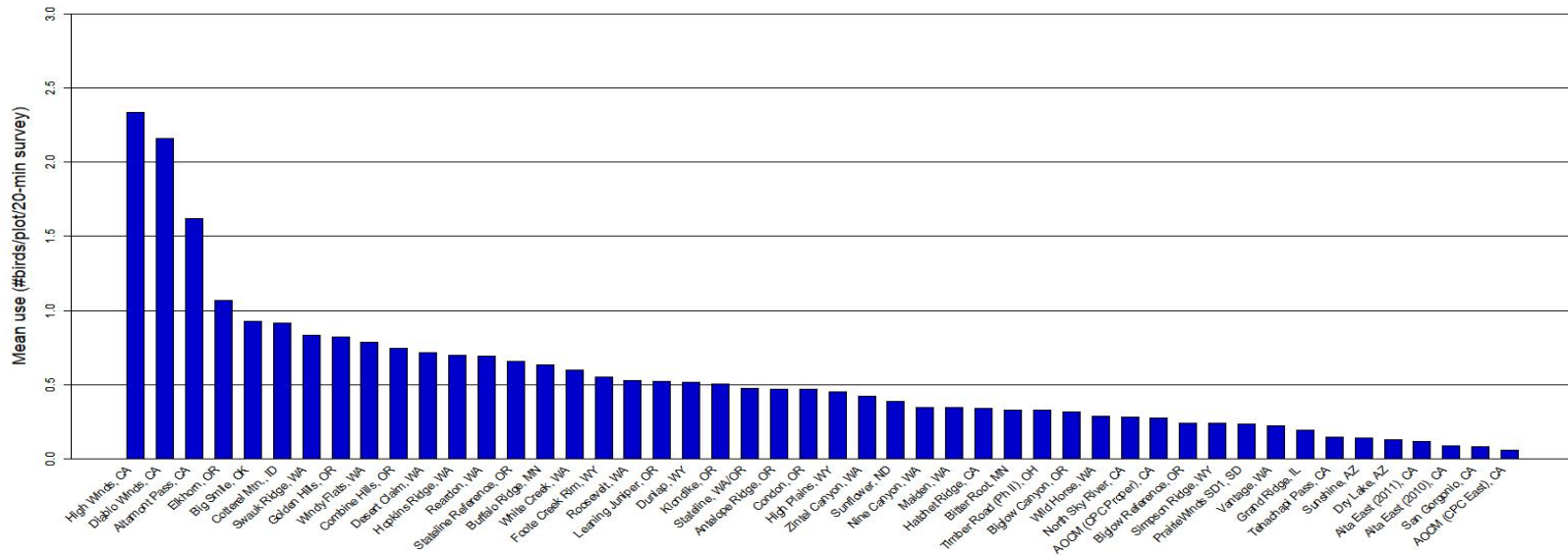
Annual mean diurnal raptor use within the Study Area was calculated as the number of birds per 10-min survey; therefore direct comparisons could not be made with other projects that reported diurnal raptor use on a per 20-min survey basis. Although not directly comparable, annual mean raptor use (0.17 birds/800-m plot/10-min survey) was at the lower end of use values reported at other wind energy facilities in North America with available data, that implemented similar protocols and had data for three or four seasons (Figure 5) and was similar to the Year 1 annual mean diurnal raptor use (0.16 birds/800-m plot/10-min survey; Derby 2017). Raptor use within the Study Area was also within the range of use values reported at other regional projects (Sunflower, North Dakota; Prairie Winds, South Dakota; Bitter Root and Buffalo Ridge, Minnesota; Figure 5).

Existing wind energy projects located in areas dominated by agriculture and in agricultural areas mixed with grasslands with available bird fatality indicate that direct impacts to all birds and raptors in these landscapes is generally low, ranging from 0.27–8.25 birds/Megawatt (MW)/year for all birds and from 0–0.47 birds/MW/year for raptors (Appendix E). Given that the majority of the Study Area is located within cultivated cropland, direct impacts to bird species are expected to be low and within these ranges.

Eagle use was low (0.03 eagles/800-m plot/60-min survey) and restricted to fall, with only three bald eagles observations recorded during fixed-point avian use surveys, for a total of nine eagle minutes; two additional bald eagles and one golden eagle were incidentally observed outside of the standardized fix-point avian use surveys. Direct impacts to eagles are expected to be low.

A total of 27 sensitive species (i.e., federally protected species under BGEPA and ESA, as well as SCP) were observed during Year 2 surveys, with whooping cranes being the only federally listed species observed. Direct impacts to whooping cranes are not expected as use by this species was low (they were only observed in spring), they were flying exclusively above the RSH, and direct impacts to either whooping cranes or sandhill cranes has not been documented within the migratory corridor (Derby et al., in press, “Whooping Crane and Sandhill Crane Monitoring at Five Wind Energy Facilities”).

Diurnal Raptors



Wind Energy Facility

Figure 5. Comparison of estimated annual diurnal raptor use (number [#] of birds/plot/20-minute survey) within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018, and diurnal raptor use at other wind facilities in central and western North America.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
High Winds, CA	Kerlinger et al. 2005	Footo Creek Rim, WY	Johnson et al. 2000b	Timber Road (Phase II), OH	Good et al. 2010
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	Biglow Canyon, OR	WEST 2005c
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	Wild Horse, WA	Erickson et al. 2003d
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	North Sky River, CA	Erickson et al. 2011
Big Smile (Dempsey), OK	Derby et al. 2010c	Klondike, OR	Johnson et al. 2002	AOCM (CPC Proper), CA	Chatfield et al. 2010
Cotterel Mtn., ID	BLM 2006	Stataline, WA/OR	Erickson et al. 2003b	Biglow Reference, OR	WEST 2005c
Swauk Ridge, WA	Erickson et al. 2003c	Antelope Ridge, OR	WEST 2009	Simpson Ridge, WY	Johnson et al. 2000b
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	PrairieWinds SD1, SD	Derby et al. 2010d
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Vantage, WA	Jeffrey et al. 2007
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a, 2003a	Grand Ridge, IL	Derby et al. 2009
Desert Claim, WA	Young et al. 2003b	Sunflower, ND	Derby and Thorn 2014	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Hopkins Ridge, WA	Young et al. 2003c	Nine Canyon, WA	Erickson et al. 2001	Sunshine, AZ	WEST and the CPRS 2006
Reardon, WA	WEST 2005b	Maiden, WA	Young et al. 2002	Dry Lake, AZ	Young et al. 2007a
Stataline Reference, OR	URS et al. 2001	Hatchet Ridge, CA	Young et al. 2007b	Alta East (2011), CA	Chatfield et al. 2011
Buffalo Ridge, MN	Johnson et al. 2000a	Bitter Root, MN	Derby and Dahl 2009	Alta East (2010), CA	Chatfield et al. 2011
White Creek, WA	NWC and WEST 2005	Timber Road (Phase II), OH	Good et al. 2010	San Gorgonio, CA	Anderson et al. 2000, Erickson et al. 2002b
		Biglow Canyon, OR	WEST 2005c	AOCM (CPC East), CA	Chatfield et al. 2010

6 REFERENCES

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Appendix A. Summary of Individuals and Groups, by Bird Type, Raptor Subtype, and Species, Observed During the Fixed-Point Avian Use Surveys Conducted Within the Aurora Avian Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Appendix A. Summary of number of observations (# Obs) and groups (# Grps) by bird type, raptor subtype, and species, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
common tern	<i>Sterna hirundo</i>	1	2	0	0	0	0	0	0	1	2
Franklin's gull	<i>Leucophaeus pipixcan</i>	12	50	12	314	0	0	29	235	53	599
herring gull	<i>Larus argentatus</i>	1	2	0	0	0	0	2	3	3	5
ring-billed gull	<i>Larus delawarensis</i>	112	170	0	0	0	0	34	65	146	235
unidentified gull	N/A	21	114	0	0	0	0	8	52	29	166
Rails/Coots		3	8	6	193	0	0	0	0	9	201
American coot	<i>Fulica americana</i>	2	7	6	193	0	0	0	0	8	200
sora	<i>Porzana carolina</i>	1	1	0	0	0	0	0	0	1	1
Diurnal Raptors		49	53	64	101	0	0	25	26	138	180
<u>Accipiters</u>		1	1	0	0	0	0	0	0	1	1
Cooper's hawk	<i>Accipiter cooperii</i>	1	1	0	0	0	0	0	0	1	1
<u>Buteos</u>		33	36	42	44	0	0	11	11	86	91
ferruginous hawk	<i>Buteo regalis</i>	0	0	1	1	0	0	0	0	1	1
red-tailed hawk	<i>Buteo jamaicensis</i>	8	10	25	26	0	0	4	4	37	40
rough-legged hawk	<i>Buteo lagopus</i>	0	0	8	9	0	0	2	2	10	11
Swainson's hawk	<i>Buteo swainsoni</i>	25	26	7	7	0	0	4	4	36	37
unidentified buteo	<i>Buteo spp</i>	0	0	1	1	0	0	1	1	2	2
<u>Northern Harrier</u>		15	16	13	47	0	0	13	14	41	77
northern harrier	<i>Circus cyaneus</i>	15	16	13	47	0	0	13	14	41	77
<u>Eagles</u>		0	0	3	3	0	0	0	0	3	3
bald eagle	<i>Haliaeetus leucocephalus</i>	0	0	3	3	0	0	0	0	3	3
<u>Falcons</u>		0	0	6	7	0	0	1	1	7	8
American kestrel	<i>Falco sparverius</i>	0	0	3	4	0	0	1	1	4	5
prairie falcon	<i>Falco mexicanus</i>	0	0	3	3	0	0	0	0	3	3
Owls		1	1	2	2	1	1	0	0	4	4
great horned owl	<i>Bubo virginianus</i>	1	1	2	2	0	0	0	0	3	3
snowy owl	<i>Bubo scandiacus</i>	0	0	0	0	1	1	0	0	1	1
Vultures		2	6	1	1	0	0	1	1	4	8
turkey vulture	<i>Cathartes aura</i>	2	6	1	1	0	0	1	1	4	8
Upland Game Birds		21	22	9	45	8	107	13	17	51	191
gray partridge	<i>Perdix perdix</i>	1	2	2	23	2	10	2	4	7	39
ring-necked pheasant	<i>Phasianus colchicus</i>	20	20	5	6	6	97	10	12	41	135
sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	0	0	0	0	0	0	1	1	1	1
unidentified grouse	N/A	0	0	1	14	0	0	0	0	1	14

Appendix A. Summary of number of observations (# Obs) and groups (# Grps) by bird type, raptor subtype, and species, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs	# Grps	# Obs
lark sparrow	<i>Chondestes grammacus</i>	1	1	1	6	0	0	0	0	2	7
loggerhead shrike	<i>Lanius ludovicianus</i>	0	0	0	0	0	0	1	1	1	1
northern shrike	<i>Lanius excubitor</i>	0	0	1	1	0	0	1	1	2	2
red-winged blackbird	<i>Agelaius phoeniceus</i>	48	75	1	63	0	0	14	21	63	159
Savannah sparrow	<i>Passerculus sandwichensis</i>	2	2	1	2	0	0	8	9	11	13
snow bunting	<i>Plectrophenax nivalis</i>	0	0	4	45	8	102	0	0	12	147
song sparrow	<i>Melospiza melodia</i>	2	3	0	0	0	0	0	0	2	3
Sprague's pipit	<i>Anthus spragueii</i>	0	0	1	2	0	0	0	0	1	2
tree swallow	<i>Tachycineta bicolor</i>	0	0	0	0	0	0	1	3	1	3
unidentified sparrow	N/A	1	1	0	0	0	0	2	55	3	56
vesper sparrow	<i>Pooecetes gramineus</i>	18	20	0	0	0	0	0	0	18	20
western kingbird	<i>Tyrannus verticalis</i>	7	9	0	0	0	0	1	1	8	10
western meadowlark	<i>Sturnella neglecta</i>	48	70	13	36	0	0	29	34	90	140
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	7	17	0	0	0	0	4	7	11	24
yellow warbler	<i>Setophaga petechia</i>	1	2	0	0	0	0	0	0	1	2
Woodpeckers		2	2	3	3	0	0	1	1	6	6
downy woodpecker	<i>Picoides pubescens</i>	1	1	0	0	0	0	0	0	1	1
northern flicker	<i>Colaptes auratus</i>	1	1	3	3	0	0	1	1	5	5
Unidentified Birds		1	36	18	831	0	0	1	1	20	868
unidentified bird (small)	N/A	1	36	18	831	0	0	1	1	20	868
Overall		682	1,528	277	4,981	57	595	463	2,209	1,479	9,313

**Appendix B. Mean Use, Percent of Total Use, and Frequency of Occurrence, by Season,
for Large and Small Birds Observed During the Fixed-Point Avian Use Surveys
Conducted within the Aurora Avian Use Study Area in Williams County, North Dakota,
from August 11, 2017 – July 26, 2018.**

Appendix B1. Mean large bird use, percent of total use, and frequency of occurrence for each large bird type and species, by season, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Survey Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Mean Use (number of large birds/800-meter plot/60-minute survey)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Waterbirds	0.17	5.91	0	3.82	1.8	23.6	0	18.8	9.2	6.1	0	6.3
American white pelican	0.05	0	0	0	0.5	0	0	0	1.0	0	0	0
double-crested cormorant	0.12	0	0	0.01	1.3	0	0	<0.1	8.1	0	0	1.0
sandhill crane	0	5.91	0	3.65	0	23.6	0	17.9	0	6.1	0	5.3
whooping crane	0	0	0	0.16	0	0	0	0.8	0	0	0	2.7
Waterfowl	2.16	10.11	0	10.76	22.9	40.4	0	52.8	24.7	21.2	0	38.5
American wigeon	0.02	0	0	0	0.2	0	0	0	1.0	0	0	0
blue-winged teal	0.13	0.21	0	0.20	1.4	0.8	0	1.0	7.2	2.0	0	4.4
cackling goose	0	0.05	0	0	0	0.2	0	0	0	2.0	0	0
Canada goose	0.20	6.94	0	6.59	2.2	27.7	0	32.3	4.1	11.1	0	21.0
canvasback	0.05	0	0	0	0.6	0	0	0	3.1	0	0	0
gadwall	0.11	0	0	0.99	1.2	0	0	4.9	6.2	0	0	8.1
greater white-fronted goose	0	1.01	0	0	0	4.0	0	0	0	1.0	0	0
green-winged teal	0	1.01	0	0	0	4.0	0	0	0	8.1	0	0
lesser scaup	0.03	0	0	0	0.3	0	0	0	1.0	0	0	0
mallard	0.34	0.25	0	0.96	3.6	1.0	0	4.7	10.4	4.0	0	23.2
northern pintail	0.03	0.04	0	0.64	0.3	0.2	0	3.2	1.0	1.0	0	15.1
northern shoveler	0.07	0.22	0	0.09	0.8	0.9	0	0.4	3.1	3.0	0	2.3
snow goose	0	0.04	0	0	0	0.2	0	0	0	1.0	0	0
tundra swan	0	0.33	0	0	0	1.3	0	0	0	3.0	0	0
unidentified duck	0.17	0	0	1.29	1.8	0	0	6.3	3.0	0	0	9.4
unidentified teal	0.99	0	0	0	10.5	0	0	0	1.0	0	0	0
Shorebirds	0.86	0.51	0	1.01	9.1	2.0	0	5.0	29.7	5.1	0	38.6
American avocet	0	0	0	0.02	0	0	0	<0.1	0	0	0	1.0
killdeer	0.30	0.48	0	0.49	3.1	1.9	0	2.4	16.4	4.0	0	22.5
marbled godwit	0	0	0	0.18	0	0	0	0.9	0	0	0	7.1
pectoral sandpiper	0.20	0	0	0	2.1	0	0	0	2.0	0	0	0
red-necked phalarope	0	0	0	0.02	0	0	0	<0.1	0	0	0	1.0
unidentified shorebird	0	0.02	0	0	0	<0.1	0	0	0	1.0	0	0
upland sandpiper	0.36	0	0	0.26	3.8	0	0	1.3	18.5	0	0	19.2

Appendix B1. Mean large bird use, percent of total use, and frequency of occurrence for each large bird type and species, by season, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Survey Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Mean Use (number of large birds/800-meter plot/60-minute survey)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
willet	0	0	0	0.04	0	0	0	0.2	0	0	0	1.0
Gulls/Terns	3.71	3.17	0	3.78	39.3	12.7	0	18.6	49.1	11.1	0	34.5
black tern	0.02	0	0	0	0.2	0	0	0	1.0	0	0	0
California gull	0.23	0	0	0	2.4	0	0	0	10.4	0	0	0
common tern	0.02	0	0	0	0.2	0	0	0	1.0	0	0	0
Franklin's gull	0.51	3.17	0	2.54	5.4	12.7	0	12.4	12.3	11.1	0	16.1
herring gull	0.02	0	0	0.04	0.2	0	0	0.2	1.0	0	0	1.3
ring-billed gull	1.75	0	0	0.67	18.6	0	0	3.3	35.8	0	0	23.2
unidentified gull	1.16	0	0	0.53	12.3	0	0	2.6	16.3	0	0	7.7
Rails/Coots	0.08	1.95	0	0	0.9	7.8	0	0	3.1	6.1	0	0
American coot	0.07	1.95	0	0	0.8	7.8	0	0	2.1	6.1	0	0
sora	0.01	0	0	0	0.1	0	0	0	1.0	0	0	0
Diurnal Raptors	0.54	0.65	0	0.30	5.7	2.6	0	1.5	38.6	42.4	0	24.4
<i>Accipiters</i>	0.01	0	0	0	0.1	0	0	0	1.0	0	0	0
Cooper's hawk	0.01	0	0	0	0.1	0	0	0	1.0	0	0	0
<i>Buteos</i>	0.36	0.42	0	0.13	3.9	1.7	0	0.6	28.4	32.3	0	11.4
ferruginous hawk	0	0.01	0	0	0	<0.1	0	0	0	1.0	0	0
red-tailed hawk	0.10	0.25	0	0.05	1.1	1.0	0	0.2	7.1	23.2	0	3.4
rough-legged hawk	0	0.09	0	0.03	0	0.4	0	0.1	0	4.0	0	2.7
Swainson's hawk	0.26	0.06	0	0.04	2.8	0.2	0	0.2	23.3	6.1	0	4.4
unidentified buteo	0	0.01	0	0.01	0	<0.1	0	<0.1	0	1.0	0	1.0
<i>Northern Harrier</i>	0.16	0.12	0	0.16	1.7	0.5	0	0.8	15.3	11.1	0	14.3
northern harrier	0.16	0.12	0	0.16	1.7	0.5	0	0.8	15.3	11.1	0	14.3
<i>Eagles</i>	0	0.03	0	0	0	0.1	0	0	0	2.0	0	0
bald eagle	0	0.03	0	0	0	0.1	0	0	0	2.0	0	0
<i>Falcons</i>	0	0.07	0	0.01	0	0.3	0	<0.1	0	5.1	0	1.0
American kestrel	0	0.04	0	0.01	0	0.2	0	<0.1	0	2.0	0	1.0
prairie falcon	0	0.03	0	0	0	0.1	0	0	0	3.0	0	0
Owls	0.01	0.02	0.01	0	0.1	<0.1	1.0	0	1.0	2.0	1.3	0
great horned owl	0.01	0.02	0	0	0.1	<0.1	0	0	1.0	2.0	0	0
snowy owl	0	0	0.01	0	0	0	1.0	0	0	0	1.3	0
Vultures	0.06	0.01	0	0.01	0.6	<0.1	0	<0.1	2.0	1.0	0	1.0
turkey vulture	0.06	0.01	0	0.01	0.6	<0.1	0	<0.1	2.0	1.0	0	1.0

Appendix B1. Mean large bird use, percent of total use, and frequency of occurrence for each large bird type and species, by season, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Survey Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Mean Use (number of large birds/800-meter plot/60-minute survey)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Upland Game Birds	0.23	0.45	1.32	0.19	2.4	1.8	94.7	0.9	17.5	8.1	9.0	12.8
gray partridge	0.02	0.23	0.13	0.05	0.2	0.9	9.4	0.3	1.0	2.0	2.6	1.3
ring-necked pheasant	0.21	0.06	1.19	0.13	2.2	0.2	85.3	0.6	16.4	5.1	6.4	10.4
sharp-tailed grouse	0	0	0	0.01	0	0	0	<0.1	0	0	0	1.0
unidentified grouse	0	0.14	0	0	0	0.6	0	0	0	1.0	0	0
wild turkey	0	0.02	0	0	0	<0.1	0	0	0	1.0	0	0
Doves/Pigeons	1.05	2.17	0.04	0.11	11.2	8.7	2.6	0.5	23.4	22.2	1.2	4.0
mourning dove	0.35	0.62	0	0.05	3.7	2.5	0	0.2	18.3	13.1	0	3.0
rock pigeon	0.71	1.56	0.04	0.06	7.5	6.2	2.6	0.3	6.1	10.1	1.2	1.0
Large Corvids	0.56	0.09	0.03	0.38	5.9	0.4	1.8	1.9	3.1	5.1	2.5	10.3
American crow	0.55	0.03	0	0.38	5.8	0.1	0	1.9	2.0	2.0	0	10.3
black-billed magpie	0	0.05	0.03	0	0	0.2	1.8	0	0	2.0	2.5	0
common raven	0.01	0.01	0	0	0.1	<0.1	0	0	1.0	1.0	0	0
Large Birds Overall	9.43	25.04	1.39	20.37	100	100	100	100				

Appendix B2. Mean small bird use, percent of total use, and frequency of occurrence for each small bird type and species, by season, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Mean Use (number of small birds/100-meter plot/10-minute survey)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Passerines	5.65	11.57	6.16	6.99	99.6	99.5	100	99.7	84.8	40.4	44.8	79.4
Alder flycatcher	0.01	0	0	0	0.2	0	0	0	1	0	0	0
American goldfinch	0.07	0	0	0	1.2	0	0	0	5.1	0	0	0
American robin	0.06	0	0	0.01	1.1	0	0	0.1	5.1	0	0	1
barn swallow	0.37	0.05	0	0.06	6.5	0.4	0	0.9	10.2	3	0	2
bobolink	0.03	0	0	0.05	0.5	0	0	0.7	3.1	0	0	1
Brewer's blackbird	0.43	0	0	0.02	7.6	0	0	0.3	11.3	0	0	1
brown-headed cowbird	0.96	0	0	0.35	17	0	0	5	32.8	0	0	11.1
brown thrasher	0.01	0	0	0	0.2	0	0	0	1	0	0	0
chestnut-collared longspur	0	0.54	0	0	0	4.6	0	0	0	3	0	0
chipping sparrow	0.01	0.02	0	0	0.2	0.2	0	0	1	1	0	0
clay-colored sparrow	0.04	0	0	0	0.7	0	0	0	3	0	0	0
cliff swallow	0.13	0	0	0.01	2.3	0	0	0.1	3.1	0	0	1
common grackle	0.07	0	0	0	1.3	0	0	0	3.1	0	0	0
common redpoll	0	0.64	1.7	1.94	0	5.5	27.5	27.6	0	6.1	9.2	6.3
eastern kingbird	0.22	0	0	0	3.9	0	0	0	15.3	0	0	0
European starling	0.06	0	0	0	1.1	0	0	0	2.1	0	0	0
grasshopper sparrow	0.27	0	0	0.07	4.7	0	0	1	22.5	0	0	7.1
gray catbird	0.01	0	0	0	0.2	0	0	0	1	0	0	0
Harris' sparrow	0	0.07	0	0	0	0.6	0	0	0	2	0	0
horned lark	0.83	6.03	2.86	2.95	14.7	51.9	46.5	42	30.7	16.2	34.6	52.3
house sparrow	0	0	0.32	0	0	0	5.2	0	0	0	2.4	0
Lapland longspur	0	2.71	0	0	0	23.3	0	0	0	6.1	0	0
lark bunting	0.01	0	0	0	0.2	0	0	0	1	0	0	0
lark sparrow	0.01	0.06	0	0	0.2	0.5	0	0	1	1	0	0
loggerhead shrike	0	0	0	0.01	0	0	0	0.1	0	0	0	1
red-winged blackbird	0.77	0.64	0	0.22	13.6	5.5	0	3.1	36	1	0	11.8
Savannah sparrow	0.02	0.02	0	0.09	0.4	0.2	0	1.3	2.1	1	0	8.1
snow bunting	0	0.45	1.28	0	0	3.9	20.7	0	0	4	10.1	0
song sparrow	0.03	0	0	0	0.5	0	0	0	2	0	0	0
Sprague's pipit	0	0.02	0	0	0	0.2	0	0	0	1	0	0
tree swallow	0	0	0	0.03	0	0	0	0.4	0	0	0	1
unidentified sparrow	0.01	0	0	0.73	0.2	0	0	10.5	1	0	0	2.7

Appendix B2. Mean small bird use, percent of total use, and frequency of occurrence for each small bird type and species, by season, observed during the fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Type/Species	Mean Use (number of small birds/100-meter plot/10-minute survey)				Percent of Use (%)				Frequency of Occurrence (%)			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
vesper sparrow	0.2	0	0	0	3.6	0	0	0	18.2	0	0	0
western kingbird	0.09	0	0	0.01	1.6	0	0	0.1	7.2	0	0	1
western meadowlark	0.71	0.32	0	0.37	12.5	2.8	0	5.3	35.9	10.1	0	28.5
yellow-headed blackbird	0.18	0	0	0.07	3.1	0	0	1	4.2	0	0	4
yellow warbler	0.02	0	0	0	0.4	0	0	0	1	0	0	0
Woodpeckers	0.02	0.01	0	0.01	0.4	<0.1	0	0.1	2	1	0	1
downy woodpecker	0.01	0	0	0	0.2	0	0	0	1	0	0	0
northern flicker	0.01	0.01	0	0.01	0.2	<0.1	0	0.1	1	1	0	1
Unidentified Birds	0	0.05	0	0.01	0	0.4	0	0.1	0	4	0	1
unidentified bird (small)	0	0.05	0	0.01	0	0.4	0	0.1	0	4	0	1
Small Birds Overall	5.67	11.63	6.16	7.01	100	100	100	100				

**Appendix C. Flight Height Characteristics for Large and Small Birds Observed During the
Fixed-Point Avian Use Surveys Conducted within the Aurora Avian Use Study Area in
Williams County, North Dakota, from August 11, 2017 – July 26, 2018**

Appendix C. Flight height characteristics for each large bird species observed during the fixed-point avian use surveys^a conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Species	# Groups Flying	Overall Mean Use	% Obs. Flying	% Flying within RSH based on initial Obs	% Within RSH at Anytime
American white pelican	1	0.01	100	100	0.01
double-crested cormorant	9	0.03	92.3	25.0	<0.01
sandhill crane	13	2.39	92.0	50.0	1.10
cackling goose	2	0.01	100	100	0.01
Canada goose	33	3.44	66.8	89.0	2.05
snow goose	1	0.01	100	100	0.01
greater white-fronted goose	1	0.25	100	100	0.25
gadwall	23	0.28	90.8	16.2	0.04
canvasback	2	0.01	80.0	75.0	<0.01
green-winged teal	5	0.25	80.0	16.2	0.03
northern pintail	15	0.18	65.6	50.0	0.06
mallard	47	0.39	70.9	21.0	0.06
killdeer	30	0.32	62.7	4.1	<0.01
California gull	14	0.06	100	4.5	<0.01
Franklin's gull	49	1.56	92.0	34.3	0.49
ring-billed gull	140	0.61	93.6	20.0	0.11
unidentified gull	27	0.43	84.9	29.1	0.11
red-tailed hawk	27	0.10	76.9	53.3	0.04
ferruginous hawk	1	<0.01	100	100	<0.01
Swainson's hawk	28	0.09	80.6	34.5	0.03
turkey vulture	4	0.02	100	75.0	0.02
rough-legged hawk	9	0.03	81.8	33.3	<0.01
Cooper's hawk	1	<0.01	100	100	<0.01
rock pigeon	21	0.59	100	21.5	0.13
common raven	2	<0.01	100	50.0	<0.01
unidentified bird (small)	2	0.02	50.0	33.3	<0.01

Obs = Observations.

^a 800-meter (m; 2,625-foot [ft]) radius plot and 60-minute (min) survey for large birds; 100-m (328-ft) radius plot and 10-min survey for small birds.

^b The likely “rotor-swept height” for potential collision with a turbine blade, or 25–150 m (82–492 ft) above ground level.

Appendix D. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes During the Fixed-Point Avian Use Surveys Conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Appendix D1. Mean use (number of birds/plot^a/survey^b) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Bird Type/Raptor Subtype	Survey Point										
	1	2	3	4	5	6	7	8	9	10	11
Waterbirds	0	0.42	0	13.08	15.08	0.50	0.14	0	0.92	0	11.86
Waterfowl	1.27	7.25	0.92	2.92	2.50	15.83	15.86	1.12	3.67	0.17	0.29
Shorebirds	1.00	0.17	0.17	0.17	0.50	1.58	1.00	0.12	0.50	0	0
Gulls/Terns	0.09	1.67	0.75	11.33	2.92	4.33	1.86	12.75	0.83	1.08	11.86
Rails/Coots	0	0.17	0	0	0	6.92	5.43	0	0	0	0
Diurnal Raptors	0.55	0.33	0.17	0.67	0.50	0.42	0.43	0.88	0.25	0.42	0.43
<i>Accipiters</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0.12</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Buteos</i>	<i>0.45</i>	<i>0.33</i>	<i>0.17</i>	<i>0.50</i>	<i>0.25</i>	<i>0.25</i>	<i>0.43</i>	<i>0</i>	<i>0.17</i>	<i>0.33</i>	<i>0.29</i>
<i>Northern Harrier</i>	<i>0.09</i>	<i>0</i>	<i>0</i>	<i>0.17</i>	<i>0.25</i>	<i>0.08</i>	<i>0</i>	<i>0.50</i>	<i>0.08</i>	<i>0.08</i>	<i>0.14</i>
<i>Eagles</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0.08</i>	<i>0</i>	<i>0.25</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Falcons</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Owls	0	0	0	0	0	0	0	0	0	0	0.14
Vultures	0	0	0	0	0	0	0	0	0	0	0
Upland Game Birds	0.09	0.17	0.08	0	1.42	0.17	0.43	0	0	0.08	0.29
Doves/Pigeons	0	0.17	0.08	0.33	0.17	0.75	1.29	0.25	0.08	1.50	0
Large Corvids	0.09	0.08	0.17	1.00	0	0.58	0	0	0	0	0
Overall Large Birds	3.09	10.42	2.33	29.50	23.08	31.08	26.43	15.12	6.25	3.25	24.86
Passerines	3.18	1.83	0.92	65.08	4.08	5.58	6.14	5.50	5.75	5.42	1.86
Woodpeckers	0	0	0	0	0	0.08	0	0	0	0	0
Unidentified Birds	0	0	0	0	0.08	0	0	0.25	0	0.08	0
Overall Small Birds	3.18	1.83	0.92	65.08	4.17	5.67	6.14	5.75	5.75	5.50	1.86

^a 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

^b 60-minute (min) surveys for large birds, 10-min surveys for small birds.

Appendix D1 (continued). Mean use (number of birds/plot^a/survey^b) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

Bird Type/Raptor Subtype	Survey Point										
	12	13	14	15	16	17	18	19	20	21	22
Waterbirds	0	0	3.00	18.92	0	1.25	0	0	0	0	0.17
Waterfowl	1.75	1.00	0.78	0.75	4.50	8.83	1.80	0	18.17	0.14	1.42
Shorebirds	0.17	2.12	0	0.58	0.20	0.33	0.40	0.42	1.33	0.43	0.25
Gulls/Terns	0.75	0.12	0.11	6.08	1.10	1.83	2.10	0.83	0.75	0.14	7.17
Rails/Coots	0	0	0	0	0	0	0	0	0	0	0
Diurnal Raptors	0.58	0.75	0.33	0.92	0.70	0.50	0.50	0.25	0.50	0.43	0.08
<i>Accipiters</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Buteos</i>	0.42	0.62	0	0.42	0.40	0.42	0.30	0.08	0.33	0.14	0.08
<i>Northern Harrier</i>	0.08	0.12	0.22	0.25	0.30	0.08	0.20	0.17	0.08	0.29	0
<i>Eagles</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Falcons</i>	0.08	0	0.11	0.25	0	0	0	0	0.08	0	0
Owls	0	0	0	0.08	0	0	0	0.08	0	0	0
Vultures	0	0.25	0	0	0	0	0	0	0	0	0
Upland Game Birds	0	0.25	0	8.25	0.80	0.17	0.10	1.42	0.08	0.14	0
Doves/Pigeons	1.33	2.38	0.44	0.42	0.90	0.58	1.60	0	1.42	1.14	3.00
Large Corvids	0.08	0.12	5.67	0.67	0	0	0	0.08	0.17	0	0
All Large Birds	4.67	7.00	10.33	36.67	8.20	13.50	6.50	3.08	22.42	2.43	12.08
Passerines	6.83	4.50	3.11	5.00	5.00	2.08	7.50	2.92	4.83	4.29	15.17
Woodpeckers	0	0	0	0	0	0	0	0	0	0	0
Unidentified Birds	0	0	0	0	0	0	0.10	0	0	0	0
All Small Birds	6.83	4.50	3.11	5.00	5.00	2.08	7.60	2.92	4.83	4.29	15.17

^a. 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

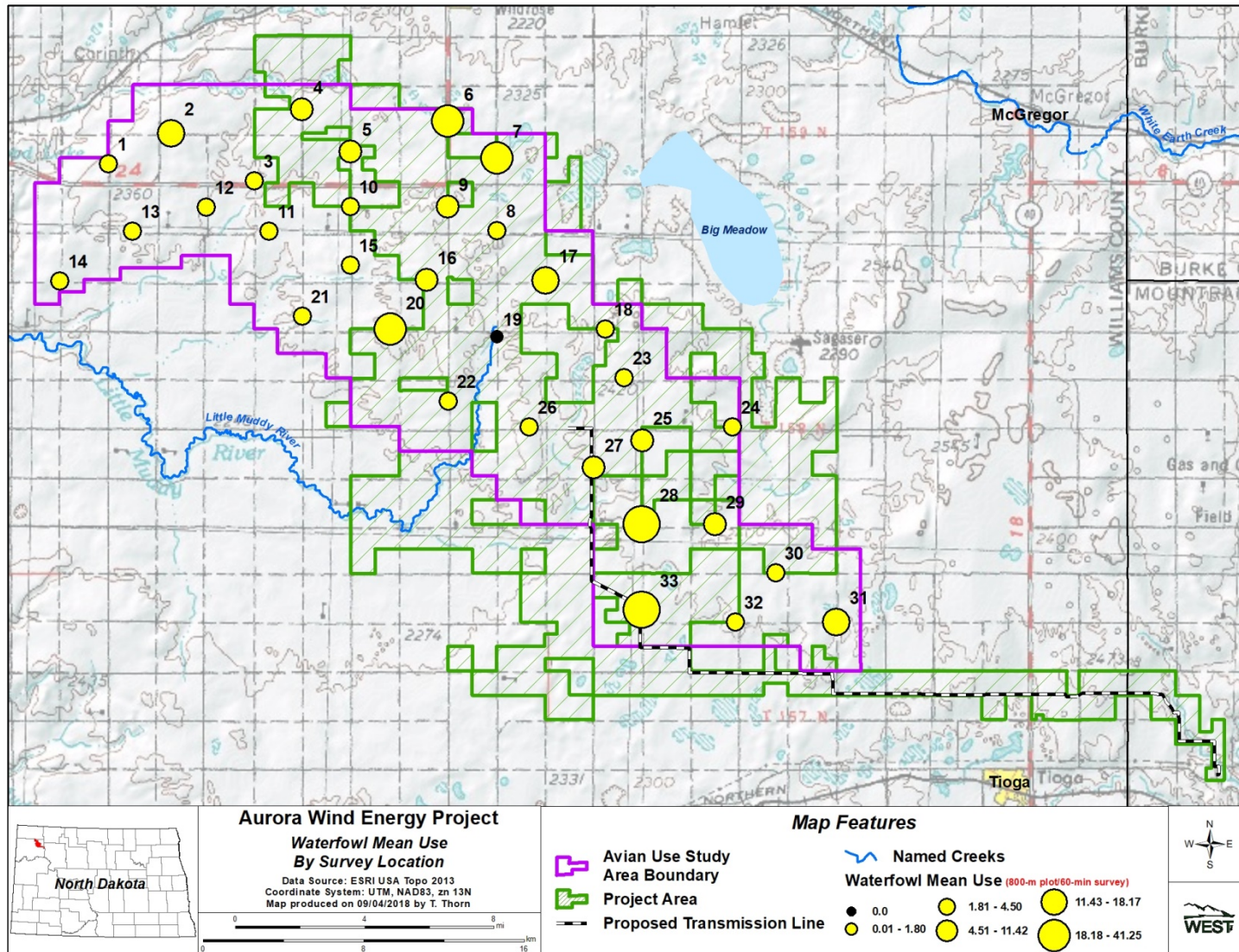
^b. 60-minute (min) surveys for large birds, 10-min surveys for small birds.

Appendix D1 (*continued*). Mean use (number of birds/plot^a/survey^b) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

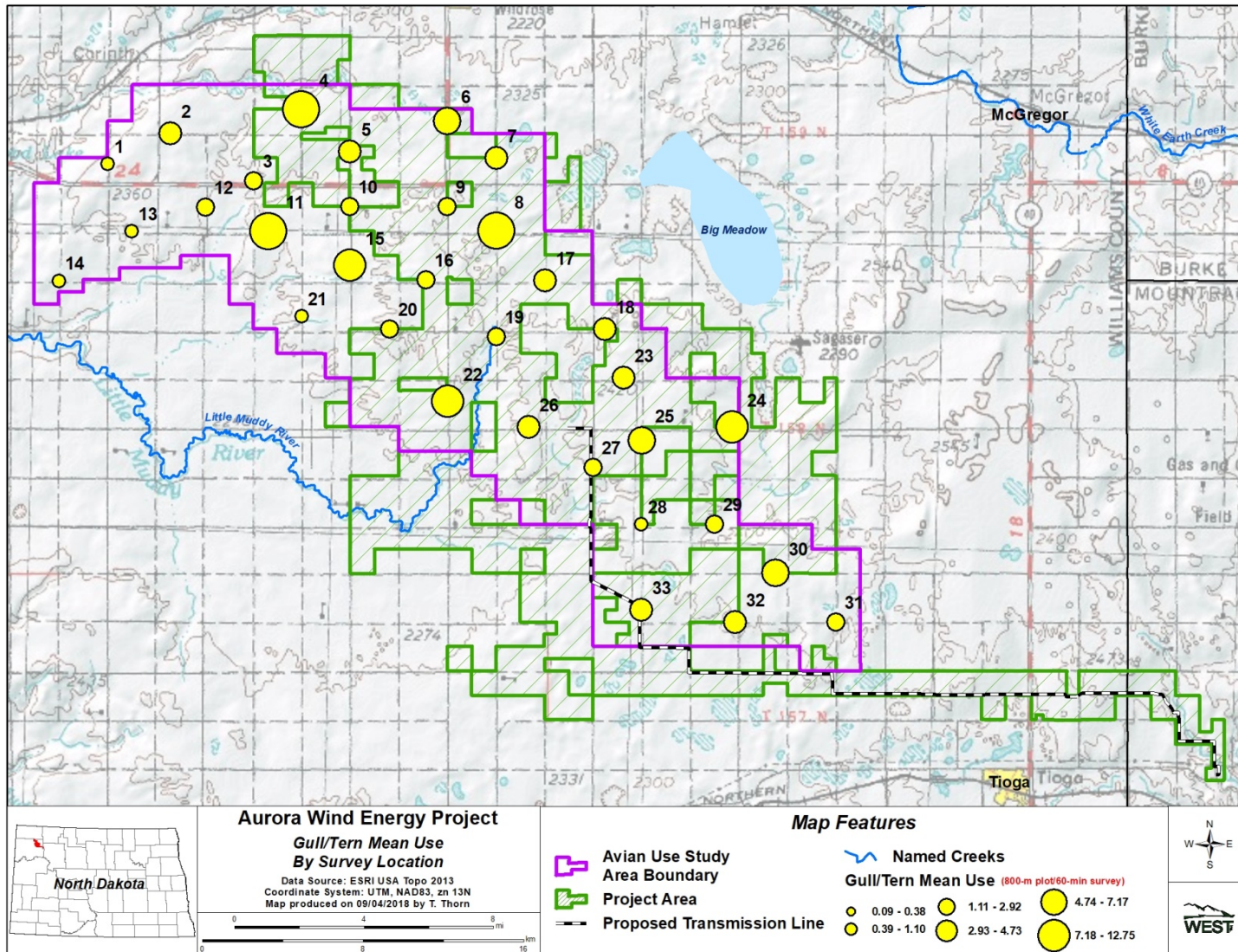
Bird Type/Raptor Subtype	Survey Point										
	23	24	25	26	27	28	29	30	31	32	33
Waterbirds	0	0	0	0	0	0	0	0	0	0	14.50
Waterfowl	0.17	0.42	3.27	1.67	4.17	41.25	3.29	0.67	11.42	0.67	39.42
Shorebirds	0.33	0.25	3.36	0.17	2.17	0.50	1.00	0.50	0.67	0.42	0.50
Gulls/Terns	2.00	7.08	4.73	2.17	0.50	0.38	0.71	4.25	0.75	1.58	2.75
Rails/Coots	0	4.92	0	0	0	0	0	0	1.58	0	0
Diurnal Raptors	0.08	0.17	0.09	0.33	0.33	0.50	0.57	0.33	0.17	0.17	0.42
<i>Accipiters</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Buteos</i>	<i>0.08</i>	<i>0.08</i>	<i>0</i>	<i>0.33</i>	<i>0.17</i>	<i>0.38</i>	<i>0.43</i>	<i>0.08</i>	<i>0.08</i>	<i>0.08</i>	<i>0.33</i>
<i>Northern Harrier</i>	<i>0</i>	<i>0.08</i>	<i>0.09</i>	<i>0</i>	<i>0.08</i>	<i>0.12</i>	<i>0.14</i>	<i>0.25</i>	<i>0.08</i>	<i>0.08</i>	<i>0</i>
<i>Eagles</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Falcons</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0.08</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0.08</i>
Owls	0	0	0.09	0	0	0	0	0	0	0	0
Vultures	0.08	0	0	0	0.33	0	0	0.08	0	0	0
Upland Game Birds	0	0.50	0	0.08	0	0	0	0.33	1.42	0.25	0
Doves/Pigeons	4.25	3.33	0.55	1.50	0.17	0	0	2.00	0	0.33	0.25
Large Corvids	0	0.25	0.36	0	0	0.12	0	0	0	0	0
All Large Birds	6.92	16.92	12.45	5.92	7.67	42.75	5.57	8.17	16.00	3.42	57.83
Passerines	1.92	3.75	3.18	3.17	6.00	31.62	4.43	9.92	13.75	2.58	2.42
Woodpeckers	0.08	0.08	0	0	0	0	0	0	0	0.08	0
Unidentified Birds	0	0	0	0	0.08	0	0	0	0	0	0
All Small Birds	2.00	3.83	3.18	3.17	6.08	31.62	4.43	9.92	13.75	2.67	2.42

^a. 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

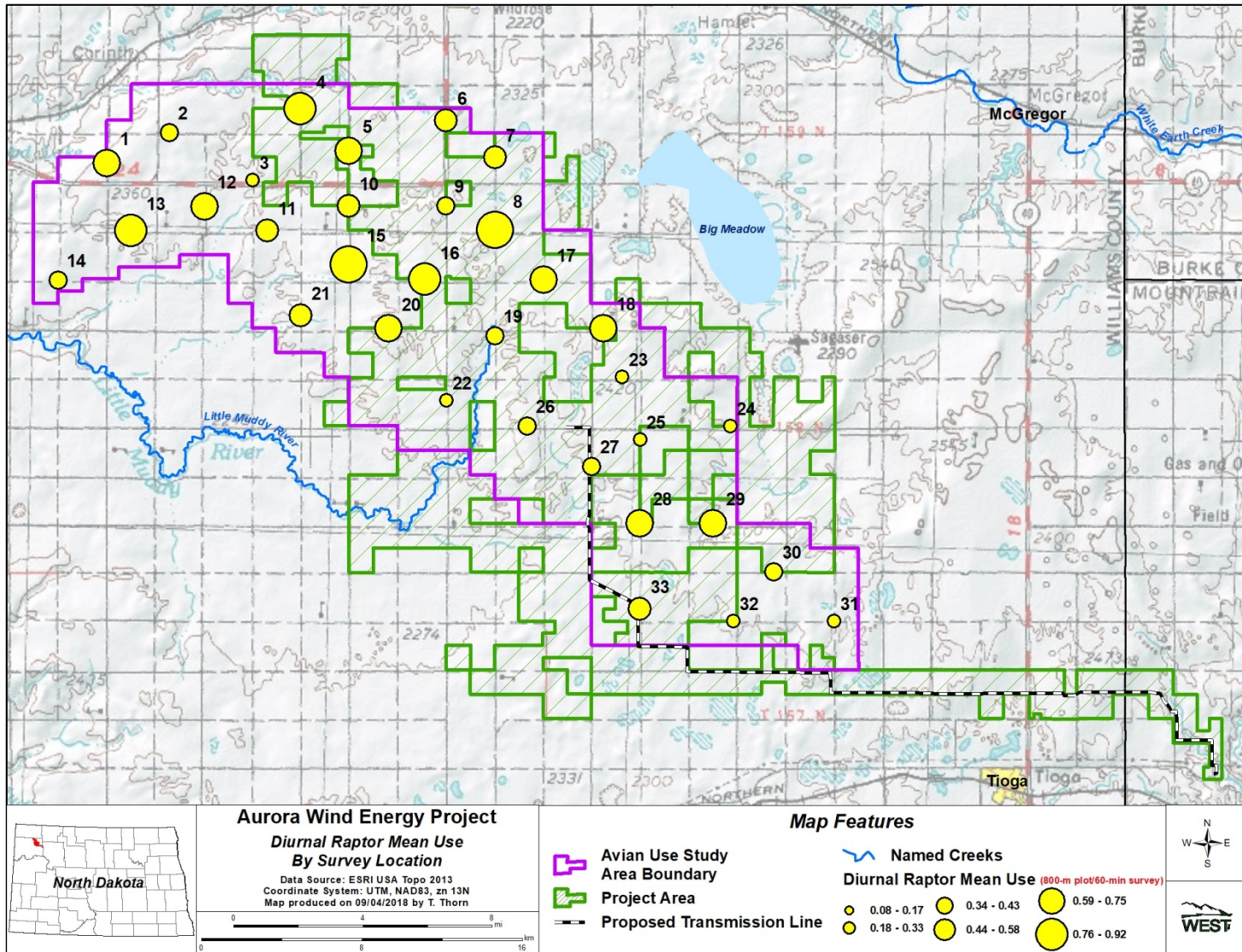
^b. 60-minute (min) surveys for large birds, 10-min surveys for small birds.



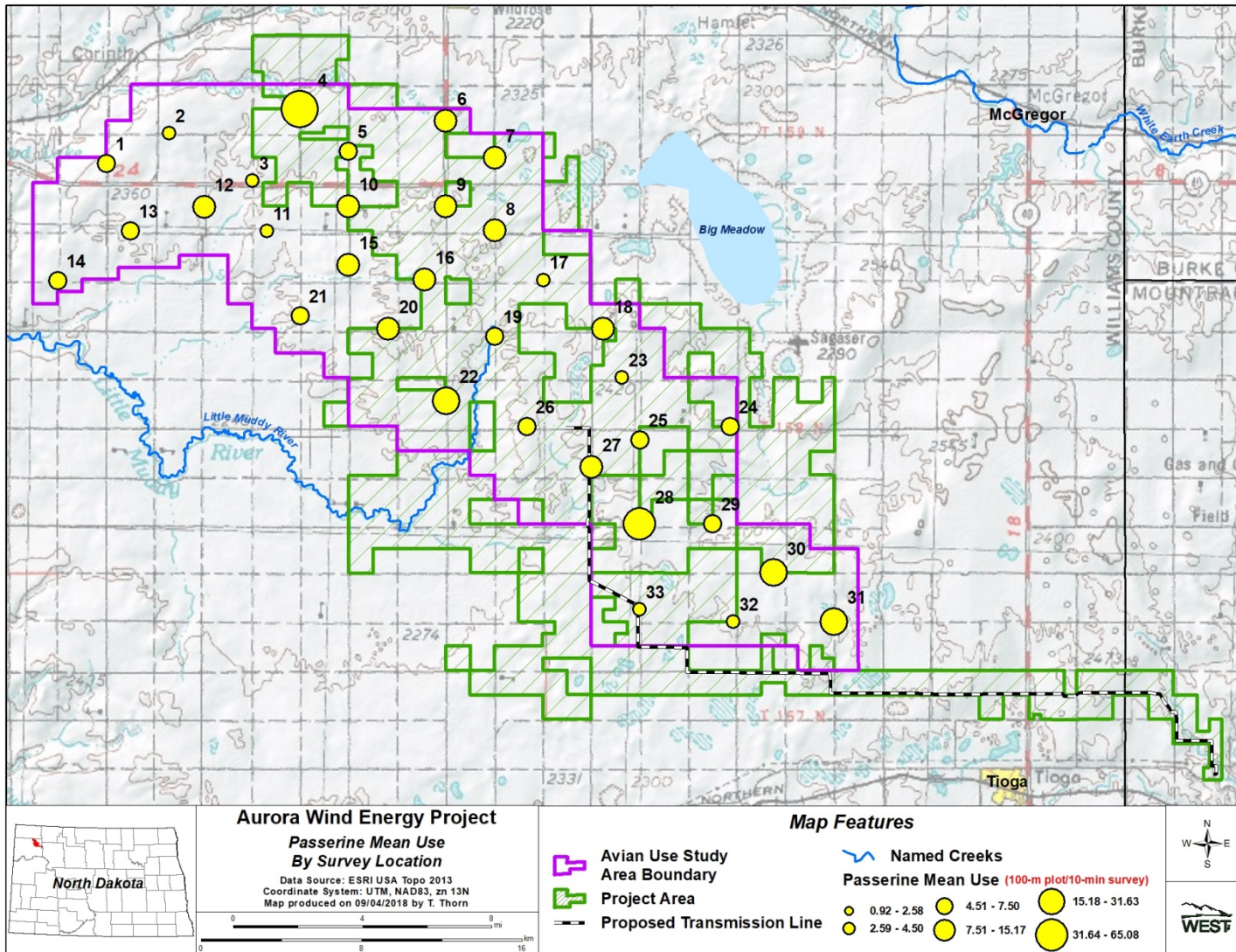
Appendix D2. Mean waterfowl use by survey point determined from fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.



Appendix D2 (continued). Mean gulls/terns use by survey point determined from fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.



Appendix D2. Mean diurnal raptor use by survey point determined from fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.



Appendix D2 (continued). Mean passerine use by survey point determined from fixed-point avian use surveys conducted within the Aurora Avian Use Study Area in Williams County, North Dakota, from August 11, 2017 – July 26, 2018.

**Appendix E. Fatality Estimates for all Birds and Raptors at Wind Energy Facilities in
Midwestern North America.**

Appendix E. Fatality estimates (birds/Megawatt/year) for all birds and raptors at wind energy facilities in Midwestern North America.

Project Name	Bird fatalities	Raptor fatalities	Predominant Habitat Type	Citation
Barton I & II, IA (2010-2011)	5.50	0	agriculture	Derby et al. 2011b
Big Blue, MN (2013)	0.60	0	agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	0.37	0	agriculture	Fagen Engineering 2015
Blue Sky Green Field, WI (2008; 2009)	7.17	0	agriculture	Gruver et al. 2009
Buffalo Ridge I, SD (2009-2010)	5.06	0.20	agriculture/grassland	Derby et al. 2010f
Buffalo Ridge II, SD (2011-2012)	1.99	0	agriculture, grassland	Derby et al. 2012a
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	NA	NA	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	NA	NA	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	NA	NA	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	NA	NA	agriculture	Johnson et al. 2004
Cedar Ridge, WI (2009)	6.55	0.18	agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	3.72	0.13	agriculture	BHE Environmental 2011
Crescent Ridge, IL (2005-2006)	NA	NA	agriculture	Kerlinger et al. 2007
Crystal Lake II, IA (2009)	NA	NA	agriculture	Derby et al. 2010b
Elm Creek II, MN (2011-2012)	3.64	0	agriculture, grassland	Derby et al. 2012b
Elm Creek, MN (2009-2010)	1.55	0	agriculture	Derby et al. 2010g
Forward Energy Center, WI (2008-2010)	NA	NA	agriculture	Grodsky and Drake 2011
Fowler I, II, III, IN (2010)	NA	NA	agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	NA	NA	agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	NA	NA	agriculture	Good et al. 2013a
Fowler I, IN (2009)	2.83	0	agriculture	Johnson et al. 2010a
Fowler III, IN (2009)	NA	NA	agriculture	Johnson et al. 2010b
Grand Ridge I, IL (2009-2010)	0.48	0	agriculture	Derby et al. 2010a
Harrow, Ont (2010)	NA	NA	agriculture	Natural Resource Solutions 2011
Heritage Garden I, MI (2012-2013)	1.30	NA	agriculture	Kerlinger et al. 2014
Heritage Garden I, MI (2013-2014)	2.40	NA	agriculture	Kerlinger et al. 2014
Kewaunee County, WI (1999-2001)	1.95	0	agriculture	Howe et al. 2002
Moraine II, MN (2009)	5.59	0.37	agriculture/grassland	Derby et al. 2010h
NPPD Ainsworth, NE (2006)	1.63	0.06	agriculture/grassland	Derby et al. 2007

Appendix E. Fatality estimates (birds/Megawatt/year) for all birds and raptors at wind energy facilities in Midwestern North America.

Project Name	Bird fatalities	Raptor fatalities	Predominant Habitat Type	Citation
Pioneer Prairie II, IA (2011-2012)	0.27	0	agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	NA	NA	agriculture	Chodachek et al. 2014
PrairieWinds ND1 (Minot), ND (2010)	1.48	0.05	agriculture	Derby et al. 2011d
PrairieWinds ND1 (Minot), ND (2011)	1.56	0.05	agriculture, grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2011-2012)	1.41	0	grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	grassland	Derby et al. 2013
PrairieWinds SD1, SD (2013-2014)	1.66	0.17	grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	0.84	0	agriculture	Good et al. 2013b
Ripley, Ont (2008)	3.09	0.1	agriculture	Jacques Whitford 2009
Rugby, ND (2010-2011)	3.82	0.06	agriculture	Derby et al. 2011c
Top Crop I & II (2012-2013)	1.35	NA	agriculture	Good et al. 2013c
Top of Iowa, IA (2003)	0.42	0	agriculture	Jain 2005
Top of Iowa, IA (2004)	0.81	0.17	agriculture	Jain 2005
Wessington Springs, SD (2009)	8.25	0.06	grassland	Derby et al. 2010e
Wessington Springs, SD (2010)	0.89	0.07	grassland	Derby et al. 2011a
Winnebago, IA (2009-2010)	3.88	0.27	agriculture/grassland	Derby et al. 2010i