BASIN ELECTRIC
POWER COOPERATIVE
1717 EAST INTERSTATE AVENUE
BISMARCK, NORTH DAKOTA 58503
PHONE: 701-223-0441 FAX: 701-557-5336

April 8, 2014

RECEIVED
APR - 9 2014
NORTH DAKOTA
PUBLIC SERVICE COMMISSION

Jerry Lien
North Dakota Public Service Commission
600 East Boulevard Avenue, Dept. 408
Bismarck, ND 58505

Re: Case No. PU-08-075

Dear Mr. Lien:

This letter is in response to your letter dated February 12, 2014, received by Basin Electric Power Cooperative (**Basin Electric**) on February 20, 2014 regarding Post Construction Inspection, Case No. PU-08-075. Your letter stated the North Dakota Public Service Commission (**NDPSC**) retained a third-party vendor to conduct a Post Construction Inspection of the PrairieWindsND wind facility. It appears this inspection was completed in January, 2012. As more than two years have passed, current conditions at the wind facility may not be indicative of those observed during the inspection.

Your letter included a number of recommended actions, generally addressing the submittal of additional information related to certain Conditions in the Order issued by the NDPSC. A multidisciplinary team, consisting of electrical and civil engineers and environmental personnel, provided information to address the issues raised in your letter.

The requested information is provided below, including a brief synopsis of the NDPSC information request followed by Basin Electric's response. The sequence of responses is consistent with the order of the information requests in your letter.

Issue 1: Provide Class III cultural survey information for relocation of four access roads and one turbine.
Response: See enclosed Metcalf Archaeological Consultants survey.

Issue 2: No line marker posts were installed at highway crossings.
Response: Basin Electric personnel inspected facility highway crossings in March 2014, and found appropriate markers to be in place. Photo-documentation of a representative line marker post is enclosed.

Issue 3: Reclamation was not complete in the vicinity of turbine D51.
Response: Given the current season and snow cover, Basin Electric was not able to evaluate this issue. Basin Electric will follow up during spring/summer 2014 and will report its findings to the NDPSC.

Issue 4: Some of the locations where collector lines crossed roads sank and need additional maintenance.

92 PU-08-75 Filed 04/09/2014 Pages: 160
Response to Feb. 12, 2014 letter re third-party post construction inspection report
Basin Electric Power Cooperative
Kevin Solie

Response: Given the current season and snow cover, Basin Electric was not able to evaluate this issue. Basin Electric will follow up during spring/summer 2014 and will report its findings to the NDPSC.

Issue 5: No record of a comprehensive decommissioning plan and estimated decommissioning costs were found in the case file.

Response: Information pursuant to NDAC 69-09-09 was submitted to the NDPSC in March 2010. Copy of submittal is enclosed.

Issue 6: Basin Electric should provide evidence that no drainage tile was found, broken, or damaged.

Response: No drainage tile was found during construction. This observation is consistent with local soil conditions and agricultural practices in that the soils are generally well-drained and drainage tile is not necessary or utilized.

Issue 7: Relates to post construction clean-up activities. Items such as 2" plastic casing pipe and other debris were observed during the third-party 2012 inspection.

Response: Basin Electric personnel conducted a site reconnaissance in March 2014. Casing pipes, trailers, equipment parked and miscellaneous debris are apparently left from when Rural Water systems were installed, (after wind farm construction, clean-up and reclamation were completed). Debris (cable reels and garbage) near the Collector Substation were removed in 2013.

Issue 8: Basin Electric should provide a copy of educational materials prepared for landowners.

Response: A copy of *a* handout provided to the public describing the Project is enclosed. In addition, periodic communications provided to landowners (letters or memoranda) describing current issues are enclosed.

Issue 9: Provide a copy of the annual bird mortality reports.

Response: Bird mortality reports for the required two-year monitoring period are enclosed.

Issue 10: Provide a written procedure stating how complaints would be handled.

Response: Enclosed.

Issue 11: Provide documentation that roads were bored.

Response: All road crossings were permitted by the local Townships, Ward County and the North Dakota Department of Transportation. Individual permits were issued by the governing entities for each location and designated the areas to be bored. Basin Electric complied with the requirements of each individual permit.

Please contact me if you have any further concerns.

Sincerely,

Kevin L. Solie
Senior Water Quality/Waste Management Coordinator

kls/ds
enclosures

cc: Deborah Levchak

RESPONSE #1

MANUSCRIPT DATA RECORD FORM

1. Manuscript Number:

2. SHPO Reference #: 08-576

3. Author(s): Kimball M. Banks

4. Title: Addendum I – Prairiewinds – ND 1 Project: A Class III Cultural Resource Inventory of a Proposed Wind Energy Farm in Ward County, North Dakota

5. Report Date: February 2010

6. Number of Pages: 14

7. Type: I

8. Acres: 180 acres

9. Legal Location(s):

County	TWP	R	SEC	SU
Ward	151	82	7	SO
	151	83	1-4, 9-10, 12-14, and 16	GA
	152	83	13-15, 21-23, 25-29, 33-34, 36	SO

Addendum Survey Report

Submitted by Metcalf Archaeological Consultants, Inc.
PO Box 2154, Bismarck, North Dakota 5802
Phone: 701-258-1215, Email: macnodak@metcalfarchaeology.com

1. **Report Title:** Addendum I - Prairiewinds - ND1 Project: A Class III Cultural Resource Inventory of a Proposed Wind Energy Farm in Ward County, North Dakota

2. **Author:** Ed Stine

3. **Report Date(s):** February 2010

4. **Fieldwork Dates:** August 15, 20, 25, September 1, 2, 9, 10, 23, and October 6, 13, 20, 26, 28, 2009

5. **Acreage:** 180 acres

6. **Project Sponsor:** Basin Electric Power Cooperative, Bismarck, North Dakota

7. **Historic Context (Study Unit):** Souris River Study Unit (Unit # 11) and Garrison Study Unit (Unit # 6)

8. **Legal Description/Location of Undertaking Area of Potential Effects (APE):** Maps depicting the project APEs are presented in Appendix A. The project APEs are in the following locations in Ward County:

   T. 152N, R. 83W, sections 13, 14, 15, 21, 22, 23, 25, 26, 27, 28, 29, 33, 34, and 36;
   T. 151N, R. 82W, Section 7;
   T. 151N, R. 83W, sections 1, 2, 3, 4, 9, 10, 12, 13, 14, and 16.

   The revisited/fenced sites are in the following locations in Ward County:

32WD1636	T.152N, R.83W	SW/NW/NE	Section 21
32WD1638	T.152N, R.83W	N/SE/NW	Section 36
32WD1641	T.152N, R.83W	NW/SE/SE	Section 27
32WD1646	T.151N, R.83W	SE/SE/SE	Section 14
32WD1648	T.152N, R.83W	SW/SE/SE	Section 22
32WD1650	T.152N, R.83W	SE/SE/SE	Section 22
32WD1651	T.152N, R.83W	SW/NW	Section 25
32WD1653	T.151N, R.83W	SE/NW/NW	Section 9
32WD1654	T.151N, R.83W	NW/NE/NW	Section 9
32WD1655	T.151N, R.83W	NE/NE/NW	Section 9
32WD1659	T.151N, R.83W	SE/NE/NE	Section 10
32WD1666	T.152N, R.83W	NE/NE/SW	Section 14
32WD1684	T.152N, R.83W	SE/SW/SW	Section 20
32WD1686	T.152N, R.83W	NE/NW/SW	Section 25
32WD1687	T.152N, R.83W	SW/NE/SW	Section 25
32WD1688	T.151N, R.83W	NE/NE/NW & NW/NW/NE	Section 10
32WD1689	T.152N, R.83W	NE/SE/SW	Section 36

Addendum Survey Report

Submitted by Metcalf Archaeological Consultants, Inc.
PO Box 2154, Bismarck, North Dakota 5802
Phone: 701-258-1215, Email: macnodak@metcalfarchaeology.com

9. **Description of Project:** Multiple small corridor modifications and small blocks are needed for construction of the Prairiewinds ND 1 Wind Energy Farm. These modifications are the result of: Landowner requests for route changes to reduce or eliminate impacts to croplands; archaeological site avoidance; environmental reasons including wetlands avoidance; construction needs including turn-around areas, equipment and turbine component lay-down areas, and crane-walk routes. Much of the construction re-routes are the result of unusually heavy rains saturating work areas and routes as originally planned.

   Metcalf Archaeological Consultants, Inc. (MAC) was requested to conduct Class III cultural resource inventories of the proposed route changes and extra turn-around and lay-down blocks as they became necessary during construction. In all, 20 corridor routes totaling 8365 meters in length or 102 acres and 13 blocks totaling 78 acres were inventoried. Corridor widths varied from 100 feet to 200 feet. In some cases access roads and collector lines were planned for the same corridor and required up to 200 feet. In other cases a single use was planned requiring only 100 or 125 feet of corridor width.

10. **Records Search:** A search of the site and manuscript files at the State Historical Society of North Dakota was performed on May 11, 2009. This search encompassed the overall APE and the surrounding sections within one mile of the APE. The results are documented in the Addendum (Banks 2009) and are not repeated here. A total of 37 historic sites, 23 prehistoric sites, five architectural sites, and four prehistoric isolated occurrences were recorded within or adjacent to the overall APE. Fifteen cultural resource inventories have occurred within or adjacent to that APE. The only changes to the original search would be the addition of cultural resources documented in the Addendum (Banks 2009). Only those sites and inventories within one mile of the current APE are plotted on the project maps included herein.

11. **Field Personnel:** Kimball M. Banks, serving as Principal Investigator, Field Directors Ed Stine and William J. Bluemle and crew Aaron Barth, Suzanne Canevello, Bill Christensen, Brian Houle, Nichole Reisdorf, Jonathan Schwartz, and Signe Snortland conducted the inventories.

12. **Field Methods and Conditions:** The inventory was accomplished using parallel zig-zag pedestrian transects spaced at 15 to 20 meter intervals over the access corridors and/or blocks. Usually Erin Dukhart of Basin Electric met with the survey crew in the field and pointed out the project needs and associated inventory areas. On several occasions Basin Electric provided shape files of proposed project changes and/or locations for additional inventory that MAC downloaded into Magellan GPS units to locate the inventory areas.

   All inventoried locations were mapped with the GPS units. Shortly after construction began, archaeological sites were revisited and site boundaries were identified with Basin Electric and construction representatives. Orange storm fencing was placed around the sites. Field notes were maintained and representative digital photographs were taken to document inventory conditions and encountered resources. Copies of the maps, notes and photos are on file at the MAC Bismarck office.

The project is located in rolling to gently rolling uplands of the Drift Prairie. Relief is generally not pronounced although the small hills and rises are favored for wind turbine placement. This "knob-and-kettle" terrain consists of small hills and ridges interspersed with sloughs, prairie potholes and small, shallow lakes. The APE is in an area lacking external drainage, moisture being captured in the sloughs and potholes. Soils are loam to sandy loam, often containing rocks and gravels, and formed in glacial till. In general soils are of the Max-Williams or Williams-Bowbells association. Max-Williams soils are described as well drained rolling to strongly sloping while Williams Bowbells soils are well drained and nearly level (Howey et al 1974:3, 7). The APE encompassed both native prairie and plowed fields. The ground surface visibility (GSV) ranged from 10% to nearly 90%, with an average of around 50% at most locations. Generally, areas of native prairie were sufficiently grazed that any stone features could be easily identified. Figures 1 through 5 document the field conditions.

13. Results and Recommendations: One isolated find, 32WDx664, was documented. The isolate was located in a plowed field (GSV 40%) and consists of a Knife River flint biface fragment. It appears to be the mid-section of a projectile point but all diagnostic attributes are absent. The isolate is recommended as not eligible for the National Register. No additional cultural resources were documented during the course of the inventory. The sites near the APE, documented during the original project inventories, have been fenced and provided that there is no trespass within site boundaries a finding of *No Historic Properties Affected* is recommended.

14. References Cited:

Howey R. L, C. Farris, F, Glatt, F. Hauff, S. Lahlum, S. Larson, L. Neubauer, and F. Wahl

1974 *Soil Survey of Ward County, North Dakota.* United States Department of Agriculture, Soil Conservation Service

Appendix A:
Project Map Section

Maps have been removed from report to protect locations of mapped cultural resources.

Appendix B:
Project Photo Section

Figure 1: View to the north over crane walk west of Highway 83 (Image 9-9-09, 7).

Figure 2: View to the north over crane walk, note crane in background (Image 10-26-09, 19).

Figure 3: View to the east over project area (Image 8-25-09, 7914).

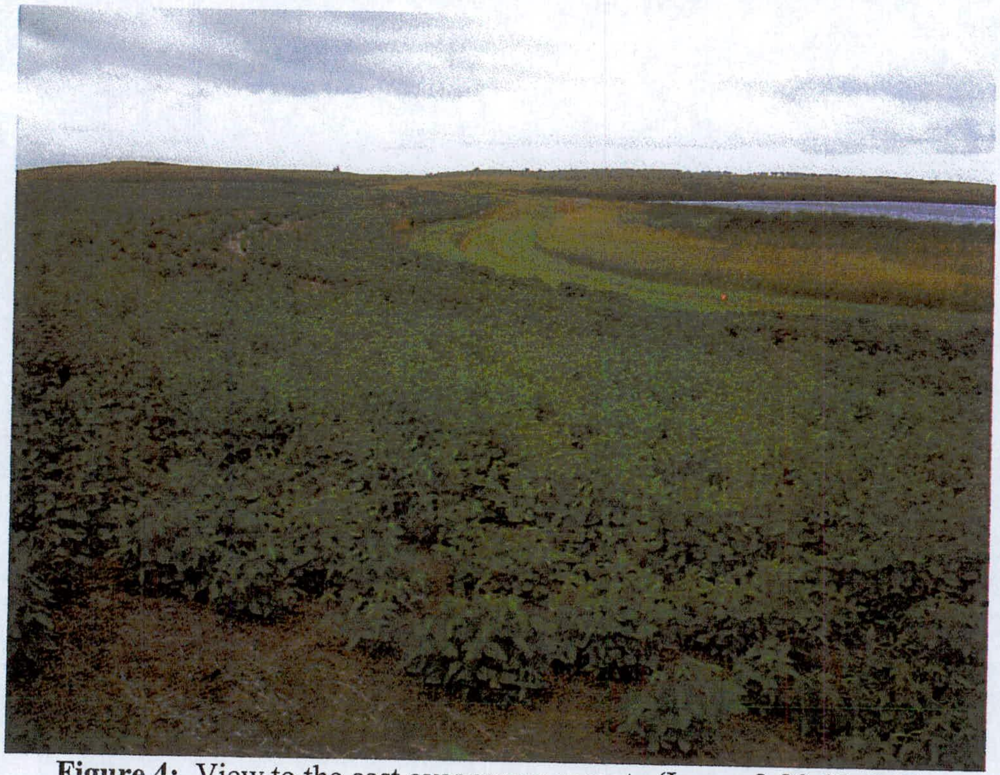


Figure 4: View to the east over access reroute (Image 8-20-09, 847).

RESPONSE #2

RESPONSE #5

BASIN ELECTRIC POWER COOPERATIVE
1717 EAST INTERSTATE AVENUE
BISMARCK, NORTH DAKOTA 58503-0564
PHONE: 701-223-0441
FAX: 701-557-5336

March 25, 2010

Darrell Nitschke, Executive Secretary
North Dakota Public Service Commission
600 East Boulevard Avenue, Dept. 408
Bismarck, ND 58505

Dear Mr. Nitschke:

Basin Electric Power Cooperative (Basin Electric) owns and operates two wind energy facilities in North Dakota, Minot Wind and PrairieWinds ND1. Minot Wind consists of two (2) NORDEX 1.3 megawatt (MW) turbines on 60-meter steel towers installed in 2002 and three (3) 1.5 MW General Electric (GE) turbines on 80-meter steel towers installed in 2009. PrairieWinds ND1, also installed in 2009, consists of seventy-seven (77) 1.5 MW GE turbines on 80-meter steel towers. PrairieWinds ND1, a wholly-owned subsidiary of Basin Electric, was permitted by the North Dakota Public Service Commission under Energy Conversion Site Compatibility Certificate No. 14.

Enclosed please find the decommissioning and cost estimate information for the facilities described above. If you have any questions or concerns regarding this matter, please contact me at 701.557.5495.

Sincerely,

Kevin L. Solie
Senior Environmental Analyst

/gmj
Enclosure
cc: Deb Levchak

Basin Electric Power Cooperative
Decommissioning Plan and Cost Estimate

Basin Electric Power Cooperative Facilities

Basin Electric Power Cooperative (Basin Electric) owns and operates two wind energy facilities in North Dakota, Minot Wind and PrairieWinds ND1. Minot Wind consists of two (2) NORDEX 1.3 megawatt (MW) turbines on 60-meter steel towers installed in 2002 and three (3) 1.5 MW General Electric (GE) turbines on 80-meter steel towers installed in 2009. PrairieWinds ND1, consists of seventy-seven (77) 1.5 MW GE turbines on 80-meter steel towers installed in 2009. PrairieWinds ND1, a wholly-owned subsidiary of Basin Electric, was permitted by the North Dakota Public Service Commission Energy Conversion Site Compatibility Certificate No. 14. The following decommissioning and cost estimate information pertains to all above-referenced facilities.

Decommissioning

Decommissioning and site restoration would include dismantling and removal of all towers, turbine generators, transformers, and overhead cables; removal of underground cables to a minimum depth of twenty-four inches; removal of foundations, buildings, and ancillary equipment to a minimum depth of three feet and removal of surface road material and restoration of the roads and turbine sites to substantially the same physical condition that existed immediately before construction of the commercial wind energy conversion facility or wind turbine (NDAC 69-09-09). Access roads will be removed unless the affected landowner provides written notice requesting the road or portions of the road be retained.

The site will be restored and reclaimed to the same general topography that existed just prior to the beginning of the construction. Areas disturbed by the construction of the facility and decommissioning activities would be graded, top-soiled, and reseeded according to natural resource conservation service technical guide recommendations and other agency recommendations (NDAC 69-09-09).

Decommissioning Cost and Funding

Estimated costs for decommissioning are depicted in the following table:

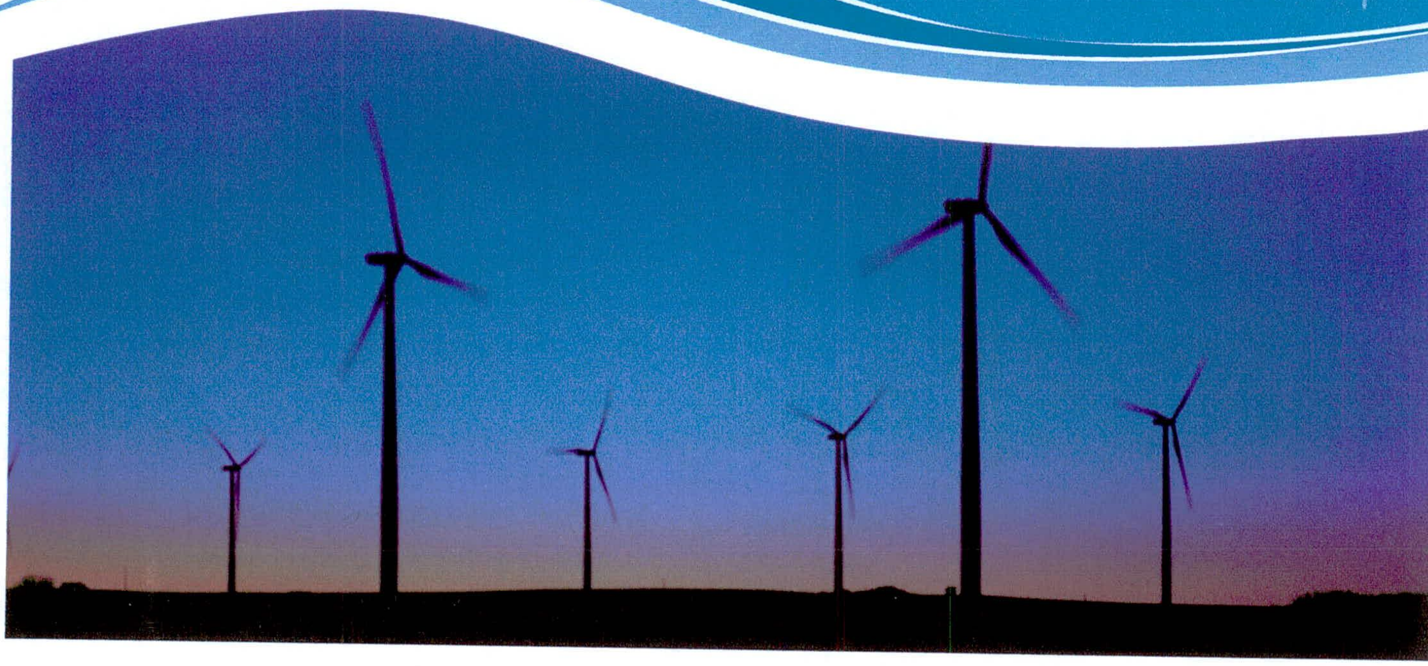
				Per Turbine Cost
Crane Mobilization (Rubber-tired crane)		$ 25,000		$ 325
Crane Demobilization		$ 25,000		$ 325
Crane Rental per week		$ 25,000	1/2 week per turbine	$ 12,500
Demolition of Turbine Pedestal		3	days each site	
	Backhoe Jackhammer	$ 150	per hour	$ 3,600
	Operator	$ 70	per hour	$ 1,680
	Truck	$ 50	per hour	$ 1,200
	2 laborers	$ 50	per hour	$ 1,200
	Welder to cut rebar	$ 70	per hour	$ 1,680
Trucks to remove Turbine Components				$ 10,000
Surface Reclamation	Days Required	2	days each site	
	Grader	$ 150	per hour	$ 2,400
	Operator	$ 70	per hour	$ 1,120
	Wheel loader	$ 120	per hour	$ 1,920
	Truck to remove gravel	$ 50	per hour	$ 800
	2 Laborers	$ 50	per hour	$ 800
Surface Area to be Seeded		Sq. Ft	per turbine	
Disturbed area around turbine		2,000		
Road Reclamation	Assume 400 feet per turbine	16,000	0.41 Acres	$ 1,000
				$ 40,550 Total

Roughly 425 tons of salvage steel per turbine are available; the current value of salvage steel is estimated to be $40,000 to $80,000 per turbine, based on historical prices. The estimated total cost for decommissioning 82 turbines is $3,325,100. The estimated value of the salvage steel ranges from $3,280,000 to $6,560,000. Accordingly, it is anticipated that the total decommissioning costs for the facilities will be covered by the salvage value of recovered facility components. If the salvage value of facility components does not cover the cost of decommissioning, Basin Electric would fund the difference.

RESPONSE #8

PrairieWinds® 1

WIND POWER PROJECT



Project Description

PrairieWinds ND1 Inc. (PrairieWinds) is proposing to construct a new 115.5 megawatt (MW) wind project in central North Dakota near Minot. Power from the facility would be supplied to Basin Electric Power Cooperative's customers through an interconnection with Western Area Power Administration's transmission system. Once environmental permitting is complete, construction would begin summer 2009. The facility is anticipated to begin commercial operation in winter 2009.

The project will support the local economy through lease payments to local landowners, support of local businesses and property tax payments to state and local governments. Many jobs will be created during construction. Even though the project will encompass 25,000 acres each turbine requires less than 1 acre of land.

Project Purpose and Need

Incentives and regulations to encourage or require the generation of power from renewable or low environmental impact resources are being actively considered and/or implemented by state governments within the Basin Electric member service areas. At the same time, a number of proposals for national Renewable Portfolio Standards (RPS) are pending in Congress. With members in nine states, Basin Electric recognizes the need for additional renewable energy capacity to service forecasted member load growth demands and to meet state mandated RPS. A 115 MW wind energy facility was determined to be the least-cost resource option to satisfy these requirements.

Project Details

Project Capacity: 115.5 MW

Turbine Type: GE 1.5sle

Number of Turbines: 77

Hub Height: 262 ft

Blade Length: 123 ft

Access Roads: 30 miles new and improved roads

Electrical System: 50 miles (underground)

Interconnection: 34.5 KV Collector substation connecting to the Western 115 KV line at the Nelson Tap.

Associated Facilities: Operations and Maintenance building

Project Construction:

At the peak of construction, up to 200 workers are expected to be hired by the contractors.

Economic Benefit:

Construction: Construction activities will increase revenue for some local businesses. In addition, construction workers are likely to spend money in local businesses.

Operation: PrairieWinds will hire and train staff from the local community to operate and maintain the wind farm. Operations and maintenance of the facility will require 8-10 permanent positions.

Community:

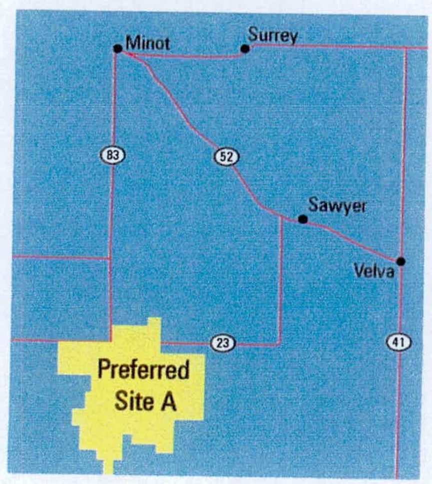
Community Benefits include an increase to the state's tax base resulting from the increase in revenues from property taxes, which are based on the value of the facility. In addition, landowners will receive payments through the life of the project.

Environmental Stewardship:

PrairieWinds is working with agencies, landowners and the community to ensure the project will blend with traditional farming and provide conservation of wildlife. Specifically, PrairieWinds has:

- Conducted landowner meetings seeking input to identify farming needs in relation to site layout
- Communicated with the county and townships, seeking input/approval on project development, construction and operation.
- Began an Environmental Assessment under the National Environmental Policy Act
- Coordinated and received input from multiple state and federal agencies
- Site layout avoids wetlands, cultural resources, residences, roads and transmission lines
- Submitted an application to the North Dakota Public Service Commission for a Certificate of Site Compatibility

Proposed Project Area:



Developer & Owner:

PrairieWinds ND1, Inc. is a wholly-owned subsidiary of Basin Electric Power Cooperative, Bismarck, ND. It was formed in 2008 to develop wind projects in Basin Electric's membership service territory.

Basin Electric generates and transmits electricity to 125 member rural electric systems in nine states: Colorado, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming. These member systems distribute electricity to about 2.6 million consumers.

Basin Electric's generating resources include: two coal-based power plants in North Dakota – the Antelope Valley Station, Beulah, and the Leland Olds Station, Stanton; a coal-based power plant in Wyoming – the Laramie River Station, Wheatland; three peaking stations – the Spirit Mound Station, Vermillion, S.D.; the Groton Generation Station Groton, S.D., and the Wisdom Unit 2 Station, Spencer, Iowa; nine combustion-turbine generators (natural gas) in the Gillette, Wyo., area; four wind turbines – two near Minot, N.D., and two near Chamberlain, S.D.; the energy produced from six baseload waste-heat stations owned and operated by Ormat Technologies Inc. along the Northern Border Pipeline, and the output of three wind farms owned and operated by NextEra Energy Resources, Juno Beach, Fla. The wind farms are located near Wilton and Edgeley/Kulm, N.D.; the other is near Highmore, S.D. For more information, go to www.basinelectric.com.

PRAIRIEWINDS. ENERGY IN MOTION

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

1717 East Interstate Avenue, Bismarck, ND 58503-0564
701-223-0441 basinelectric.com

Basin Electric Power Cooperative

Memorandum

To: PrairieWinds ND Landowners

From: Ron Rebenitsch, PE Project Manager

Date: April 21, 2009

Subject: PrairieWinds Project Update

Basin Electric has been receiving inquiries about the PrairieWinds wind project from area landowners and we want to provide you with this update.

For the past two years, Basin Electric Power Cooperative has been working to develop the first large cooperative-owned wind farm in the United States. The wind project is named PrairieWinds ND1 and would be a 115.5 megawatt (MW) wind energy project consisting of seventy-seven (77) General Electric 1.5 MW model wind turbines. The Project is located in south-central Ward County, about 15 miles south of Minot, ND and will involve approximately 25,000 acres.

The Project has completed its design work and is ready to move to construction which can begin as soon as the necessary permits are received.

Basin Electric has submitted an Application for a Certificate of Site Compatibility to the North Dakota Public Service Commission (PSC). The PSC has tentatively set the public hearing for May 26, 2009, in Minot, North Dakota.

We have received the necessary building and zoning permits from Ward County.

The most challenging issues for the Project involve the requirements of the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA). Basin Electric has applied to the Rural Utilities Service (RUS) for a federal loan guarantee for the Project. RUS is required by NEPA to prepare an analysis of any action it takes that may affect the environment. Part of this process requires RUS to consult with the United States Fish and Wildlife Service as to whether the Project may affect any threatened or endangered species or their critical habitat. That consultation process is ongoing and we are awaiting resolution of this issue.

We look forward to continuing to provide you with updated information on Project progress.

BASIN ELECTRIC
POWER COOPERATIVE

1717 EAST INTERSTATE AVENUE
BISMARCK, NORTH DAKOTA 58503-0564
PHONE: 701-223-0441
FAX: 701-557-5336

April 28, 2010

Dear Landowners:

This letter is intended to provide an update on the progress we have made thus far in spring reclamation, as well as to lay out the plan going forward.

Equipment and operating crews have been arriving on site, and more will be arriving in the coming week. The crews have begun the process of cleaning up the south laydown yard along County Road 22 as well as blading the roads.

Generally, there will be two reclamation crews. One will be working from the west side of the project area to the east, and the other crew will be working from the north end of the project area to the south. The crews will be focusing on reclaiming crop land and replacement and repair of gates first and pasture land secondly. Basin Electric and the construction contractor are anticipating that reclamation will take approximately eight weeks. It is planned that ten turbines sites and associated disturbances will be completed each week. This schedule and plan will of course, be adjusted as a result of rain or other inclement weather.

Due to the recent nice weather, some farming operations have started ahead of reclamation in restoring crop land. If you have done field work ahead of the construction contractor, your time compensation can be included with the final settlement for damages.

The construction contractor will be putting the finishing touches on the reclamation work for the three north-most turbines in the next couple of weeks. I would encourage you to visit these turbines for an example of how the finished work will look.

I apologize for any inconvenience and thank you for your patience. As you know, timing and scheduling can be challenging in the spring in North Dakota. Basin Electric is dedicated to ensuring reclamation and reseeding is done correctly, regardless of how long it takes.

Sincerely,

Jack Holt
Property & Right-of-Way Specialist
(Cell) 701-226-2857

Basin Electric Power Cooperative

Memorandum

To: PrairieWinds ND1 Landowners

From: Ron Rebenitsch

Date: June 7, 2010

Subject: Reclamation update

We wanted to give you a quick update on the status of the PrairieWinds ND1 restoration efforts. Currently, the contractor, RMT, has 23 people working on the site with 17 pieces of earthwork equipment. They have been working about a month, but progress has been slower than expected since the site received heavy rains in May (4.78 inches of rain for the month). To make up for those delays, RMT is bringing in more people and more equipment, as well as working overtime in places.

In one of our earlier letters, we said that we were going to start at the north part of the project area and move south. This was a good plan, but we have had to change it due to weather and the needs of landowners. In an effort to meet the concerns of landowners, we have been jumping to different areas in an attempt to get everyone's issues addressed to the best of our ability.

To give you an idea of the work we are trying to accomplish:

- Reclamation of over 50 miles of collector line
- Reclamation of over 20 miles of crane paths
- Cleanup and final grading of about 35 miles of new roads, not to mention all the existing roads that needed to be maintained and improved.

Although we've been working for several weeks, there is still a lot of work to do!

I also would like to mention that Jack Holt will be retiring this month so your contacts in the near future will be Amy Spilman and Shad Erdmann. I have relied heavily on Jack and will miss him greatly. He has been your strong advocate and made your concerns a priority. That is important, since we are guests on your property. As Amy and Shad take over Jack's work, I am confident they will continue his fine example of working with landowners.

I want to personally apologize for the delays in our progress. We appreciate your patience with our restoration efforts and look forward to seeing you at the dedication.

Amy Spilman's phone number: 1-800-242-2372 – toll free.
Shad Erdmann's phone number: 1-701-425-4325 – cell phone.

RESPONSE #9

Post-Construction Fatality Surveys for the PrairieWinds ND1 Wind Facility Basin Electric Power Cooperative

March – November 2010

Prepared for:

Basin Electric Power Cooperative

1717 East Interstate Ave
Bismarck, North Dakota 58503

Prepared by:

Clayton Derby, Kristen Chodachek, Terri Thorn, Kimberly Bay, and Saif Nomani

Western EcoSystems Technology Inc.
4007 State Street, Suite 109
Bismarck, North Dakota 58503

August 2, 2011

WEST Inc.

NATURAL RESOURCES • SCIENTIFIC SOLUTIONS

1.0 EXECUTIVE SUMMARY

The PrairieWinds ND1 Wind Facility, located in Ward County, North Dakota, began commercial operation in winter 2009. This facility consists of 77 wind turbines, each capable of generating 1.5 megawatts (MW) of electricity for an overall capacity of 115.5 MW of electricity. The turbine towers are 262 feet (80 meters [m]) high with a 253-foot (77-m) blade diameter, resulting in rotor swept heights of approximately 138 to 387 feet (ft; 42 to 118 m) above ground level. Power from this project flows to Basin Electric's customers through an interconnection with Western Area Power Administration's transmission system. The Minot Wind Project, which consists of two 1.3-MW turbines built in 2002, and three 1.5-MW turbines built in 2009, is located approximately 1.5 miles north of PrairieWinds ND1 and interconnects with Central Power Cooperative's Radar Substation. This monitoring effort included sampling at both facilities and therefore applies to the 77 turbines constructed as part of PrairieWindsND1 and the three turbines constructed at the Minot Wind Project in 2009. For the purpose of this report both projects are included in the reference PWND1.

Monitoring studies designed to estimate the number of bird and bat fatalities attributable to wind turbine operation were conducted in 2010. These dates correspond with the spring and fall migration periods and summer breeding periods for bats and birds. Removal and searcher efficiency trials were also conducted to estimate potential sources of bias. Fatality estimates were generated for small birds, large birds, and bats using methods consistent with the approach outlined by Shoenfeld (2004) and Erickson et al. (2005).

The overall bird fatality was estimated at 2.22 fatalities/turbine/study period (1.48 fatalities/MW/study period), which falls within the range of other fatality estimates within the Midwest and other regions of the United States and Canada.

The estimated raptor fatality rate at PWND1 was low at 0.08 raptors/turbine/study period (0.05 raptors/MW/study period). This estimate falls within the narrow fatality range of other wind facilities across North America.

The majority of bat fatalities occurred in August, which is consistent with other studies in North America. Overall, the fatality rate for bats was estimated at 3.19 fatalities/turbine/study period (2.13 fatalities/MW/study period), which is within the range reported for fatality rates at other facilities in the Midwest. Hoary bats composed the majority of bat fatalities, which is similar to other wind-energy facilities in the Midwest. Based on the timing of fatalities and habitat requirements for this bat species, most of the fatalities are likely migrating bats.

STUDY PARTICIPANTS

Western EcoSystems Technology

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REPORT REFERENCE

Derby, C., K. Chodachek, T. Thorn, K. Bay, and S. Nomani. 2011. Post-Construction Fatality Surveys for the PrairieWinds ND1 Wind Facility, Basin Electric Power Cooperative. March – November 2010. Prepared for Basin Electric Power Cooperative, Bismarck, North Dakota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

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2.0 INTRODUCTION

Basin Electric Power Cooperative (Basin) has developed a wind energy facility, the PrairieWinds ND1 Wind Energy Facility, with a capacity of 115.5 megawatts (MW) in Ward County, North Dakota. The PWND1 facility is located approximately 11 miles (17.6 kilometers [km]) south of Minot, North Dakota, in an area dominated by corn (*Zea mays*), soybean (*Glycine max*), and spring wheat (*Triticum* spp.) fields. The PWND1 consists of 77 GE 1.5-MW XLE wind turbines (Figure 2.0-1). Each turbine has a 262-foot (ft; 80-meter [m]) hub height and a 253-ft (77-m) rotor diameter. The PWND1 became operational on December 30, 2009. Power from this project flows to Basin Electric's customers through an interconnection with Western Area Power Administration's transmission system. The Minot Wind Project, which consists of two 1.3-MW turbines built in 2002, and three 1.5-MW turbines built in 2009, is located approximately 1.5 miles north of PrairieWinds ND1 and interconnects with Central Power Cooperative's Radar Substation. This monitoring effort included sampling of the 77 turbines at PWND1 and the three turbines constructed at the Minot Wind Project in 2009. For the purpose of this report both projects are included in the reference PWND1.

Basin contracted Western EcoSystems Technology, Inc. (WEST) to develop a post-construction fatality monitoring study at the PWND1 to estimate the level (high, moderate, or low relative to other wind energy facilities) for bird and bat mortality attributable to collisions with wind turbines during spring, summer, and fall in 2010 and 2011. The protocol for this monitoring study is described in more detail in the Fatality Monitoring Scope (Derby 2010).

Fatality monitoring started in spring 2010 and continued through fall 2010. Fatality monitoring included standardized carcass surveys, searcher efficiency trials, and carcass removal trials. Crop clearing was not conducted at any of the turbines.

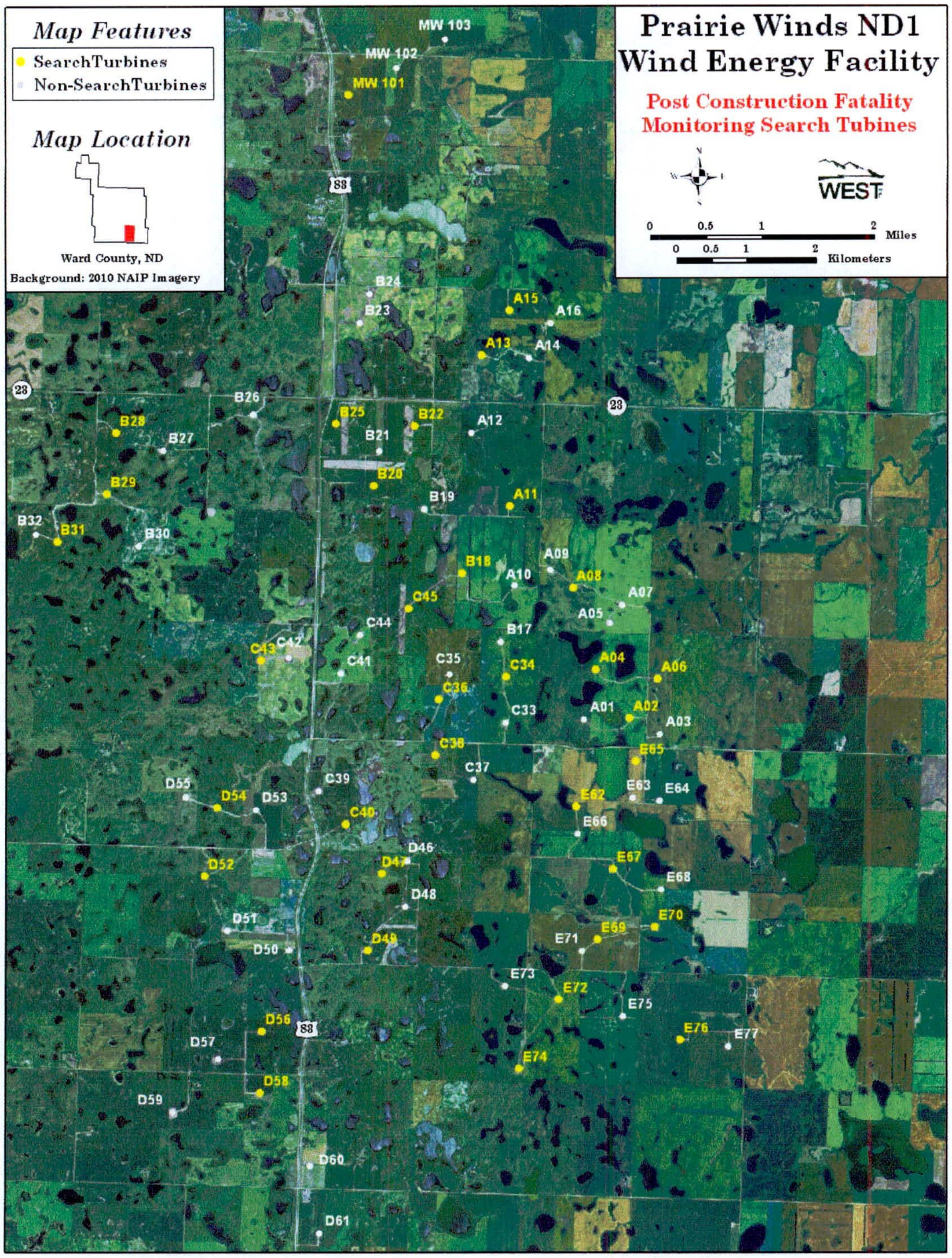

Figure 2.0-1 Location of the PrairieWinds ND1 Wind Energy Facility and turbines.

3.0 STUDY AREA

The PWND1 falls within the Northwestern Glaciated Plains Ecoregion which covers the northern tip of Montana, northwestern corner and central regions of North Dakota, and the central regions of South Dakota (Bryce et al. 1996, USEPA 2007). The Northwestern Glaciated Plains Ecoregion is a transitional region between the intensive dryland farming to the east and the predominance of cattle ranching and farming to the west. Pocking this ecoregion is a moderately high concentration of semi-permanent and seasonal wetlands. Typical vegetation includes western wheatgrass, bluestem, needle and thread, green needle and needle grass. Topography in the region is rolling, with elevations in the PWND1 ranging from 1,900-2,300 ft (579-701 m).

4.0 METHODS

Research at the PWND1 facility consisted of the following components:

(1) standardized carcass surveys of selected turbines,

(2) searcher efficiency trials to estimate the percentage of carcasses found by searchers, and

(3) carcass removal trials to estimate the length of time that a carcass remained in the field for possible detection.

Surveys were conducted from March 2010 through October 2010, a period corresponding to the likely spring and fall migration periods and summer breeding period for birds and bats. All casualties located within areas surveyed, regardless of species, were recorded and a cause of death was determined if possible. The total number of bird and bat casualties (including dead and injured birds and bats) were estimated by adjusting for search frequency, removal bias (length of stay in the field), searcher efficiency bias (percent found), and area searched. For carcasses where the cause of death was not apparent, the assumption that the fatality was caused by a wind turbine collision was made for the analysis. This approach likely led to an overestimate of the true number of facility-related fatalities, but most wind energy facilities have used this conservative approach because of the relatively high costs associated with obtaining accurate estimates of natural or reference mortality (see Johnson et al. 2000).

4.1 Sample Size, Search Area, and Search Frequency

Thirty-five of the 77 turbines were selected for survey at the PWND1 site (Figure 2.0-1). Of those, 26 turbines were located in tilled agricultural crops and nine were grassland. Square search plots were centered on each turbine, with the minimum distance searched in any direction equal to 100 m. Transects were walked 10 m apart within each plot to sample the area under the structure (Figure 4.1-1). All 35 turbines were searched once every 14 days during the spring migration (March 15-May15), summer breeding season (May 16 – August 15), and fall migration (August 16 – November 1). Once agricultural crops became too high to effectively search, only turbine pads, access roads, and other portions of the plots with low vegetation out to 100 m were searched (Figure 4.1-2). This change in search area was accounted for in the analysis.

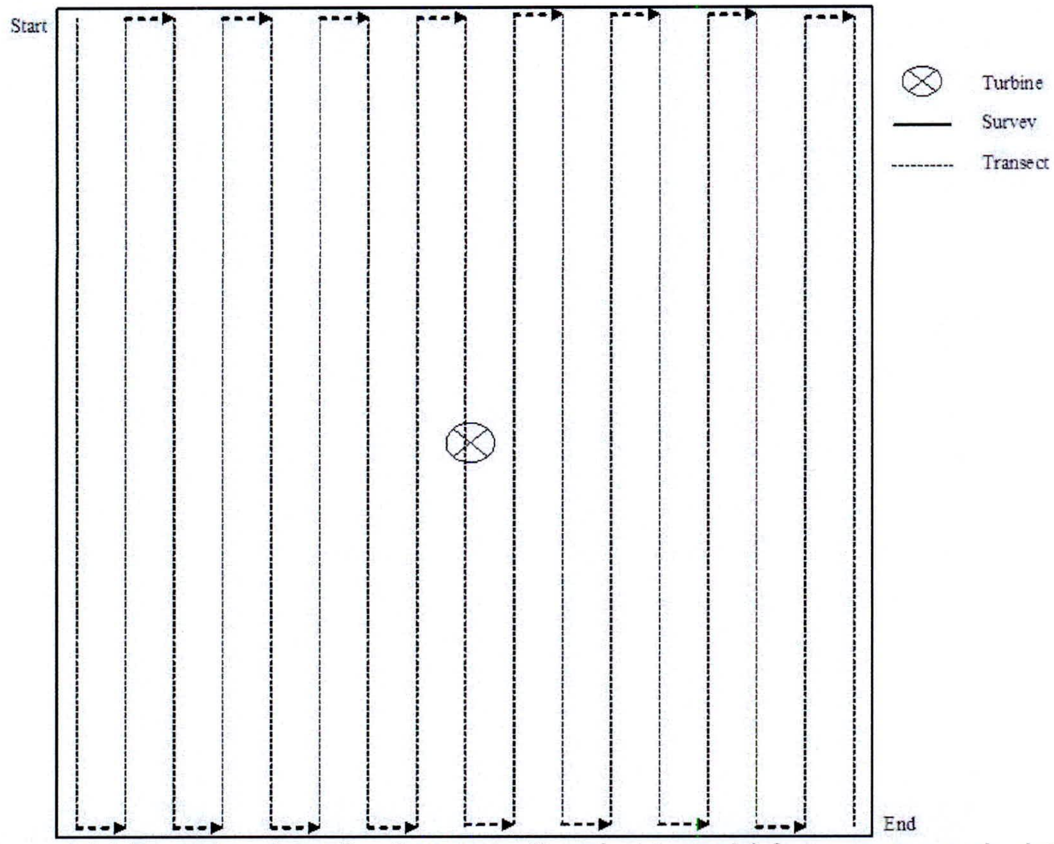

Figure 4.1-1 Example schematic of survey pattern (not to scale) for carcass search plots. Transects will be placed 10 meters apart. Turbine pad and access road (not shown) were included in the area searched.

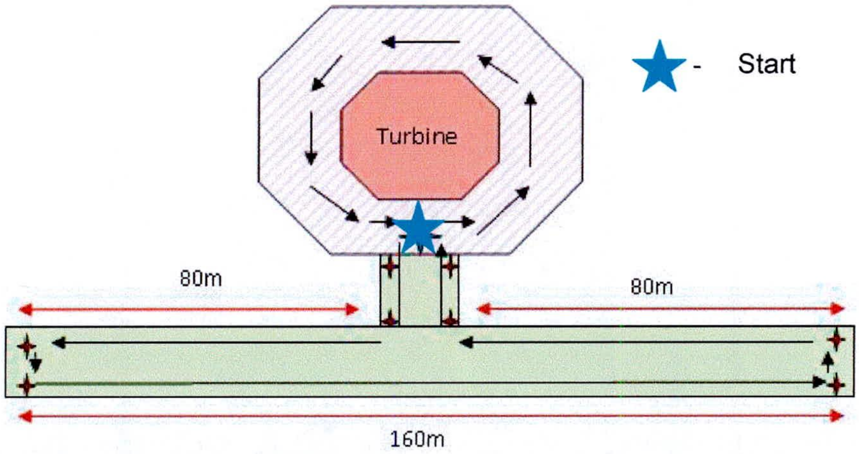

Figure 4.1-2 Example schematic of search area along road and turbine pad (not to scale) for carcass search plots. Area searched varied, but was measured at each turbine searched.

4.2 Standardized Carcass Searches

Carcass searching began on March 17, 2010, after all turbines were commercially operational. Thirty-five turbines were systematically searched for bird and bat casualties that were attributable to collision with the turbines. Personnel trained in proper search techniques conducted the carcass searches. Searchers walked at a casual walking rate of approximately 45-60 meters per minute (about 148-197 feet per minute) along each 10-m transect, scanning both the turbine pad, road, and transects for casualties (Figure 4.1-1). The order that searches were performed was randomized so that each turbine was searched at various periods during the day.

The condition of each bird and bat carcass found was recorded using the following categories:

- Intact - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger; or

- Scavenged/Dismembered - an entire carcass, which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that has been heavily infested by insects.

For bird carcasses, the following category was also used in addition to the two categories listed above:

- Feather Spot - 10 or more feathers found at one location indicating predation or scavenging.

In addition to carcasses, any injured birds or bats observed in search plots or elsewhere in the study area were recorded and treated as a fatality for analysis purposes. For all casualties found, data recorded included species, sex and age when possible, date and time collected, Universal Transverse Mercator (UTM) location, condition (intact, scavenged, feather spot), distance and bearing to turbine, and any comments that may indicate cause of death or injury. All casualties located were photographed as found and plotted on a detailed map of the study area, showing the location of the wind turbines and associated facilities, such as overhead power lines and meteorological (met) towers.

Casualties found outside the formal search time but inside of search plots were treated following the above protocol as closely as possible. Bird and bat casualties found in non-search areas (e.g., near a PWND1 turbine not being searched) were coded as incidental discoveries and documented in a similar fashion as those found during standard searches, but these casualties were not included in the estimates of total fatalities.

4.3 Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of casualties that were found by the searchers. These trials were conducted in the same plots in which standardized searches occurred. Trials were conducted in each season of monitoring and for each searcher. Estimates of searcher efficiency were used to correct for detection bias by adjusting the total number of carcasses found for those missed by the searchers.

Searcher efficiency trials were conducted by placing "detection" carcasses in the same plots that were searched for carcasses. Efficiency trials commenced with the start of carcass searches and were conducted periodically throughout spring, summer, and fall. Searchers conducting carcass searches did not know the locations where the "detection" carcasses were placed in a search plot. A total of 48 searcher-efficiency trial carcasses for the entire study were used, with 28 small carcasses and 20 large carcasses. Small dark birds (e.g. house sparrows [*Passer domesticus*]) were used as a substitution for bat carcasses as bat carcasses were not available. Avian carcasses consisted of non-native/non-protected or commercially available species, such as house sparrows, rock pigeons (*Columba livia*), or game bird species. All "detection" carcasses were placed at random locations within areas being searched prior to the carcass search on the same day. Carcasses were dropped from waist height or higher and allowed to land in a random posture. Each trial carcass was discreetly marked (e.g., tape or thread on the leg of the carcass) so that it could be identified as a "detection" carcass after it was found. The number and location of the "detection" carcasses found during the carcass search was recorded. The number of carcasses available for detection during each trial was determined immediately after the trial by the person responsible for distributing the carcasses.

4.4 Carcass Removal Trials

The objective of carcass removal trials was to estimate the length of time avian and bat carcasses remained in the search area before being removed by scavengers or by other means. Carcass removal includes removal by predation or scavenging, or removal by another means, such as being plowed into a field. Carcass removal studies were conducted during each season concurrently with standardized carcass searching. Estimates of carcass removal were used to adjust carcass counts for removal bias.

Removal trial carcasses were placed at random locations at turbines not being searched as part of the carcass search protocol. The placed carcasses were located randomly within the plots (random distance and direction from turbine). During each season of the study (3 seasons), approximately 21 carcasses were placed during each season, for a total of 62 carcasses for the entire study. Similar to searcher efficiency trials, both small carcasses (32 carcasses) and large carcasses (30 carcasses) were used. By spreading trials throughout the study period, the effects of varying weather, climatic conditions, and scavenger densities were taken into account. Bird carcasses used were similar to those used in the searcher efficiency trials. All trial carcasses were discreetly marked to avoid confusion with turbine fatalities. Major habitats represented around the turbines were included in these trials. Carcasses were dropped from waist height or higher and allowed to land in a random posture.

Personnel conducting carcass searches monitored the trial carcasses over a 30-day period according to the following schedule as closely as possible. Carcasses were checked every day for the first four days, and then on days 7, 10, 14, 20, and 30. Experimental carcasses not removed by scavengers were left at the location until the end of the carcass removal trial. At the end of the 30-day period any remaining evidence of the carcass was removed.

4.5 Statistical Methods for Fatality Estimates

Estimates of facility-related fatalities are based on:

(1) Observed number of carcasses found during standardized searches during the monitoring period for which the cause of death was likely facility-related;

(2) Non-removal rates, which are expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials; and

(3) Searcher efficiency, which is expressed as the proportion of placed carcasses found by searchers during searcher efficiency trials; and

(4) Proportion of the area searched around each turbine.

The number of bird and bat fatalities attributable to operation of the PWND1 were recorded. All carcasses located within areas surveyed, regardless of species, were recorded and, if possible, a cause of death determined based on a cursory field necropsy. Total number of bird and bat carcasses was estimated by adjusting for removal, searcher efficiency bias, and area searched.

4.5.1 Definition of Variables

The following variables are used in the equations below:

- c_i the number of carcasses detected at plot i for the study period of interest (e.g., one monitoring year), for which the cause of death is either unknown or is attributed to the facility
- n the number of search plots
- k the number of turbines searched (including the turbines centered within each search plot)
- $\bar{c}$ the average number of carcasses observed per turbine per monitoring year
- s the number of carcasses used in removal trials

- s_c the number of carcasses in removal trials that remain in the study area after 30 days
- se standard error (square of the sample variance of the mean)
- t_i the time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials
- $\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials
- d the total number of carcasses placed in searcher efficiency trials
- p the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials
- I the average interval between standardized carcass searches, in days
- A proportion of the search area of a turbine actually searched
- $\hat{\pi}$ the estimated probability that a carcass is both available to be found during a search and is found, as determined by the removal trials and the searcher efficiency trials
- m the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency bias

4.5.2 Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A} \qquad (1)$$

4.5.3 Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \tag{2}$$

4.5.4 Estimation of Searcher Efficiency Rates

Searcher efficiency rates are expressed as *p*, the proportion of trial carcasses that are detected by searchers in the searcher efficiency trials. These rates were estimated by carcass size and season.

4.5.5 Estimation of Facility-Related Fatality Rates

The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \tag{3}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency bias was pooled across the study to estimate $\hat{\pi}$.

$\hat{\pi}$ is calculated as follows:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(\frac{I}{\bar{t}}\right) - 1}{\exp\left(\frac{I}{\bar{t}}\right) - 1 + p} \right].$$

This formula has been independently verified by Shoenfeld (2004). The final reported estimates of *m* and associated standard errors and 90 percent confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics.

For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$, and *m* are calculated. A total of 5,000 bootstrap samples were used. The reported estimates are the mathematical means of the 5,000 bootstrap estimates. The standard deviation of the bootstrap estimates is the estimated standard error.

The lower fifth and upper ninety-fifth percentiles of the 5,000 bootstrap estimates are estimates of the lower limit and upper limit of 90 percent confidence intervals.

The formula that WEST has used has been used widely and is relatively unbiased under most conditions. It is sensitive, however, to deviations from the assumption that carcass persistence is low relative to search interval. Initial estimates of carcass persistence were used to determine whether alternate formulas should be considered (e.g., Huso 2009).

5.0 DISPOSITION OF DATA

This monitoring study provides information on fatalities and total bird and bat mortality associated with development of the PWND1 and the data used to evaluate the overall impacts of the facility on birds and bats. The final disposition of data from the study is with Basin, the facility owner, and includes the data forms and electronic data files. During the study, the raw data forms were housed with the contractor conducting the study.

6.0 RESULTS

Surveys were conducted from March through October 2010 at the PWND1. All casualties (including dead and injured birds and bats) located within areas surveyed, regardless of species, were recorded and a cause of death or injury determined, if possible. Results of the standardized carcass searches for both birds and bats, searcher efficiency, carcass removal trials, and adjusted fatality estimates for birds and bats are presented in the sections below.

6.1 Search Area and Habitat

Due to the growth of agricultural crops during the summer, searchable area decreased but after harvest, searchable area was similar to that in spring (Table 6.1-1a and 6.1-1b). Total area searched (acres), percent area searched as a function of the maximum search area, and the proportion of detection types within each search plot were calculated for each plot. The proportion of area searched was similar for all distances from the turbine during spring and fall (Table 6.1-1a) but generally decreased with increased distances from turbines during summer (Table 6.1-1b). Not less than 92 percent of available search area in all 10 m zones was searched during spring and fall 2010 (Figure 6.1-1a). In summer 2010, the percent area searched ranged from approximately 97 percent for the 0 to 10 m band around the turbines to slightly more than 13 percent for the 140 to 150 m band (Figure 6.1-1b).

Table 6.1-1a. Proportion of the area searched in 10-meter distance bands at the PrairieWinds ND1 Wind Project during spring and fall 2010.

Distance (Meters)	Total Acres	Acres Searched	Percent Searched
10	2.70	2.70	100.0
20	8.11	8.11	100.0
30	13.53	13.53	100.0
40	18.98	18.87	99.4
50	24.41	23.97	98.2
60	29.84	29.03	97.3
70	35.27	33.84	95.9
80	40.70	38.72	95.1
90	46.08	43.42	94.2
100	51.32	48.01	93.6
110	35.88	33.39	93.1
120	21.72	20.09	92.5
130	12.42	11.50	92.6
140	4.70	4.36	92.8
150	0.15	0.15	100.0

Table 6.1-1b. Proportion of the area searched in 10-meter distance bands at the PrairieWinds ND1 Wind Project during summer 2010.

Distance (Meters)	Total Acres	Acres Searched	Percent Searched
10	2.70	2.61	96.7
20	8.11	7.12	87.8
30	13.53	10.97	81.1
40	18.87	14.83	78.6
50	23.97	17.83	74.4
60	29.03	18.13	62.5
70	33.84	14.65	43.3
80	38.72	13.49	34.8
90	43.42	13.51	31.1
100	48.01	14.31	29.8
110	33.39	9.71	29.1
120	20.09	5.81	28.9
130	11.50	3.46	30.1
140	4.36	1.35	31.0
150	0.15	0.02	13.3

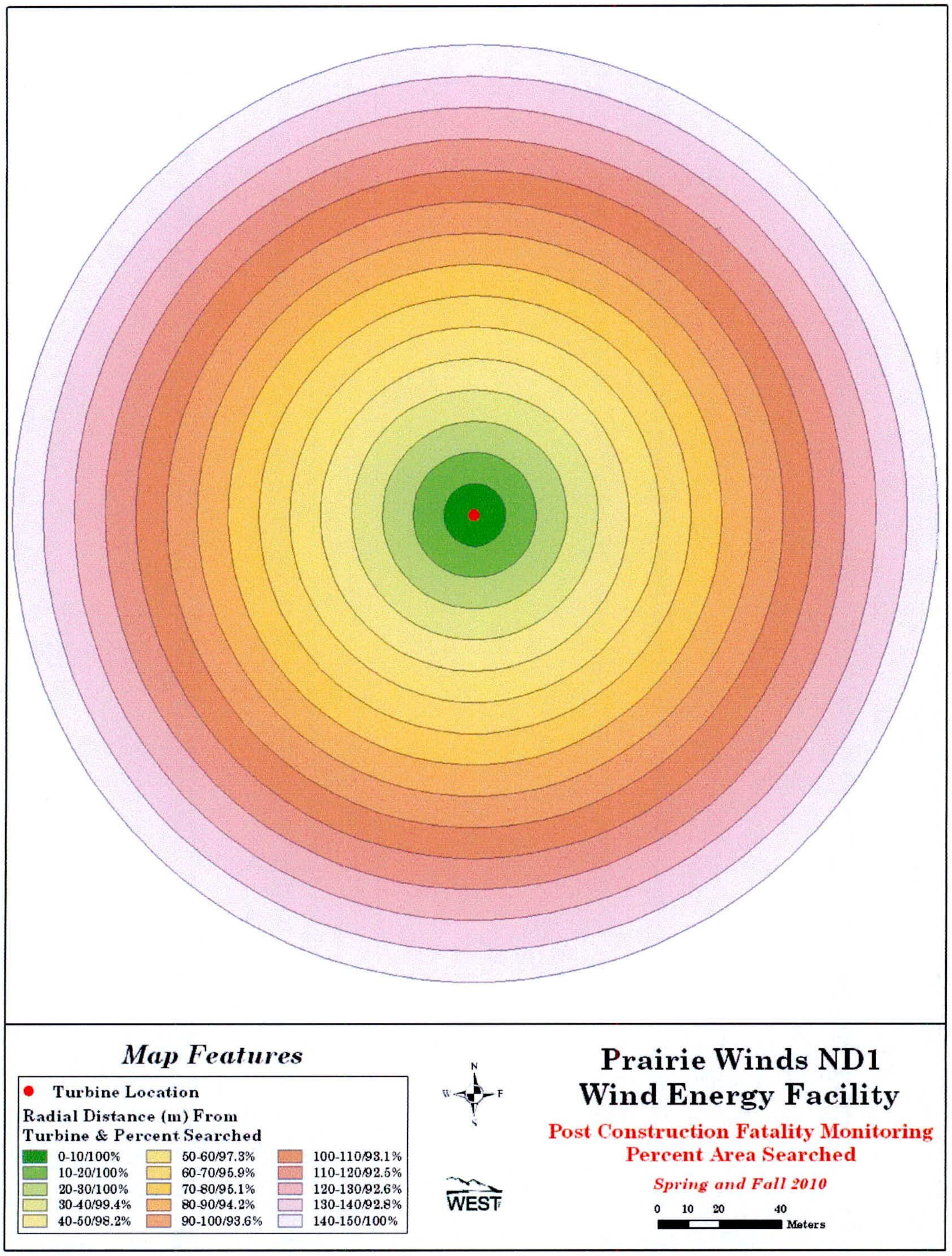

Figure 6.1-1a Fatality search area percentages at the PrairieWinds ND1 Wind Facility during spring and fall 2010.

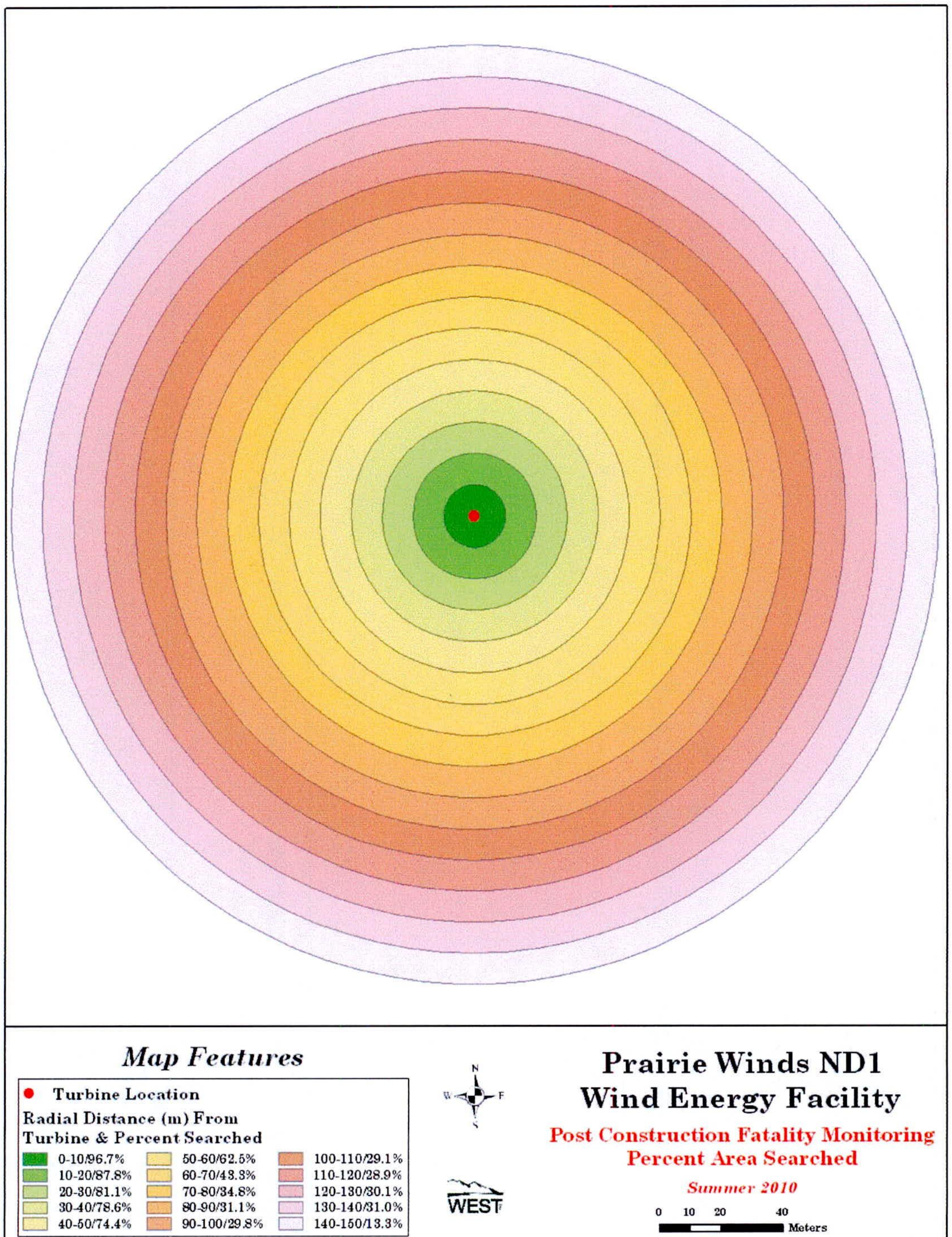

Figure 6.1-1b Fatality search area percentages at the PrairieWinds ND1 Wind Facility during summer 2010.

6.2 Standardized Carcass Surveys

Thirty-five of the 80 turbines (representing approximately 44 percent of the total number of turbines) were searched. During the study, all 35 turbines were searched every 14 days except during the last survey in which only 14 of the 35 turbines were searched because the survey period was only 7 days (Figure 2.0-1). Overall, a total of 36 birds and 41 bats were found during standardized carcass surveys, with seven additional bird and two additional bat fatalities found incidentally inside of search plots and 13 birds and two bats found incidentally outside of search plots (Table 6.2-1 and Table 6.2-2, respectively). Bird and bat carcasses found off survey plots were excluded from analysis of estimated total mortality.

Table 6.2-1 Summary of bird species found during fatality study at the PrairieWinds ND1 Wind Facility.

	Scheduled Searches		Incidental (on plot)		Incidental (off plot)		All Fatalities	
Species	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**
American coot	1	2.8	0	0.0	0	0.0	1	1.8
American goldfinch	0	0.0	0	0.0	1	7.7	1	1.8
American kestrel	1	2.8	0	0.0	0	0.0	1	1.8
black tern	1	2.8	0	0.0	0	0.0	1	1.8
dark-eyed junco	0	0.0	1	14.3	0	0.0	1	1.8
eared grebe	1	2.8	0	0.0	0	0.0	1	1.8
gadwall	1	2.8	2	28.6	3	23.1	6	10.7
gray partridge	2	5.6	2	28.6	0	0.0	4	7.1
horned lark	2	5.6	0	0.0	0	0.0	2	3.6
house wren	1	2.8	0	0.0	0	0.0	1	1.8
lesser scaup	0	0.0	0	0.0	1	7.7	1	1.8
mallard	10	27.8	1	14.3	6	46.2	17	30.4
marsh wren	1	2.8	0	0.0	0	0.0	1	1.8
mourning dove	2	5.6	0	0.0	0	0.0	2	3.6
pied-billed grebe	0	0.0	0	0.0	1	7.7	1	1.8
red-eyed vireo	2	5.6	0	0.0	0	0.0	2	3.6
ring-necked pheasant	2	5.6	0	0.0	0	0.0	2	3.6
rock pigeon	1	2.8	0	0.0	0	0.0	1	1.8
sharp-shinned hawk	1	2.8	0	0.0	0	0.0	1	1.8
song sparrow	1	2.8	0	0.0	0	0.0	1	1.8
vesper sparrow	0	0.0	1	14.3	0	0.0	1	1.8
western grebe	1	2.8	0	0.0	0	0.0	1	1.8
western meadowlark	2	5.6	0	0.0	0	0.0	2	3.6
yellow-headed blackbird	0	0.0	0	0.0	1	7.7	1	1.8
unidentified gull	1	2.8	0	0.0	0	0.0	1	1.8
unidentified bird (large)	1	2.8	0	0.0	0	0.0	1	1.8
unidentified bird (small)	1	2.8	0	0.0	0	0.0	1	1.8
Overall	**36**	**100[a]**	**7**	**100[a]**	**13**	**100[a]**	**56**	**100[a]**

[a]Total from numbers in table may be > than 100% due to number rounding.

Table 6.2-2 Summary of bat species found during fatality study at the PrairieWinds ND1 Wind Facility.

Species	Scheduled Searches		Incidental (on plot)		Incidental (off plot)		All Fatalities	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent
hoary bat	21	51.2	0	0	1	50	22	48.9
little brown bat	8	19.5	1	50	1	50	10	22.2
eastern red bat	7	17.1	1	50	0	0	8	17.8
silver-haired bat	4	9.8	0	0	0	0	4	8.9
unidentified bat	1	2.4	0	0	0	0	1	2.2
Overall	**41**	**100**	**2**	**100**	**2**	**100**	**45**	**100**

6.2.1 Bird Fatalities

6.2.1.1. Characteristics of Bird Fatalities

During the survey period, a total of 56 bird fatalities, consisting of 25 identified species and two unidentified species, were found at PWND1 (Table 6.2-1, Figures 6.2-1a and 6.2-1b). Of these, 15 were large identified and one large unidentified bird species while eight were small indentified and one unidentified bird species (Table 6.2-1). Mallards (*Anas platyrhynchos*) were the most common carcass found during both scheduled searches and incidentally (Table 6.2-1). No other species had more than two individuals found during scheduled carcass searches, while there were five gadwalls (*Anas strepera*) found incidentally (Table 6.2-1).

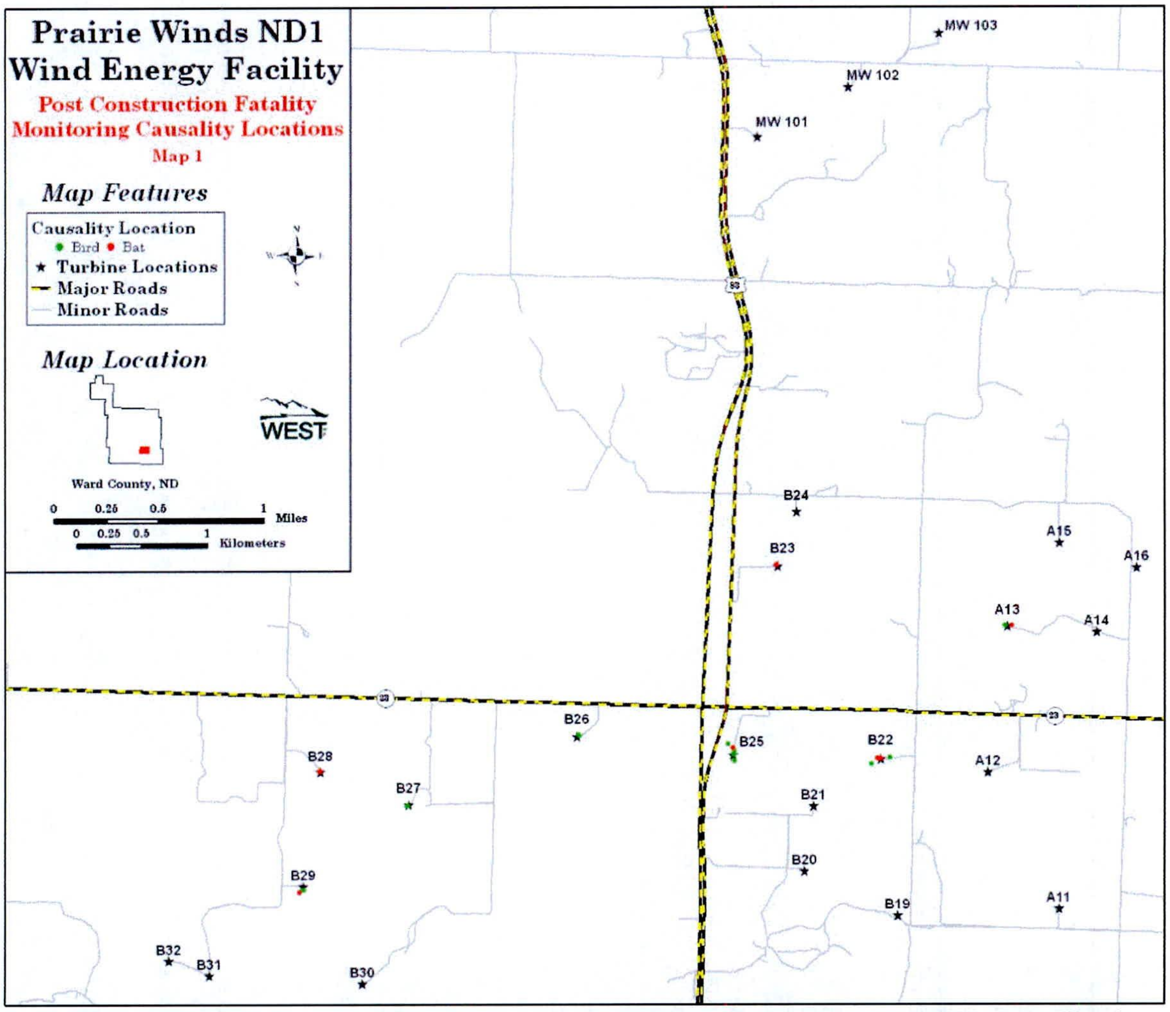

Figure 6.2-1a Location of avian and bat fatalities within the PrairieWinds ND1 Wind Facility from March 17 – October 30, 2010 (Map 1 – northern turbines).

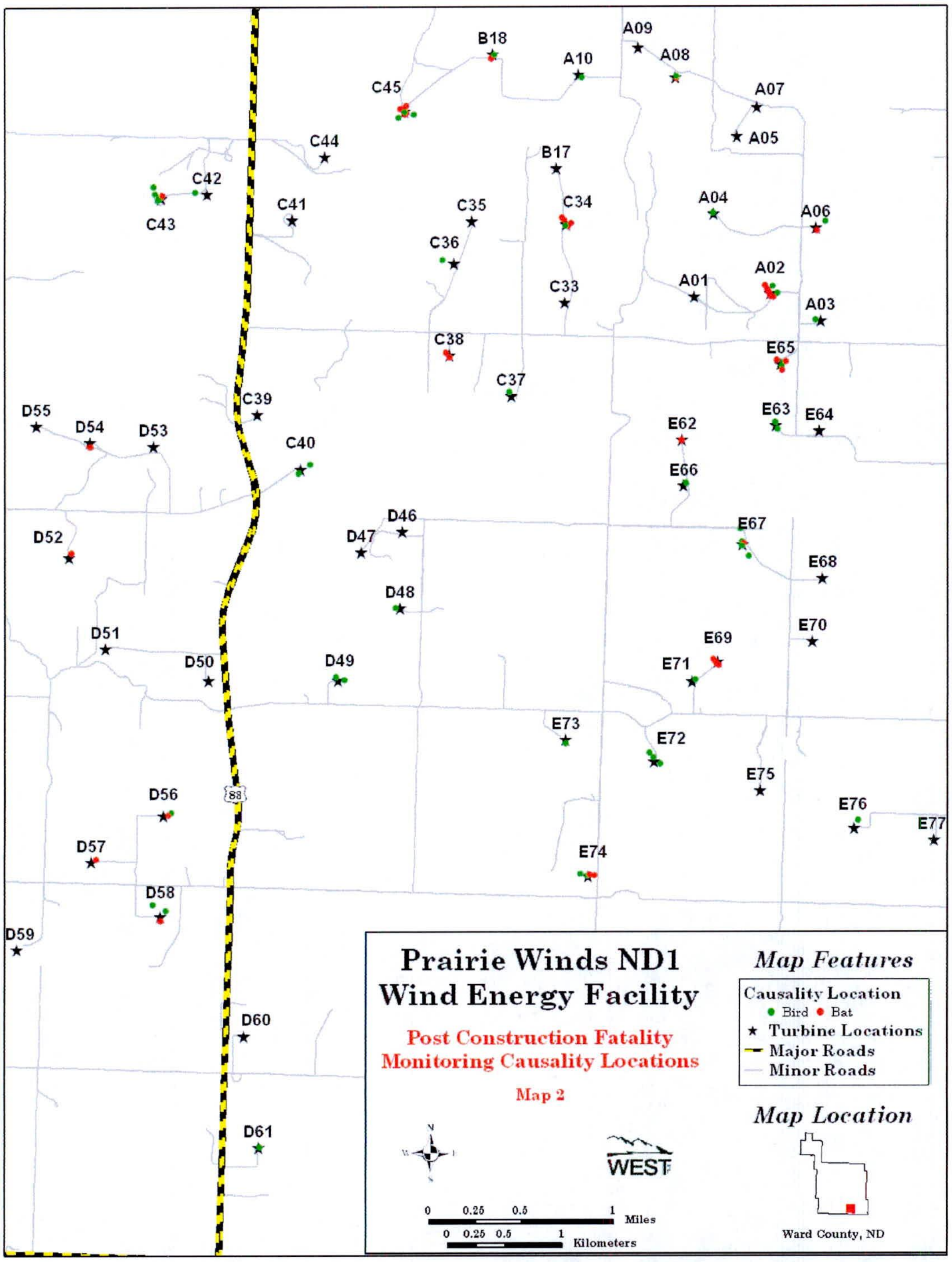

Figure 6.2-1b Location of avian and bat fatalities within the PrairieWinds ND1 Wind Facility from March 17 – October 30, 2010 (Map 2 – southern turbines).

6.2.1.4 Distribution of Bird Fatalities: Temporal Patterns

Fatalities were found during all three seasons (Table 6.2-3, Figure 6.2-2). There were no recorded fatalities found within survey areas during scheduled searches or incidentally during March. Fatalities peaked in spring (46.4% of total fatalities) and became less as the seasons progressed into fall (17.9% of total fatalities).

Table 6.2-3 Seasonal distribution of bird fatalities found during carcass searches and as incidental finds within the PrairieWinds ND1 Wind Facility; March 17 – October 30, 2010.

Season	Dates	Bird Fatalities	Percent Composition
Spring	3/15/2010 – 5/22/2010	26	46.4
Summer	5/23/2010 – 8/15/2010	20	35.7
Fall	8/16/2009 – 10/31/2010	10	17.9
Overall		**56**	**100**

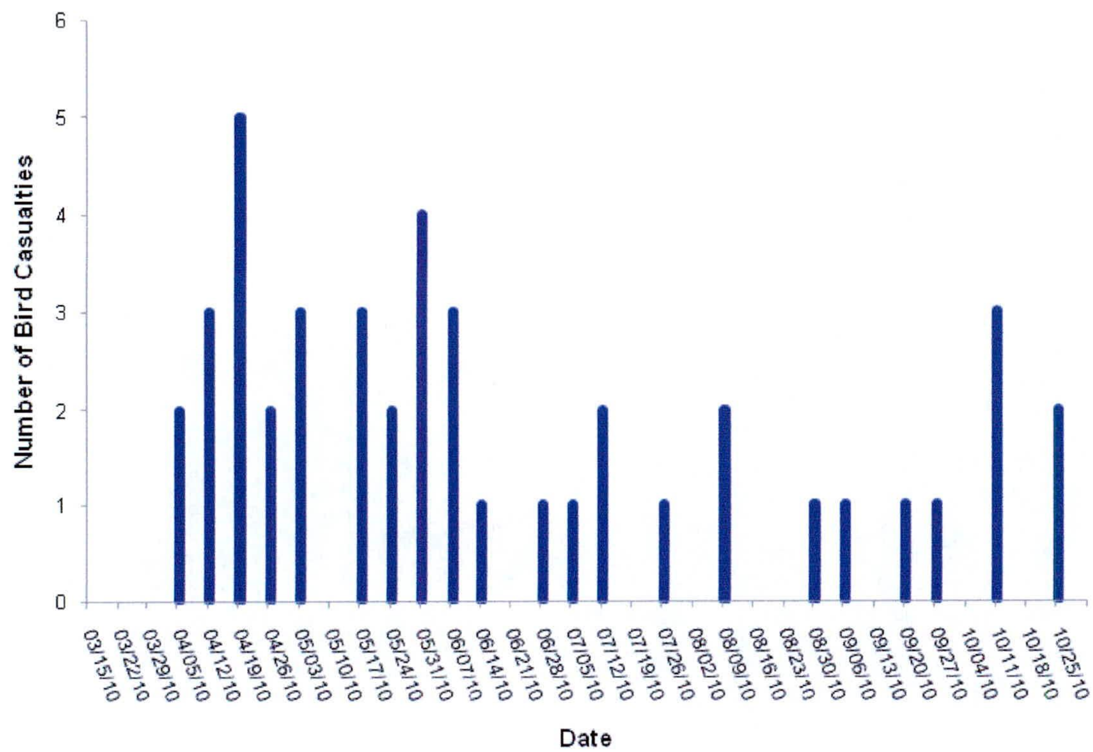

Figure 6.2-2 Temporal distribution of bird fatalities found during the survey period March 17 - October 30, 2010 at the PrairieWinds ND1 Wind Facility.

6.2.1.5 Distribution of Bird Fatalities: Spatial Patterns and Turbines

Bird fatalities were located at 22 of the 35 turbines, with turbines B25, C43, and E67 having the greatest (4) number of fatalities recorded (Figure 6.2-3). Bird fatalities per turbine ranged from zero to 4 fatalities (Figure 6.2-3), with an average of 0.63 birds found per turbine. Fatalities were located throughout the entire project with slightly more found in the east-central part of PWND1 (Figures 6.2-1a and 6.2-1b).

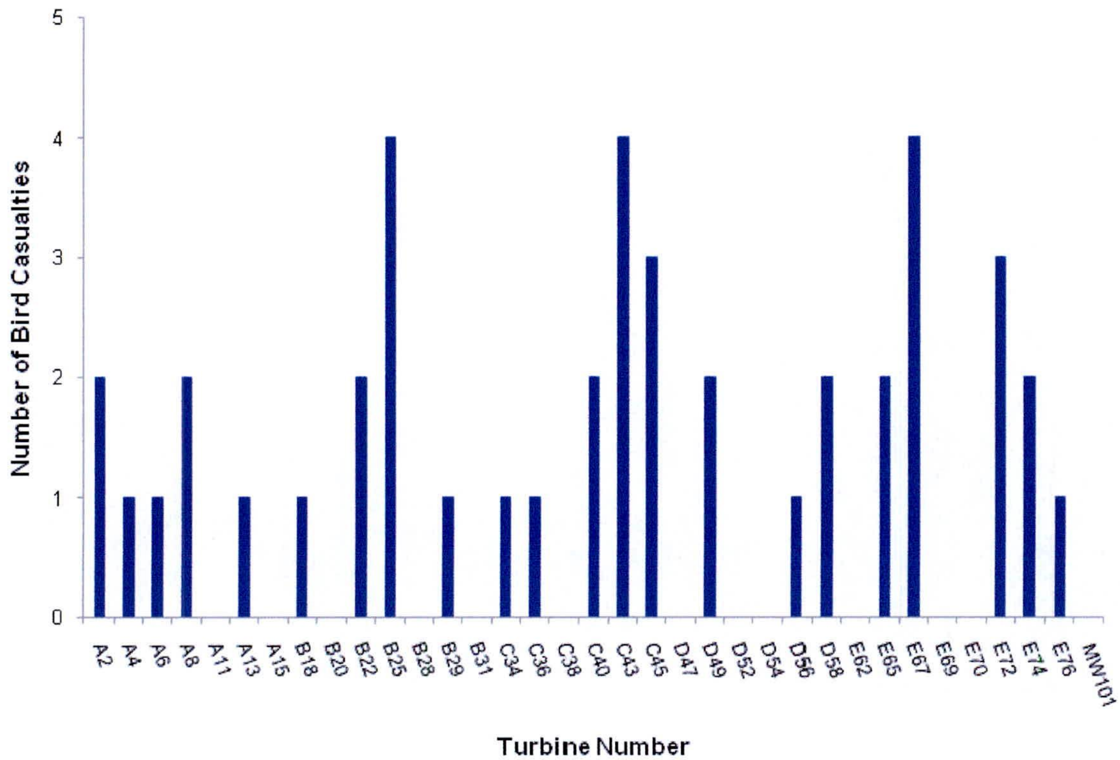

Figure 6.2-3 Spatial distribution, by turbine location, of bird fatalities within the PrairieWinds ND1 Wind Facility, March 17 – October 30, 2010.

6.2.1.6 Distribution of Fatalities: Distance from Turbine

Slightly more than half (55.4 %) of all bird fatalities were found less than or equal to 40 m (131 ft) from the turbine, followed by about 44.6% found greater than 60 m (197 ft), and the remaining eight percent found between 40 and 60 m (131 and 197 ft; Table 6.2-4). However, the findings do not account for detection and scavenging bias, or the searched area, which may vary as a function of distance from turbine.

Table 6.2-4 Distribution of bird casualties by distance (meters) from turbines at the PrairieWinds ND1 Wind Facility, March 17 – October 30, 2010.

Distance to Turbine (Meters)	Number of Casualties	Percent Bird Casualties
0 – 10	10	17.9
11 – 20	5	8.9
21 – 30	8	14.3
31 – 40	8	14.3
41 – 50	3	5.4
51 – 60	2	3.6
61 – 70	4	7.1
71 – 80	5	8.9
81 – 90	4	7.1
91 – 100	3	5.4
> 100	4	7.1

6.2.2 Bat Fatalities

6.2.2.1 Characteristics of Bat Fatalities

A total of 45 bat fatalities were found at PWND1 over the course of the survey period (Table 6.2-2). Two bat fatalities were found incidentally within the search plots and two were also found incidentally off the search plots (Table 6.2-2). Four different bat species were identified at the PWND1, including 22 hoary bat (*Lasiurus cinereus*) carcasses, representing approximately 50% of all bat fatalities (Table 6.2-2). One unidentified bat fatality was also documented during the survey period (Table 6.2-2).

6.2.2.2 Distribution of Bat Fatalities: Temporal Patterns

The majority of bat fatalities were found during summer (66.7 percent); while the remaining 33.3% of fatalities were recorded during fall (Table 6.2-5; Figure 6.2-4). Twenty-six of the 30 fatalities found during the summer were collected between August 5 and 13, 2010 (Figure 6.2-4). No bat carcasses were found before May 26 or after September 28, 2010 (Figure 6.2-4).

Table 6.2-5 Seasonal distribution of bat fatalities found during carcass searches and as incidental finds within the PrairieWinds ND1 Wind Facility; March 17 – October 30, 2010.

Season	Dates	Bat Fatalities	Percent Composition
Spring	3/15/2010 – 5/22/2010	0	0.0
Summer	5/23/2010 – 8/15/2010	30	66.7
Fall	8/16/2009 – 10/31/2010	15	33.3
Overall		**45**	**100**

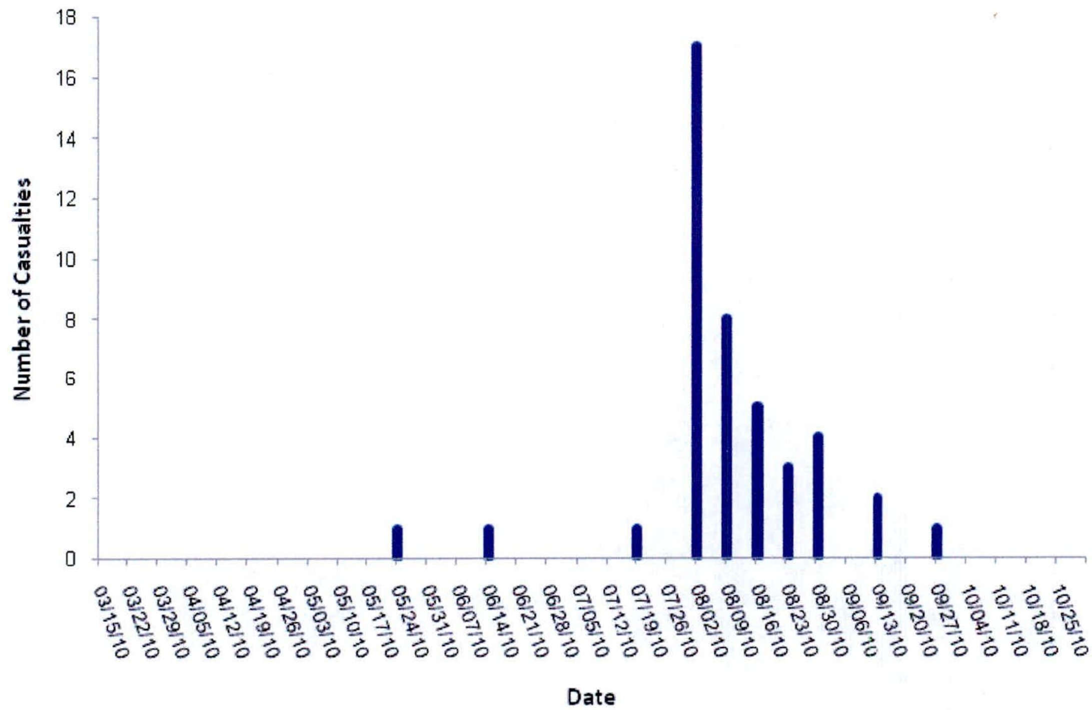

Figure 6.2-4 Temporal distribution of bat fatalities found during the survey period March 17 - October 30, 2010 at the PrairieWinds ND1 Wind Facility.

6.2.2.5 Distribution of Bat Fatalities: Spatial Patterns and Turbines

Bat fatalities were located at 22 of the 35 search turbines (Figure 6.2-5), with an average of 0.49 bats found per turbine. Bat fatalities were distributed throughout the PWND1 (Figure 6.2-1).

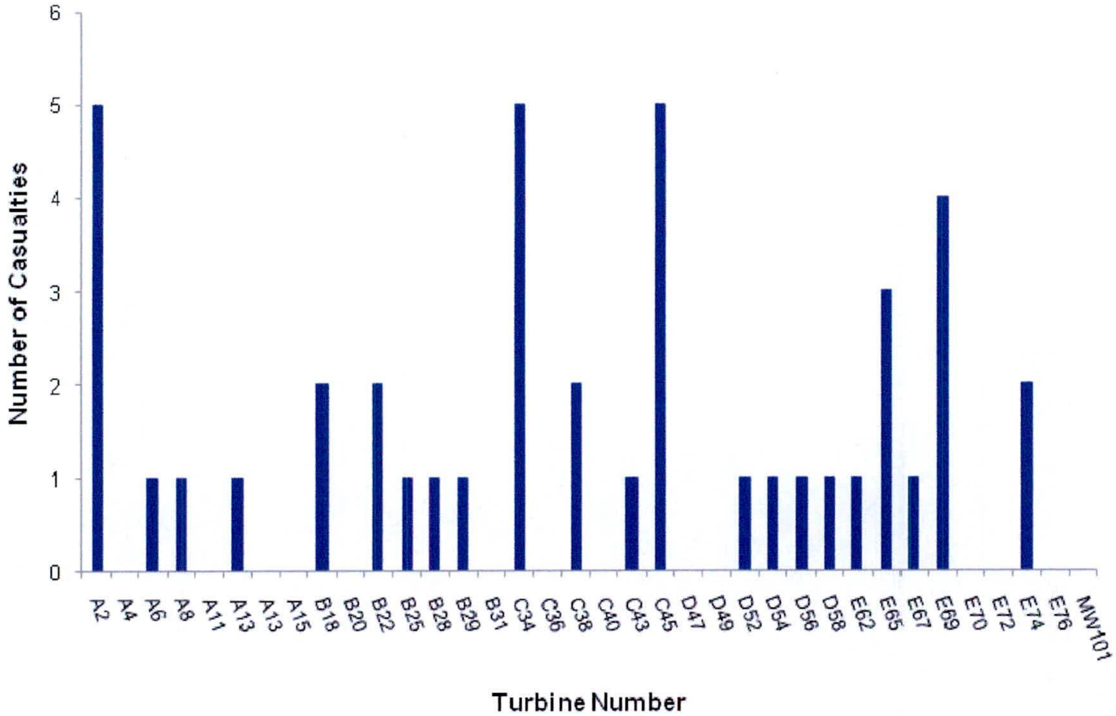

Figure 6.2-5 Spatial distribution, by turbine location, of bat fatalities within the PrairieWinds ND1 Wind Facility, March 17 – October 30, 2010.

6.2.2.6 Distribution of Fatalities: Distance from Turbine

The majority (77.8%) of all fatalities were found greater than 10 m (33 ft) but less than 50 m (164 ft) from the turbine (164 ft; Table 6.2-6). However, these percentages do not account for detection and scavenging bias, or the searched area, which may vary as a function of distance from turbine.

Table 6.2-6 Distribution of bat casualties by distance (meters) from turbines at the PrairieWinds ND1 Wind Facility, March 17 – October 30, 2010.

Distance to Turbine (Meters)	Number of Casualties	Percent Bat Casualties
0 – 10	5	11.1
11 – 20	7	15.6
21 – 30	7	15.6
31 – 40	11	24.4
41 – 50	10	22.2
51 – 60	3	6.7
61 – 70	1	2.2
71 – 80	1	2.2
> 80	0	0

6.3 Searcher Efficiency Trials

A total of 28 small and 18 large birds were used at PWND1 (Table 6.3-1). Overall searcher efficiency for large bird carcasses was estimated to be 66.7% for all trials and 64.3% for small birds (Table 6.3-1). Bat carcasses were not available for trials, so small bird estimates were used for bats.

Table 6.3-1 Searcher efficiency at the PrairieWinds ND1 Wind Facility as a function of date and size class from March17 to October 30, 2010.

Size	Date	Number Placed	Number Available	Number Found	Percent Found
	4/27/2010	8	8	5	62.5
	5/11/2010	6	6	6	100
	10/13/2010	7	7	4	57.1
Small Birds	10/14/2010	3	3	1	33.3
	10/18/2010	2	2	1	50.0
	10/19/2010	2	2	1	50.0
Overall		**28**	**28**	**18**	**64.3**
	4/27/2010	3	3	0	0.0
	5/11/2010	5	5	5	100
	10/13/2010	3	3	3	60.0
Large Birds	10/14/2010	3	3	2	66.7
	10/18/2010	2	2	1	50.0
	10/19/2010	2	2	1	50.0
Overall		**18**	**18**	**12**	**66.7**

6.4 Carcass Removal Trials

Overall, a total of 62 bird carcasses were placed in the PWND1 during the monitoring period, including 30 large birds and 32 small birds. By day four, approximately 80% of small birds remained and 40% remained by day 14 (Figure 6.4-1). For large birds, approximately 90% of the large birds remained by day four, and nearly 75% remained by day 14 (Figure 6.4-1). By the end of the 30-day monitoring period, approximately 15% of small birds remained while about 55% of large birds remained (Figure 6.4-1).

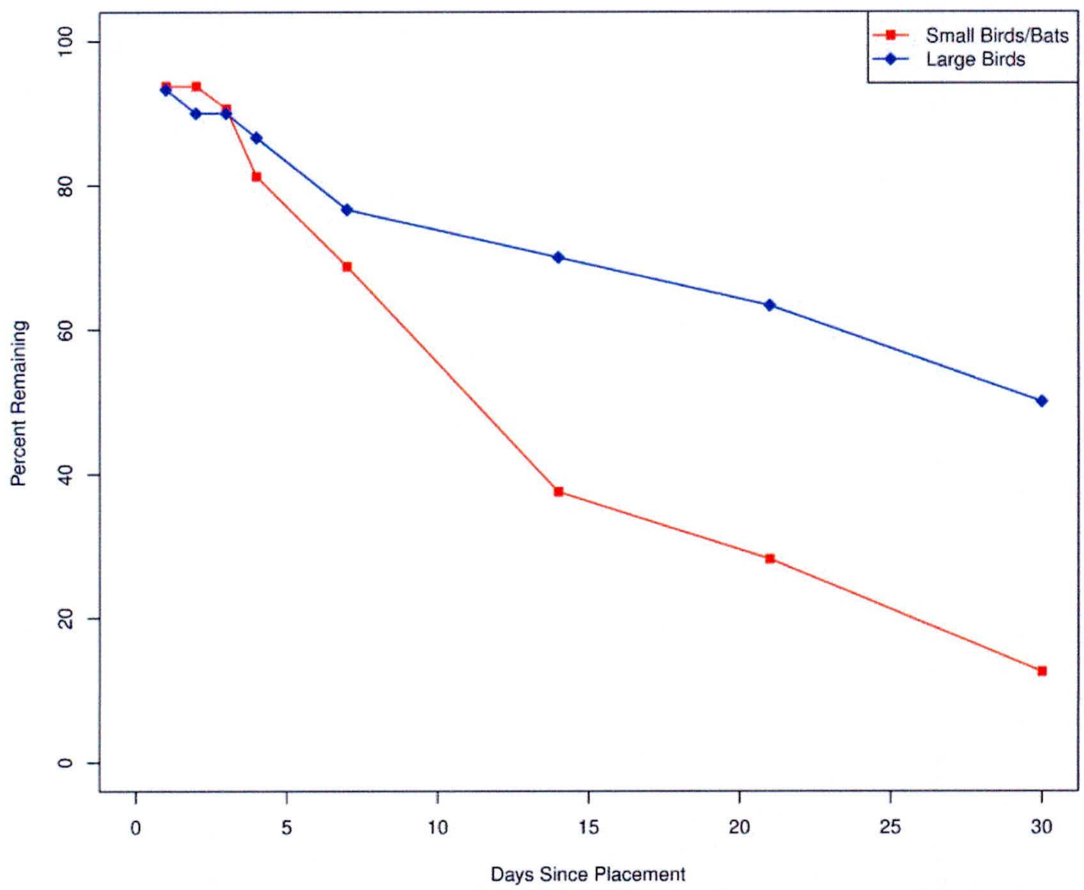

Figure 6.4-1 Scavenger removal rates for large and small birds within the PrairieWinds ND1 Wind Facility, March 17 – October 30, 2010. Small bird scavenging rates also represent scavenging rates for bats.

6.5 Adjusted Fatality Estimates

Fatality estimates, standard errors, and confidence intervals (CI) were calculated for birds (Tables 6.5-1) and bats (Tables 6.5-2). The fatality estimates are adjusted based on the corrections for carcass removal, observer detection bias, and the proportion of the plot searched. Estimates were calculated for the spring, summer, and fall seasons and for large and small birds.

6.5.1 Birds

The estimated average probability a small bird casualty would remain until a scheduled search and would be found ranged from 0.06 to 0.30 over the three seasons (Appendix A). The two largest confidence intervals (CI; 0.37-0.59 and CI; 0.39-0.61) occurred during late summer and late fall, respectively (Appendix A). All other CI ranges were less (Appendix A).

The probability of large bird, raptor, and waterbird casualties remaining and being found were all higher than for small birds. But again, the range in the estimated average probabilities over the three seasons was narrow (0.71 to 0.73; Appendix A). The largest CI (0.56-0.82) for all three bird types occurred during late fall (Appendix A). All other CI's ranges were less than that (Appendix A).

The overall adjusted estimated number of small bird fatalities per turbine was greatest during the spring season; with an adjusted estimate of 0.30 (CI: 0.06-0.58) small bird fatalities per turbine (Table 6.5-1). The summer season had the lowest estimated small bird fatalities at 0.20 (CI: 0.05-0.43). For large birds, estimated fatalities per turbine was highest in summer at 0.76 (CI: 0.40-1.19; Table 6.5-1). The lowest estimated large bird fatalities occurred during fall at 0.21 (CI: 0.08-0.75; Table 6.5-1). The overall adjusted estimated number of raptor fatalities per turbine was greatest during the spring season; with an adjusted estimate of 0.08 (CI: 0.00-0.20) raptor fatalities per turbine (Table 6.5-1). For waterfowl, estimated fatalities per turbine were similar for spring and summer; 0.29 and 0.28 waterfowl fatalities per turbine, respectively (Table 6.5-1).

For the three season study period, the overall adjusted fatality rate per turbine for all birds was 2.22 (CI: 1.74-3.33) fatalities per turbine (Table 6.5-1) or 1.48 birds per MW. Additionally, the overall adjusted fatality rate per turbine for raptors and waterfowl, respectively, were 0.08 (CI: 0.00-0.20) and 0.57 (CI: 0.29-1.00) fatalities per turbine (Table 6.5-1) or 0.05 and 0.38 birds per MW.

Table 6.5-1 Bootstrap point estimates (mean) and lower and upper limits of 90 percent confidence intervals for seasonal bird fatality rate estimation at the PrairieWinds ND1 Wind Facility from March 17, 2010 to October 30, 2010.

Adjusted Fatality Estimates based on Season (fatalities/turbine)									
	Spring			**Summer**			**Fall**		
		90% Confidence Interval			**90% Confidence Interval**			**90% Confidence Interval**	
	mean	**lower limit**	**upper limit**	**mean**	**lower limit**	**upper limit**	**mean**	**lower limit**	**upper limit**
Small Birds	0.30	0.06	0.58	0.20	0.05	0.43	0.26	0.07	0.57
Large Birds	0.49	0.19	0.86	0.76	0.40	1.19	0.21	0.08	0.75
Raptors	0.08	0.00	0.20	0.00	-	-	0.00	-	-
Waterfowl	0.29	0.08	0.56	0.28	0.11	0.52	0.00	-	-

Overall Adjusted Fatality Estimates (birds/turbine/study period)			
		90% Confidence Interval	
	mean	**lower limit**	**upper limit**
All Birds	**2.22**	**1.74**	**3.33**
Raptors	**0.08**	**0.00**	**0.20**
Waterfowl	**0.57**	**0.29**	**1.00**

6.5.2 Bats

The estimated average probability a bat casualty would remain until a scheduled search and would be found ranged from 0.50 to 0.51 over the three seasons (Appendix A). The widest confidence intervals (CI; 0.38-0.61 and CI; 0.39-0.62) occurred during spring and fall (Appendix A). All other CI's ranges were narrower than that (Appendix A).

The summer season has the highest adjusted estimated number of bat fatalities per turbine at 2.10 (CI: 1.30-3.26; Table 6.5-2). On the other hand, the spring season had zero estimated bat fatalities per turbine (Table 6.5-2). The overall adjusted bat fatality estimate was 3.19 (CI: 2.15-4.53) bat fatalities per turbine (Table 6.5-2) or 2.13 bat fatalities per MW.

Table 6.5-2 Bootstrap point estimates (mean) and lower and upper limits of 90 percent confidence intervals for seasonal bat fatality rate estimation at the PrairieWinds ND1 Wind Facility from March 17, 2010 to October 30, 2010.

Adjusted Fatality Estimates based on Season (fatalities/turbine)								
Spring			**Summer**			**Fall**		
	90% Confidence Interval			**90% Confidence Interval**			**90% Confidence Interval**	
mean	**lower limit**	**upper limit**	**mean**	**lower limit**	**upper limit**	**mean**	**lower limit**	**upper limit**
0	-	-	2.10	1.30	3.26	1.09	0.62	1.73

Overall Adjusted Fatality Estimates (bats/turbine/study period)			
		90% Confidence Interval	
	mean	**lower limit**	**upper limit**
All Bats	**3.19**	**2.15**	**4.53**

7.0 DISCUSSION

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson et al. (2005), and accounted for search interval, total area searched, proportion of area searched at specific distances from the turbine, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change through time at a given location and must be accounted for when attempting to estimate fatality rates. This was accounted for by conducting scavenging trials for small and large birds throughout each search period. The scavenging and efficiency rates for bats were considered to be the same as that of small birds given the small number of bat carcasses available for testing. Searcher efficiency trials were also conducted throughout each search period within different plot conditions to account for any biases. As vegetation density or height increases, the level of difficulty in detection rates also increases.

Separate fatality rate estimates were calculated for bats, small birds, and large birds based on ground cover type, search interval, and season. For both birds and bats, confidence intervals overlapped fatality estimates (see Tables 6.5-1 and 6.5-2), indicating that the estimates were consistent regardless of season.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006). The overall design of this study incorporates several assumptions or factors that affect the results of the fatality estimates. First, all bird and bat casualties found within the standardized search plots during the study were included in the analysis. Second, it was assumed that all bird and bat carcasses found during the study were due to collision with wind turbines. True cause of death is unknown for most of the fatalities. It is possible that some of the bird or bat fatalities were caused by predators, and some of the casualties included in the data pool were potentially due to natural causes (background mortality).

Additionally, there are other potential negative biases. For example, no adjustments were made for fatalities possibly occurring outside of the search boundaries. Search boundaries were established a minimum distance of 100 meters from the turbines to focus on birds and bats. Based on the distribution of fatalities as a function of distance from turbines (Figures 6.2-3 and 6.2-5), a small percentage of bird fatalities possibly fell outside the search plots and may have been missed. This factor would lead to an underestimate of fatality rates.

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. This may occur if the types of birds used are larger or smaller than the carcasses of fatalities, more or less cryptic in color than the actual fatalities, or other potential reasons. Northern bobwhite quail, rock pigeons, European starlings (*Sturnus vulgaris*), house sparrows, mallards (*Anas platyrhynchos*), and ring-necked pheasants were used to represent the range of bird fatalities expected. It is believed that this diversity captures the range of sizes and other characteristics of actual fatalities and should be a reasonable representation of scavenging rates of the birds as a group. An additional bias within these trials was that small birds were used to represent bat fatalities, which may not be directly comparable to actual scavenging or detection rates for bats.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this could lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for these placed carcasses are lower than for actual fatalities. The logic is that if the trials are based on too many carcasses on a given day, scavengers are unable to access all trial carcasses, whereas they could potentially access and remove all wind turbine collision fatalities (Smallwood et al. 2010). If this is the case, and the trial carcass density is much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. Conversely, placing carcasses in an area could bring in additional scavengers, therefore artificially overestimating scavenging rates compared to actual fatalities with ongoing trials. This was addressed by placing relatively few carcasses at any one time in any one location.

7.1 Bird Fatalities

During the one-year study period, 56 bird fatalities were found during scheduled carcass searches. Of the identifiable birds found during scheduled searches and/or incidentally, none were species protected under threatened or endangered species legislation (e.g., ESA 1973).

Bird fatality rates at other sites with publically-available data across North America exhibit a wide range of mortality, from 0.08 birds/MW/study period at the Oklahoma Wind Energy Center (Piorkowski 2006) to 13.93 birds/MW/study period at the Buffalo Mountain facility in Tennessee (Nicholson et al. 2005; Table 7.1-1). Within the Midwest, bird estimates ranged from 0.42 fatalities/MW/study period at the Top of Iowa facility (Jain 2005) to 8.25 fatalities/MW/study period at the Wessington Springs Facility in South Dakota (Derby et al. 2010g; Table 7.1-1). The estimated bird fatality rate of 1.48 bird fatalities/MW/study period at the PWND1 ranked low, fifty-first, when compared to these other wind energy facilities across North America (Figure 7.1-1). The estimated total bird fatality at the PWND1 falls within the range of other Midwestern projects, ranking sixteenth of 22 projects, including PWND1 (Table 7.1-1).

Table 7.1-1 Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
PrairieWinds ND1, ND	**1.48**	**80**	**120**
Midwest			
Wessington Springs, SD	8.25	34	51
Blue Sky Green Field, WI	7.17	88	145
Cedar Ridge, WI	6.55	41	68
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN	5.59	33	49.5
Buffalo Ridge I, SD	5.06	24	50.4
Winnebago, WI	3.88	10	20
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Ripley, Ont.	3.09	38	76
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
Buffalo Ridge, MN (Phase I; 1996)	2.19	73	25
Kewaunee County, WI	1.98	31	20
Buffalo Ridge, MN (Phase I; 1998)	1.67	73	25
NPPD Ainsworth, NE	1.63	36	59.4
Elm Creek, MN	1.55	67	100
Buffalo Ridge, MN (Phase I; 1997)	1.33	73	25
Buffalo Ridge, MN (Phase I; 1999)	0.76	73	25
Crescent Ridge, IL	0.87	33	49.5
Top of Iowa, IA (2004)	0.73	89	80
Grand Ridge, IL	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Pacific Northwest			
Leaning Juniper, OR	6.66	67	100.5
Stateline, OR/WA (2002)	3.17	454	263
Klondike II, OR	3.10	50	75
Klondike III, OR	3.02	122	375
Hopkins Ridge, WA (2008)	2.99	83	150
Nine Canyon, WA	2.76	37	48
Stateline, OR/WA (2003)	2.68	454	263
Combine Hills, OR	2.56	41	41
Big Horn, WA	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA	1.55	127	229
Stateline II, OR/WA (2006)	1.23	454	263
Hopkins Ridge, WA (2006)	1.23	83	150
Vansycle, OR	0.95	38	24.9
Klondike, OR	0.95	16	24
Elkhorn, OR	0.64[B]	61	101
Marengo I, WA	0.27	78	140.4
Marengo II, WA	0.16	39	70.2
California			
Dillon, CA	4.71	45	45
Diablo Winds, CA	4.29	31	20
High Winds, CA (2004)	1.62	90	162
High Winds, CA (2005)	1.10	90	162
SMUD Solano, CA	0.99		15

Table 7.1-1 Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
	Rocky Mountains		
Foote Creek Rim, WY (Phase I; 1999)	3.40	69	41.4
Judith Gap, MT	3.01	90	135
Foote Creek Rim, WY (Phase I; 2000)	2.42	69	41.4
Foote Creek Rim, WY (Phase I; 2001/2002)	1.93	69	41.4
Summerview, Alb. (2006)	1.06	39	70.2
	Southern Plains		
Buffalo Gap, TX	1.32	67	134
Oklahoma Wind Energy Center, OK	0.08	68	102
	Southeast		
Buffalo Mountain, TN (2000-2003)	13.93	3	1.98
Buffalo Mountain, TN (2005)	1.10	18	28.98
	Northeast		
Maple Ridge, NY (2006)	5.81	120	198
Mount Storm, WV (2009)	5.73	82	164
Noble Ellenburg, NY (2009)	3.79	54	80
Maple Ridge, NY (2007)	3.44	195	321.75
Casselman, PA (Spring & Fall 2008)	3.13	23	34.5
Wolfe Island, Ont. (Report 1; May- June 2009)	3.04	86	197.8
Mountaineer, WV	3.00	44	66
Noble Bliss, NY (2008)	2.86	67	100
Noble Bliss, NY (2009)	2.81	67	100
Stetson Mountain, ME	2.68	38	57
Noble Clinton, NY (2008)	2.17	67	100
Maple Ridge, NY (2008)	2.07	195	321.75
Mount Storm, WV (2008)	1.91	82	164
Cohocton/Dutch Hill, NY	1.88	50	125
Mars Hill, ME (2008)	1.76	28	42
Mars Hill, ME (2007)	1.67	28	42
Munnsville, NY	1.48	23	34.5
Noble Ellenburg, NY (2008)	1.40	54	80
Noble Clinton, NY (2009)	1.17	67	100

A=number of bird fatalities/MW/study period

Table 7.1-1 (*continued*) Wind energy facilities in North America with fatality data for all bird species, grouped by geographic region.

Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
Wessington Springs, SD	Derby et al. 2010g	Elkhorn, OR	Jeffrey et al. 2009b
Blue Sky Green Field, WI	Gruver et al. 2009	Marengo I, WA	URS Corporation 2010a
Cedar Ridge, WI	BHE Environmental 2010	Marengo II, WA	URS Corporation 2010b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	Dillon, CA	Chatfield et al. 2009
Moraine II, MN	Derby et al. 2010f	Diablo Winds, CA	WEST 2008
Buffalo Ridge I, SD	Derby et al. 2010c	High Winds, CA (04)	Kerlinger et al. 2006
Winnebago, IA	Derby et al. 2010b	High Winds, CA (05)	Kerlinger et al. 2006
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	SMUD Solano, CA	Erickson and Sharp 2005
Ripley, Ont.	Jacques Whitford 2009	Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Judith Gap, MT	TRC 2008
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003
Kewaunee County, WI	Howe et al. 2002	Foote Creek Rim, WY (Phase I; 01/02)	Young et al. 2003
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	Summerview, Alb. (06)	Brown and Hamilton 2006
NPPD Ainsworth, NE	Derby et al. 2007	Buffalo Gap, TX	Tierney 2007
Elm Creek, MN	Derby et al. 2010e	Oklahoma Wind Energy Center, OK	Piorkowski 2006
Crescent Ridge, IL	Kerlinger et al. 2007	Buffalo Mountain, TN (00-03)	Nicholson et al. 2005
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Buffalo Mountain, TN (05)	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	Maple Ridge, NY (06)	Jain et al. 2007
Top of Iowa, IA (04)	Jain 2005	Mount Storm, WV (09)	Young et al. 2010
Grand Ridge, IL	Derby et al. 2010h	Noble Ellenburg, NY (09)	Jain et al. 2010c
Top of Iowa, IA (03)	Jain 2005	Maple Ridge, NY (07)	Jain et al. 2008
Leaning Juniper, OR	Gritski et al. 2008	Casselman, PA (Spring & Fall 08)	Arnett et al. 2009b
Stateline, OR/WA (02)	Erickson et al. 2004	Wolfe Island, Ont. (Report 1: May - June 09)	Stantec Ltd. 2010
Klondike II, OR	NWC and WEST 2007	Mountaineer, WV	Kerns and Kerlinger 2004
Klondike III, OR	Gritski et al. 2009	Noble Bliss, NY (08)	Jain et al. 2009e
Hopkins Ridge, WA (08)	Young et al. 2009b	Noble Bliss, NY (09)	Jain et al. 2010a
Nine Canyon, WA	Erickson et al. 2003	Stetson Mountain, ME	Stantec 2009b
Stateline, OR/WA (03)	Erickson et al. 2004	Noble Clinton, NY (08)	Jain et al. 2009c
Combine Hills, OR	Young et al. 2006	Maple Ridge, NY (08)	Jain et al. 2009d
Big Horn, WA	Kronner et al. 2008	Mount Storm, WV (08)	Young et al. 2009a
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Cohocton/Dutch Hill, NY	Stantec 2010
Biglow Canyon I, OR (Phase I; 08)	Jeffrey et al. 2009a	Mars Hill, ME (08)	Stantec 2009a
Wild Horse, WA	Erickson et al. 2008	Mars Hill, ME (07)	Stantec 2008a
Stateline II, OR/WA	Erickson et al. 2007	Munnsville, NY	Stantec 2008b
Hopkins Ridge, WA (06)	Young et al. 2007	Noble Ellenburg, NY (08)	Jain et al. 2009b
Vansycle, OR	Erickson et al. 2000	Noble Clinton, NY (09)	Jain et al. 2010b
Klondike, OR	Johnson et al. 2003		

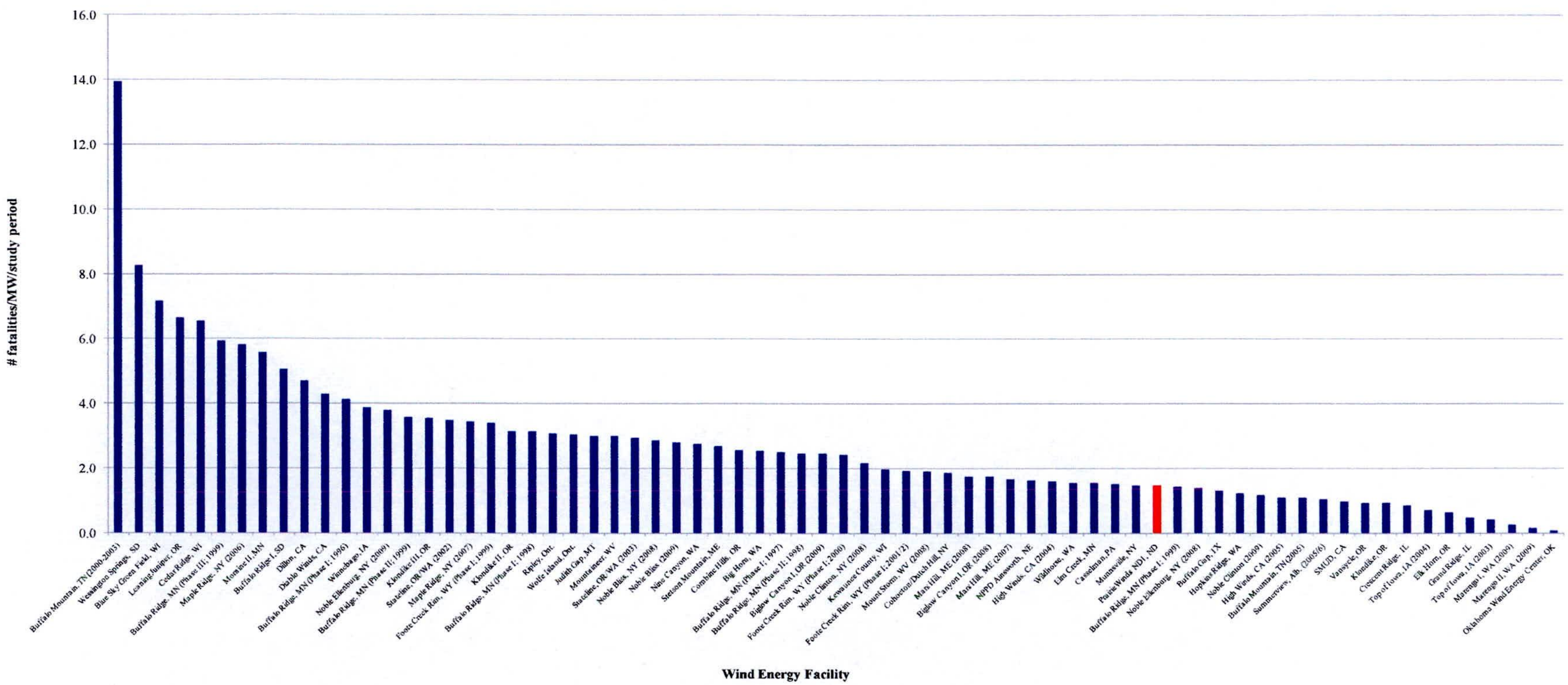

Figure 7.1-1 All bird fatality rates at North American wind energy facilities, with the PrairieWinds ND1 Wind Facility highlighted in red.

Figure 7.1-1 (*continued*) All bird fatality rates at North American wind energy facilities.

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND	This study				
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Judith Gap, MT	TRC 2008	Elm Creek, MN	Derby et al. 2010e
Wessington Springs, SD	Derby et al. 2010g	Mountaineer, WV	Kerns and Kerlinger 2004	Casselman, PA (Spring & Fall 08)	Arnett et al. 2009b
Blue Sky Green Field, WI	Gruver et al. 2009	Stateline, OR/WA (03)	Erickson et al. 2004	Munnsville, NY	Stantec 2008b
Leaning Juniper, OR	Gritski et al. 2008	Noble Bliss, NY (08)	Jain et al. 2009e	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000
Cedar Ridge, WI	BHE Environmental 2010	Noble Bliss, NY (09)	Jain et al. 2010a	Noble Ellenburg, NY (08)	Jain et al. 2009b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	Nine Canyon, WA	Erickson et al. 2003	Buffalo Gap, TX	Tierney 2007
Maple Ridge, NY (06)	Jain et al. 2007	Stetson Mountain, ME	Stantec 2009b	Hopkins Ridge, WA (06)	Young et al. 2007
Moraine II, MN	Derby et al. 2010f	Combine Hills, OR	Young et al. 2006	Noble Clinton, NY (09)	Jain et al. 2010b
Buffalo Ridge I, SD	Derby et al. 2010c	Big Horn, WA	Kronner et al. 2008	High Winds, CA (05)	Kerlinger et al. 2006
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Buffalo Mountain, TN (05)	Fiedler et al. 2007
Dillon, CA	Chatfield et al. 2009	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Summerview, Alb. (06)	Brown and Hamilton 2006
Diablo Winds, CA	WEST 2008	Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	SMUD Solano, CA	Erickson and Sharp 2005
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003	Vansycle, OR	Erickson et al. 2000
Winnebago, IA	Derby et al. 2010b	Noble Clinton, NY (08)	Jain et al. 2009c	Klondike, OR	Johnson et al. 2003
Noble Ellenburg, NY (09)	Jain et al. 2010c	Kewaunee County, WI	Howe et al. 2002	Crescent Ridge, IL	Kerlinger et al. 2007
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Foote Creek Rim, WY (Phase I; 01/02)	Young et al. 2003	Top of Iowa, IA (04)	Jain 2005
Klondike III, OR	Gritski et al. 2009	Mount Storm, WV (08)	Young et al. 2009a	Elkhorn, OR	Jeffrey et al. 2009b
Stateline, OR/WA (02)	Erickson et al. 2004	Cohocton/Dutch Hill, NY	Stantec 2010	Grand Ridge, IL	Derby et al. 2010h
Maple Ridge, NY (07)	Jain et al. 2008	Mars Hill, ME (08)	Stantec 2009a	Top of Iowa, IA (03)	Jain 2005
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003	Biglow Canyon I, OR (Phase I; 08)	Jeffrey et al. 2009a	Marengo I, WA	URS Corporation 2010a
Klondike II, OR	NWC and WEST 2007	Mars Hill, ME (07)	Stantec 2008a	Marengo II, WA	URS Corporation 2010b
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	NPPD Ainsworth, NE	Derby et al. 2007	Oklahoma Wind Energy Center, OK	Piorkowski 2006
Ripley, Ont.	Jacques Whitford 2009	High Winds, CA (04)	Kerlinger et al. 2006		
Wolfe Island, Ont. (Report 1: May - June 09)	Stantec Ltd. 2010	Wild Horse, WA	Erickson et al. 2008		

Raptor fatality rates at other sites with publically-available data across North America exhibit a relatively small range of mortality, from zero birds/MW/study period at several wind energy facilities to 0.87 birds/MW/study period at the Diablo Winds Facility in California (WEST 2008; Figure 7.1-2). The estimated raptor fatality rate of 0.05 bird fatalities/MW/study period at the PWND1 ranked twenty-sixth out of 41 when compared to these other wind energy facilities across North America (Figure 7.1-2).

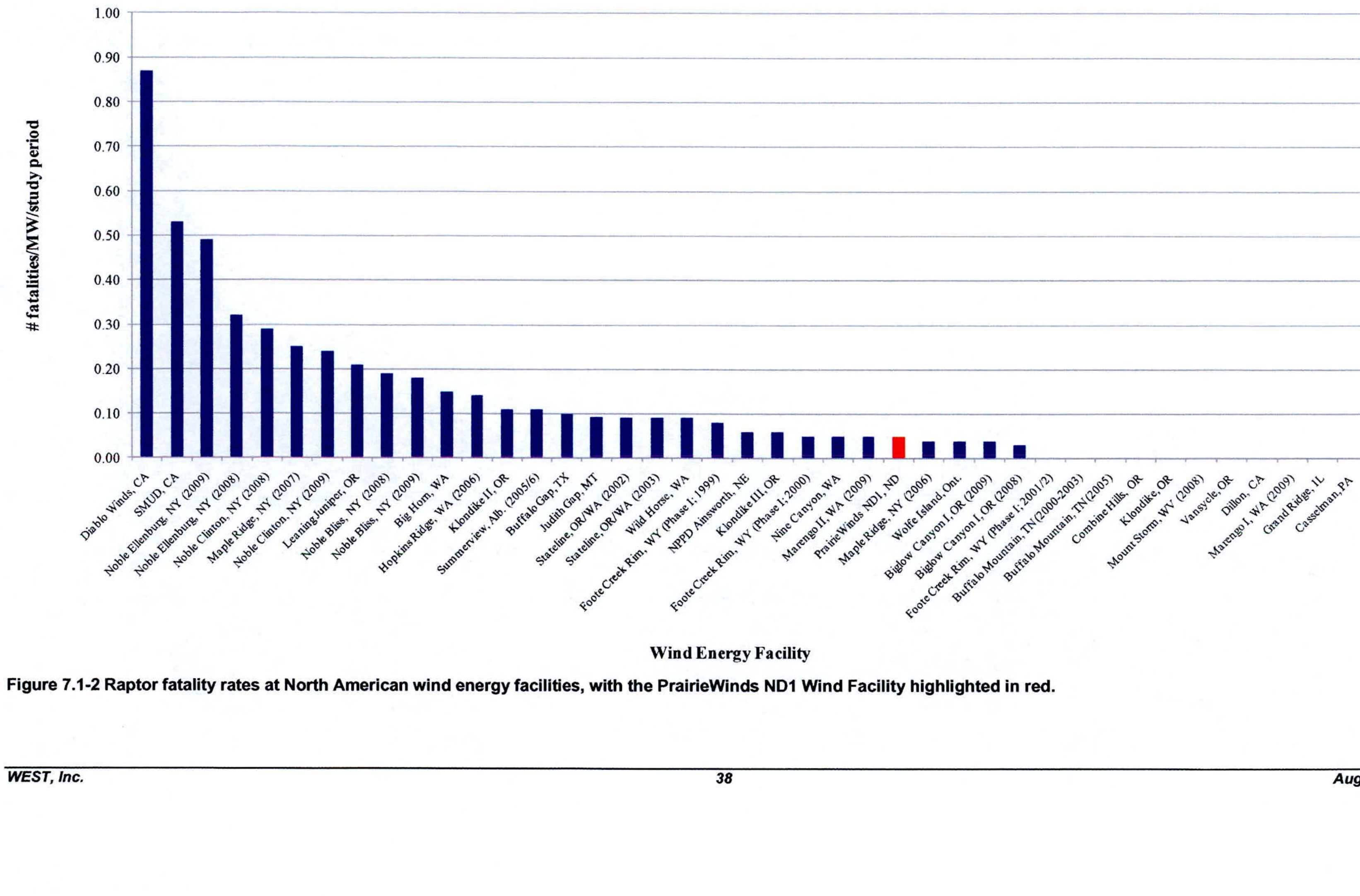

Figure 7.1-2 Raptor fatality rates at North American wind energy facilities, with the PrairieWinds ND1 Wind Facility highlighted in red.

Figure 7.1-2 (*continued*). Raptor rates at North American wind energy facilities.

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND	This study				
Diablo Winds, CA	WEST 2008	Buffalo Gap, TX	Tierney 2007	Biglow Canyon, WA (Phase I; 08)	Jeffrey et al. 2009a
SMUD Solano, CA	Erickson and Sharp 2005	Judith Gap, MT	TRC 2008	Foote Creek Rim, WY (Phase I; 01/02)	Young et al. 2003
Noble Ellenburg, NY (09)	Jain et al. 2010c	Stateline, OR/WA (02)	Erickson et al. 2004	Buffalo Mountain, TN (00-03)	Nicholson 2003, Nicholson et al. 2005
Noble Ellenburg, NY (08)	Jain et al. 2009b	Stateline, OR/WA (03)	Erickson et al. 2004	Buffalo Mountain, TN (05)	Fiedler et al. 2007
Noble Clinton, NY (08)	Jain et al. 2009c	Wild Horse, WA	Erickson et al. 2008	Combine Hills, OR	Young et al. 2006
Maple Ridge, NY (07)	Jain et al. 2009a	Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003	Klondike, OR	Johnson et al. 2003
Noble Clinton, NY (09)	Jain et al. 2010b	NPPD Ainsworth, NE	Derby et al. 2007	Mount Storm, WV (08)	Young et al. 2009a
Leaning Juniper, OR	Gritski et al. 2008	Klondike III, OR	Gritski et al. 2009	Vansycle, OR	Erickson et al. 2000
Noble Bliss, NY (08)	Jain et al. 2009e	Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003	Dillon, CA	Chatfield et al. 2009
Noble Bliss, NY (09)	Jain et al. 2010a	Nine Canyon, WA	Erickson et al. 2003	Marengo I, WA	URS Corporation 2010a
Big Horn, WA	Kronner et al. 2008	Marengo II, WA	URS Corporation 2010b	Grand Ridge, IL	Derby et al. 2010h
Hopkins Ridge, WA (06)	Young et al. 2007	Maple Ridge, NY (06)	Jain et al. 2007	Casselman, PA (Spring & Fall 08)	Arnett et al. 2009b
Klondike II, OR	NWC and WEST 2007	Wolfe Island, Ont. (Report 1: May - June 09)	Stantec Ltd. 2010		
Summerview, Alb. (06)	Brown and Hamilton 2006	Biglow Canyon, WA (Phase I; 09)	Enk et al. 2010		

7.2 Bat Fatalities

During this study, a total of 30 bat fatalities were found during the summer, with the majority of those found during late summer, and 15 bat fatalities located during the fall. No fatalities were located during the spring season. This is consistent with other fatality studies in the US which have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005, Arnett et al. 2008).

Bat fatality estimates from 71 other wind energy studies across North America ranged from 0.07 to 39.70 bat fatalities/MW/study period (Erickson and Sharp 2005, Kerlinger et al. 2007; Table 7.2-1). The estimated bat fatality rate of 2.13 bat fatalities/MW/study period at the PWND1 ranked low, forty-first, when compared to these wind energy facilities (Figure 7.2-1).

Generally, the highest fatality estimates for bats have come from the eastern US, particularly from the Appalachian region, where fatality estimates have ranged as high as 39.7 bat fatalities per MW (Fiedler et al. 2007), and from the Midwest and parts of the Northeast (Table 7.2-1). In the Midwest, fatality estimates for bats from wind energy facilities studied between 1998 and 2009 range between 0.16 and 30.61 bat fatalities per MW (Derby et al. 2010c, BHE Environmental 2010; Table 7.2-1). Overall bat mortalities at PWND1 were within the range found at other sites in the Midwest and lower than many recent studies from the region.

The majority of bat fatalities identified at the PWND1 were composed of a migratory tree bat (hoary bat); which is similar to species composition at most other wind energy facilities in the Midwest (Jain 2005, Gruver et al. 2009). Based on the timing of fatalities for hoary bat and the lack of forest cover that might provide habitat for resident bats, most of the fatalities were likely migratory bats, which is typically the case at other wind energy facilities in North America (Johnson 2005, Arnett et al. 2008).

Table 7.2-1 Wind energy facilities in North America with activity and mortality data for bat species.

Wind Energy Facility	Bat Activity Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1, ND		**2.13**	**80**	**120**
	Midwest			
Cedar Ridge, WI		30.61[F]	41	68
Blue Sky Green Field, WI	7.7[D]	24.57	88	145
Top of Iowa, IA (2004)	34.9[C]	10.27	89	80
Fowler Ridge I, IN (2009)		8.09	162	301
Crystal Lake, IA		7.42[E]	80	200
Top of Iowa, IA (2003)	34.9[C]	7.16	89	80
Kewaunee County, WI		6.45	31	20
Ripley, Ont.		4.67	38	76
Winnebago, IA		4.54	10	20
Buffalo Ridge, MN (Phase II; 2001)		4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001)		3.71	138	103.5
Crescent Ridge, IL		3.27	33	49.5
Buffalo Ridge, MN (Phase III; 1999)		2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)		2.59	143	107.25
Moraine II, MN		2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)		2.16	143	107.25
Grand Ridge, IL		2.10	66	99
Fowler Ridge III, IN (2009)		1.84[G]	60	99
Buffalo Ridge, MN (Phase III; 2002)		1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002)		1.64	143	107.25
Elm Creek, MN		1.49	67	100
Wessington Springs, SD	0.18	1.48	34	51
NPPD Ainsworth, NE		1.16	36	59.4
Buffalo Ridge, MN (Phase I; 1999)		0.39	73	25
Buffalo Ridge I, SD		0.16	24	50.4
Timber Road II, OH	2.78			
	Pacific Northwest			
Nine Canyon, WA		2.47	37	48
Stateline, OR/WA (2003)		2.29	454	300
Biglow Canyon, OR (Phase I; 2008)		1.99	76	125.4
Leaning Juniper, OR		1.98	67	100.5
Big Horn, WA		1.90	133	199.5
Combine Hills, OR		1.88	41	41
Hopkins Ridge, WA (2008)		1.39	83	150
Elkhorn, OR (2008)		1.26	61	101
Vansycle, OR		1.12	38	24.9
Klondike III, OR		1.11	122	375
Stateline, OR/WA (2002)		1.09	454	263
Stateline, WA/OR (2006)		0.95	454	263
Klondike, OR		0.77	16	24
Hopkins Ridge, WA (2006)		0.63	83	150
Biglow Canyon, OR (Phase I; 2009)		0.58	76	125.4
Klondike II, OR		0.40	50	75
Wild Horse, WA		0.39	127	229
Marengo II, WA		0.27	39	70.2
Marengo I, WA		0.17	78	140.4

Table 7.2-1 Wind energy facilities in North America with activity and mortality data for bat species.

Wind Energy Facility	Bat Activity Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
	California			
High Winds, CA (2004)		2.51	90	162
Dillon, CA		2.17	45	45
High Winds, CA (2005)		1.52	90	162
SMUD Solano, CA		0.07		15
Alta-Oak Creek Mojave, CA	2.5			
	Rocky Mountains			
Summerview, Alb. (2008)	5.3	14.62	39	70.2
Summerview, Alb. (2006)		10.27	39	70.2
Judith Gap, MT		8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)		3.97	69	41.4
Foote Creek Rim, WY (Phase I; 2001/2002)		1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2	1.05	69	41.4
	Southern Plains			
Oklahoma Wind Energy Center, OK		0.53	68	102
Buffalo Gap, TX		0.10	67	134
	Southeast			
Buffalo Mountain, TN (2005)		39.70	18	29
Buffalo Mountain, TN (2000-2003)	23.7	31.54	3	2
	Northeast			
Mountaineer, WV	38.3	31.69	44	66
Mount Storm, WV (2009)		24.32	82	164
Meyersdale, PA		18.00	20	30
Cohocton/Dutch Hill, NY		16.02	50	125
Maple Ridge, NY (2006)		15.00	120	198
Noble Bliss, NY (2008)		14.66	67	100
Casselman, PA (Spring & Fall 2008)		12.61	23	34.5
Mount Storm, WV (2008)	35.2	12.11	82	164
Casselman, PA (Fall 2008)		9.91	23	34.5
Maple Ridge, NY (2007)		9.42	195	321.75
Noble Clinton, NY (2009)		6.48	67	100
Wolfe Island, Ont. (Report 1: May-June 2009)		6.42	86	197.8
Noble Bliss, NY (2009)		5.50	67	100
Noble Ellenburg, NY (2008)		5.45	54	80
Noble Ellenburg, NY (2009)		5.34	54	80
Maple Ridge, NY (2008)		4.96	195	321.75
Noble Clinton, NY (2008)		3.63	67	100.5
Mars Hill, ME (2007)		2.91	28	42
Munnsville, NY (2008)		1.93	23	34.5
Stetson Mountain, ME	0.30	1.40	38	57
Mars Hill, ME (2008)		0.45	28	42

A=bat passes per detector-night
B=number of bats fatalities/MW/study period
C=averaged across phases and/or study years, and may not be directly related to fatality estimates
D=bat activity not measured concurrently with bat fatality studies
E=estimate includes incidentals
F=number of bat fatalities/MW spring and fall survey period only
G= number of bat fatalities/MW/spring season only

Table 7.2-1 (*continued*) Wind energy facilities in North America with mortality data for bat species.
Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Cedar Ridge, WI		BHE Environmental 2010	Klondike II, OR		NWC and WEST 2007
Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2009	Wild Horse, WA		Erickson et al. 2008
Top of Iowa, IA (2004)	Jain 2005	Jain 2005	Marengo II, WA		URS Corporation 2010b
Fowler Ridge I, IN		Johnson et al. 2010a	Marengo I, WA		URS Corporation 2010a
Crystal Lake II, IA		Derby et al. 2010a	High Winds, CA (04)		Kerlinger et al. 2006
Top of Iowa, IA (2003)	Jain 2005	Jain 2005	Dillon, CA		Chatfield et al. 2009
Kewaunee County, WI		Howe et al. 2002	High Winds, CA (05)		Kerlinger et al. 2006
Ripley, Ont.		Jacques Whitford 2009	SMUD Solano, CA		Erickson and Sharp 2005
Winnebago, IA		Derby et al. 2010b	Alta-Oak Creek Mojave, CA	Erickson et al. 2010	
Buffalo Ridge, MN (Phase II; 01)		Johnson et al. 2004	Summerview, Alb. (08)	Baerwald 2008	Baerwald 2008
Buffalo Ridge, MN (Phase III; 01)		Johnson et al. 2004	Summerview, Alb. (06)		Brown and Hamilton 2006
Crescent Ridge, IL		Kerlinger et al. 2007	Judith Gap, MT		TRC 2008
Buffalo Ridge, MN (Phase III; 99)		Johnson et al. 2004	Foote Creek Rim, WY (Phase I; 99)		Young et al. 2003
Buffalo Ridge, MN (Phase II; 99)		Johnson et al. 2004	Foote Creek Rim, WY (Phase I; 01/02)		Young et al. 2003
Moraine II, MN		Derby et al. 2010e	Foote Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003
Buffalo Ridge, MN (Phase II; 98)		Johnson et al. 2004	Oklahoma Wind Energy Center, OK		Piorkowski 2006
Grand Ridge, IL		Derby et al. 2010h	Buffalo Gap, TX		Tierney 2007
Fowler Ridge III, IN		Johnson et al. 2010b	Buffalo Mountain, TN (05)		Fiedler et al. 2007
Buffalo Ridge, MN (Phase III; 02)		Johnson et al. 2004	Buffalo Mountain, TN (00-03)	Fiedler 2004	Nicholson et al. 2005
Buffalo Ridge, MN (Phase II; 02)		Johnson et al. 2004	Mountaineer, WV	Arnett (pers comm. 2005)	Kerns and Kerlinger 2004
Elm Creek, MN		Derby et al. 2010e	Mount Storm, WV (09)		Young et al. 2010
Wessington Springs, SD	Derby et al. 2008	Derby et al. 2010g	Meyersdale, PA		Arnett et al. 2005
NPPD Ainsworth, NE		Derby et al. 2007	Cohocton/Dutch Hill, NY		Stantec 2010
Buffalo Ridge, MN (Phase I; 99)		Johnson et al. 2000	Maple Ridge, NY (06)		Jain et al. 2007
Buffalo Ridge, SD		Derby et al. 2010c	Noble Bliss, NY (08)		Jain et al. 2009e
Timber Road II, OH	Good et al. 2009		Casselman, PA (Spring & Fall 08)		Arnett et al. 2009b
Nine Canyon, WA		Erickson et al. 2003	Mount Storm, WV (08)	Young et al. 2009a	Young et al. 2009a
Stateline, OR/WA (03)		Erickson et al. 2004	Casselman, PA (Fall 08)		Arnett et al. 2009a
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009a	Maple Ridge, NY (07)		Jain et al. 2008
Leaning Juniper, OR		Gritski et al. 2008	Noble Clinton, NY (09)		Jain et al. 2010b
Big Horn, WA		Kronner et al. 2008	Wolfe Island, Ont. (Report 1; May-June 09)		Stantec, Ltd. 2010
Combine Hills, OR		Young et al. 2006	Noble Bliss, NY (09)		Jain et al. 2010a
Hopkins Ridge, WA (08)		Young et al. 2009b	Noble Ellenburg, NY (08)		Jain et al. 2009b
Elkhorn, OR (08)		Jeffrey et al. 2009b	Noble Ellenburg, NY (09)		Jain et al. 2010c
Vansycle, OR		Erickson et al. 2000	Maple Ridge, NY (08)		Jain et al. 2009d
Klondike III, OR		Gritski et al. 2009	Noble Clinton, NY (08)		Jain et al. 2009c
Stateline, OR/WA (02)		Erickson et al. 2004	Mars Hill, ME (07)		Stantec 2008a
Stateline, OR/WA (06)		Erickson et al. 2007	Munnsville, NY		Stantec 2008b
Klondike, OR		Johnson et al. 2003	Stetson Mountain, ME	Stantec 2009b	Stantec 2009b
Hopkins Ridge, WA (06)		Young et al. 2007	Mars Hill, ME (08)		Stantec 2009a
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010			

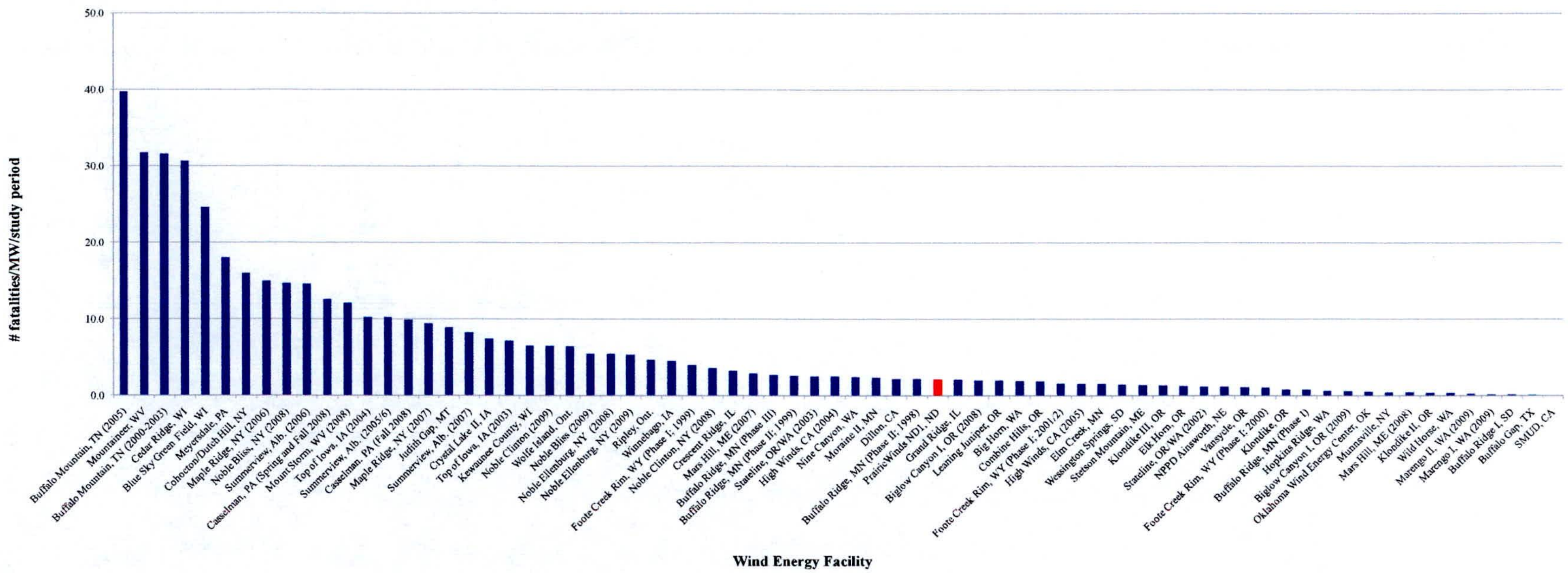

Figure 7.2-1 All bat fatality rates at North American wind energy facilities, with the PrairieWinds ND1 Wind Facility highlighted in red.

Figure 7.2-1 All bat fatality rates at North American wind energy facilities (continued).

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND	This study				
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Noble Ellenburg, NY (09)	Jain et al. 2010c		Stantec 2009b
Mountaineer, WV	Kerns and Kerlinger 2004	Ripley, Ont.	Jacques Whitford 2009	Klondike III, OR	Gritski et al. 2009
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Winnebago, IA	Derby et al. 2010b	Elkhorn, OR (08)	Jeffrey et al. 2009b
Cedar Ridge, WI	BHE Environmental 2010	Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003	Stateline, OR/WA (02)	Erickson et al. 2004
Blue Sky Green Field, WI	Gruver et al. 2009	Noble Clinton, NY (08)	Jain et al. 2009c	Vansycle, OR	Erickson et al. 2000
Meyersdale, PA	Arnett et al. 2005	Crescent Ridge, IL	Kerlinger et al. 2007	NPPD Ainsworth, NE	Derby et al. 2007
Cohocton/Dutch Hill, NY	Stantec 2010	Mars Hill, ME (07)	Stantec 2008a	Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003
Maple Ridge, NY (06)	Jain et al. 2007	Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2004	Klondike, OR	Johnson et al. 2003
Noble Bliss, NY (08)	Jain et al. 2009e	Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2004	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000
Summerview, Alb. (08)	Baerwald 2008	Stateline, OR/WA (03)	Erickson et al. 2004	Hopkins Ridge, WA (06)	Young et al. 2007
Casselman, PA (Spring & Fall 08)	Arnett et al. 2009b	High Winds, CA (04)	Kerlinger et al. 2006	Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010
Mount Storm, WV (08)	Young et al. 2009a	Nine Canyon, WA	Erickson et al. 2003	Oklahoma Wind Energy Center, OK	Piorkowski 2006
Top of Iowa, IA (2004)	Jain 2005	Moraine II, MN	Derby et al. 2010e	Munnsville, NY	Stantec 2008b
Summerview, Alb. (06)	Brown and Hamilton 2006	Dillon, CA	Chatfield et al. 2009	Mars Hill, ME (08)	Stantec 2009a
Casselman, PA (Fall 08)	Arnett et al. 2009a	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2004	Klondike II, OR	NWC and WEST 2007
Maple Ridge, NY (07)	Jain et al. 2008	Grand Ridge, IL	Derby et al. 2010h	Wild Horse, WA	Erickson et al. 2008
Judith Gap, MT	TRC 2008	Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Marengo II, WA	URS Corporation 2010b
Crystal Lake II, IA	Derby et al. 2010a	Leaning Juniper, OR	Gritski et al. 2008	Marengo I, WA	URS Corporation 2010a
Top of Iowa, IA (2003)	Jain 2005	Big Horn, WA	Kronner et al. 2008	Buffalo Ridge, SD	Derby et al. 2010c
Kewaunee County, WI	Howe et al. 2002	Combine Hills, OR	Young et al. 2006	Buffalo Gap, TX	Tierney 2007
Noble Clinton, NY (09)	Jain et al. 2010b	Foote Creek Rim, WY (Phase I; 01/02)	Young et al. 2003	SMUD Solano, CA	Erickson and Sharp 2005
Wolfe Island, Ont. (Report 1; May-June 09)	Stantec, Ltd. 2010	High Winds, CA (05)	Kerlinger et al. 2006		
Noble Bliss, NY (09)	Jain et al. 2010a	Elm Creek, MN	Derby et al. 2010e		
Noble Ellenburg, NY (08)	Jain et al. 2009b	Wessington Springs, SD	Derby et al. 2010g		

8.0 CONCLUSIONS

The bird fatality rate at the PWND1 (1.48 birds/MW/study period or 2.22 birds/turbine/study period) was lower than the average but within the range for other facilities in the Midwest, and within the overall range of projects with publically available data from across the nation.

Raptor fatality rates at the PWND1 (0.05 raptors/MW/study period or 0.08 raptors/turbine/study period) was on the lower end of the fatality range of other wind facilities with publically-available data across North America.

The bat fatality rate at the PWND1 (2.13 bats/MW/study period or 3.20 bats/turbine/study period) was found to be similar to or lower than most facilities in the west and Midwest and lower than most facilities in the east.

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10.0 APPENDIX A

Seasonal Bird and Bat Fatality Rate Estimations at the PrairieWinds ND1 Wind Facility from March through December 2010

Bootstrap point estimates (mean) and lower (ll) and upper (ul) limits of 90 percent confidence intervals (CI) for seasonal small and large bird fatality rate estimates at the PrairieWinds ND1 Wind Facility from March 17 through October 30, 2011.

	Spring (3/17-5/22)			Early Summer (5/26-6/24)			Late Summer (6/28-8/13)			Early Fall (8/16-9/17)			Late Fall (9/20-10/30)		
Parameter	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**
Search Area Adjustment															
A (small birds)	1.05			1.05			1.26			1.26			1.05		
A (large birds)	1.03			1.03			1.95			1.95			1.03		
Observer Detection															
p (small birds)	0.64	0.08	0.54-0.74	0.64	0.08	0.54-0.74	0.64	0.08	0.54-0.74	0.64	0.08	0.54-0.74	0.64	0.08	0.54-0.74
p (large birds)	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75
Observed Fatality Rates (Fatalities/turbine/study period)															
small birds	0.14	0.08	0.04-0.25	0.03	0.03	0-0.09	0.06	0.04	0.01-0.11	0.06	0.04	0-0.10	0.06	0.04	0.03-0.11
large birds	0.34	0.11	0.09-0.40	0.26	0.06	0.20-0.36	0.14	0.07	0.03-0.22	0	-	-	0.14	0.06	0.08-0.23
Average Probability of Carcass Availability and Detected															
small birds	0.50	0.06	0.39-0.60	0.51	0.07	0.41-0.62	0.49	0.07	0.37-0.59	0.51	0.06	0.40-0.61	0.50	0.07	0.39-0.61
large birds	0.71	0.08	0.57-0.82	0.73	0.07	0.58-0.83	0.71	0.08	0.56-0.81	0.72	0.08	0.57-0.82	0.71	0.08	0.56-0.82
Adjusted Fatality Estimates (Fatalities/turbine/study period)															
small birds	0.30	0.16	0.06-0.58	0.06	0.06	0-0.18	0.15	0.10	0-0.33	0.14	0.11	0-0.35	0.12	0.11	0-0.34
large birds	0.49	0.21	0.19-0.86	0.36	0.13	0.17-0.60	0.39	0.18	0.14-0.71	0	-	-	0.21	0.21	0.08-0.75
all birds	0.79	0.26	0.39-1.25	0.42	0.15	0.22-0.71	0.54	0.21	0.24-0.90	0.14	0.11	0-0.35	0.32	0.23	0.20-0.90

Adjusted Fatality Estimates (Fatalities/turbine/study period)

	Summer Combined (5/26-8/13)			Fall Combined (8/16-10/30)		
	Mean	**SE**	**CI**	**Mean**	**SE**	**CI**
small birds (season totals)	**0.20**	**0.12**	**0.05-0.43**	**0.26**	**0.16**	**0.07-0.57**
large birds (season totals)	**0.76**	**0.23**	**0.40-1.19**	**0.21**	**0.21**	**0.08-0.75**
all birds (season totals)	**0.96**	**0.26**	**0.58-1.42**	**0.47**	**0.25**	**0.32-1.13**

Adjusted Fatality Estimates (Fatalities/turbine/study period)

	Mean	SE	CI
All Birds (overall study period)	**2.22**	**0.49**	**1.74-3.33**

Bootstrap point estimates (mean) and lower (ll) and upper (ul) limits of 90 percent confidence intervals (CI) for seasonal raptors and waterfowl fatality rate estimates at the PrairieWinds ND1 Wind Facility from March 17 through October 30, 2011.

	Spring (3/17-5/22)			Early Summer (5/26-6/24)			Late Summer (6/28-8/13)			Early Fall (8/16-9/17)			Late Fall (9/20-10/30)		
Parameter	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**
Search Area Adjustment															
A (raptors and waterfowl)	1.03			1.03			1.95			1.95			1.03		
Observer Detection															
p (raptors/waterfowl)	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75	0.60	0.13	0.42-0.75
Observed Fatality Rates (Fatalities/turbine/study period)															
raptors	0.06	0.04	0-0.14	0.00	-	-	0.00	-	-	0.00	-	-	0.00	-	-
waterfowl	0.20	0.10	0.06-0.34	0.14	0.06	0.06-0.26	0.03	0.03	0-0.09	0.00	-	-	0.00	-	-
Average Probability of Carcass Availability and Detected															
raptors	0.71	0.08	0.57-0.82	0.73	0.07	0.58-0.83	0.71	0.08	0.56-0.81	0.72	0.08	0.57-0.82	0.71	0.08	0.56-0.82
waterfowl	0.71	0.08	0.57-0.82	0.73	0.07	0.58-0.83	0.71	0.08	0.56-0.81	0.72	0.08	0.57-0.82	0.71	0.08	0.56-0.82
Adjusted Fatality Estimates (Fatalities/turbine/study period)															
raptors	0.08	0.06	0-0.20	0.00	-	-	0.00	-	-	0.00	-	-	0.00	-	-
waterfowl	0.29	0.15	0.08-0.56	0.20	0.09	0.07-0.37	0.08	0.08	0-0.24	0.00	-	-	0.00	-	-

Adjusted Fatality Estimates (Fatalities/turbine/study period)

	Summer Combined (5/26-8/13)			Fall Combined (8/16-10/30)		
	Mean	**SE**	**CI**	**Mean**	**SE**	**CI**
Raptors (season totals)	**0.00**	**-**	**-**	**0.00**	**-**	**-**
Waterfowl (season totals)	**0.28**	**0.13**	**0.11-0.52**	**0.00**	**-**	**-**

Adjusted Fatality Estimates (Fatalities/turbine/study period)

	Mean	**SE**	**CI**
Raptors (overall study period)	**0.08**	**0.06**	**0-0.20**
Waterfowl (overall study period)	**0.57**	**0.20**	**0.29-1.00**

Bootstrap point estimates (mean) and lower (ll) and upper (ul) limits of 90 percent confidence intervals (CI) for seasonal bat fatality rate estimations at the PrairieWinds ND1 Wind Facility from March 17, 2011 through October 30, 2011.

	Spring (3/17-5/22)			Early Summer (5/26-6/24)			Late Summer (6/28-8/13)			Early Fall (8/16-9/17)			Late Fall (9/20-10/30)		
Parameter	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**	**Mean**	**SE**	**CI**
Search Area Adjustment															
A (bats)	1.02			1.02			1.32			1.32			1.02		
Observer Detection															
p (bats)	0.64	0.09	0.50-0.79	0.64	0.09	0.50-0.79	0.64	0.09	0.50-0.79	0.64	0.09	0.50-0.79	0.64	0.09	0.50-0.79
Observed Fatality Rates (Fatalities/turbine/study period)															
bats	0	-	-	0.06	0.04	0-0.14	0.74	0.20	0.43-1.09	0.40	0.10	0.23-0.57	0.03	0.03	0-0.09
Average Probability of Carcass Availability and Detected															
Bats	0.50	0.06	0.38-0.61	0.51	0.07	0.40-0.62	0.49	0.07	0.38-0.60	0.51	0.07	0.39-0.62	0.50	0.07	0.38-0.61
Adjusted Fatality Estimates (Fatalities/turbine/study period)															
bats	0	-	-	0.11	0.08	0-0.28	1.99	0.60	1.16-3.14	1.03	0.32	0.59-1.62	0.06	0.07	0-0.20

Adjusted Fatality Estimates (Fatalities/turbine/study period)

				Summer Combined (5/26-8/13)			Fall Combined (8/16-10/30)		
				Mean	**SE**	**CI**	**Mean**	**SE**	**CI**
Bats (season totals)	0	-	-	**2.10**	**0.61**	**1.30-3.26**	**1.09**	**0.34**	**0.62-1.73**

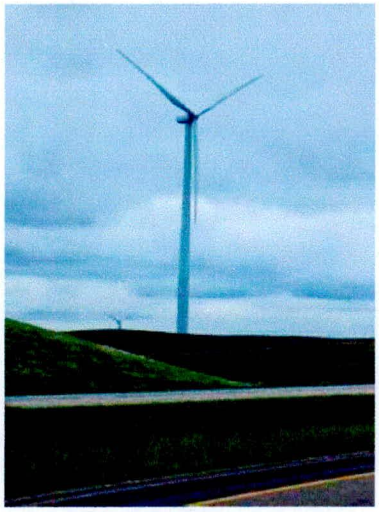
Adjusted Fatality Estimates (Fatalities/turbine/study period)

	Mean	SE	CI
Bats (overall study period)	**3.19**	**0.75**	**2.15-4.53**

Post-Construction Surveys

for the PrairieWinds ND1 (2011) Wind Facility Basin Electric Power Cooperative

March – October 2011



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August 31, 2012

NATURAL RESOURCES ♦ SCIENTIFIC SOLUTIONS

1.0 EXECUTIVE SUMMARY

The PrairieWinds ND1 Wind Facility (PWND1), located in Ward County, North Dakota, began commercial operation in winter 2009. This facility consists of 77 wind turbines, each capable of generating 1.5 megawatts (MW) of electricity for an overall capacity of 115.5 MW of electricity. The turbine towers are 262 feet (ft; 80 meters [m]) high with a 253-ft (77-m) blade diameter, resulting in rotor swept heights of 138 to 387 ft (42 to 118 m) above ground level (AGL). Power from this project flows to Basin Electric's customers through an interconnection with the Western Area Power Administration's transmission system. The Minot Wind Project, which consists of two 1.3-MW turbines, built in 2002, and three 1.5-MW turbines, built in 2009, is located approximately 1.5 miles (2.4 kilometers [km]) north of PrairieWinds ND1 and interconnects with Central Power Cooperative's Radar Substation. This monitoring effort included sampling at both facilities and therefore applies to the 77 turbines constructed as part of PrairieWindsND1 and the three turbines constructed at the Minot Wind Project in 2009. For the purpose of this report, both projects are included in the reference PWND1.

Monitoring studies designed to estimate the number of bird and bat fatalities attributable to wind turbine operation were conducted in 2010 and 2011. Removal and searcher efficiency trials were also conducted to estimate potential sources of bias. Fatality estimates were generated in 2011 for small birds, large birds, and bats using methods consistent with the approach outlined by Shoenfeld (2004) and Erickson et al. (2005).

The overall bird fatality for 2011 was estimated at 2.34 fatalities/turbine/study period (1.56 fatalities/MW/study period), which falls within the range of other fatality estimates from studies at facilities within the Midwest and other regions of the United States and Canada.

The estimated raptor fatality rate at the PWND1 was low at 0.08 raptors/turbine/study period (0.05 raptors/MW/study period). This estimate falls within the relatively narrow fatality range of raptors at other studies at wind facilities across North America.

The majority of bat fatalities occurred in August, which is consistent with other studies in North America. Overall, the 2011 fatality rate for bats was estimated at 2.09 fatalities/turbine/study period (1.39 fatalities/MW/study period), which is within the range reported for fatality rates at other facilities in the Midwest. Hoary bats composed the majority of bat fatalities at the PWND1, which is similar to other wind energy facilities in the Midwest. Based on the timing of fatalities and habitat requirements for this bat species, most of the fatalities are likely migrating bats.

STUDY PARTICIPANTS

Western EcoSystems Technology

Clayton Derby	Project Manager
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REPORT REFERENCE

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2.0 INTRODUCTION

The PrairieWinds ND1 (2011) Wind Facility (PWND1), located in Ward County, North Dakota, began commercial operation in winter 2009. This facility consists of 77 wind turbines, each capable of generating 1.5 megawatts (MW) of electricity for an overall capacity of 115.5 MW of electricity. The turbine towers are 262 feet (ft; 80 meters [m]) high with a 253-ft (77-m) blade diameter, resulting in rotor swept heights of 138 to 387 ft (42 to 118 m) above ground level (AGL). Power from this project flows to Basin Electric's customers through an interconnection with the Western Area Power Administration's transmission system. The Minot Wind Project, which consists of two 1.3-MW turbines, built in 2002, and three 1.5-MW turbines, built in 2009, is located approximately 1.5 miles (2.4 kilometers [km]) north of PrairieWinds ND1 and interconnects with Central Power Cooperative's Radar Substation. This monitoring effort included sampling at both facilities and therefore applies to the 77 turbines constructed as part of PrairieWindsND1 and the three turbines constructed at the Minot Wind Project in 2009. For the purpose of this report, both projects are included in the reference PWND1.

Basin contracted Western EcoSystems Technology, Inc. (WEST) to develop a post-construction fatality monitoring study at the PWND1 to estimate the level (high, moderate, or low relative to other wind energy facilities) for bird and bat mortality attributable to collisions with wind turbines during spring, summer, and fall in 2010 and 2011. The protocol for this monitoring study is described in more detail in the Fatality Monitoring Scope (Derby 2010).

Fatality monitoring for Year 2 started in spring 2011 and continued through fall 2011. Fatality monitoring included standardized carcass surveys, searcher efficiency trials, and carcass removal trials.

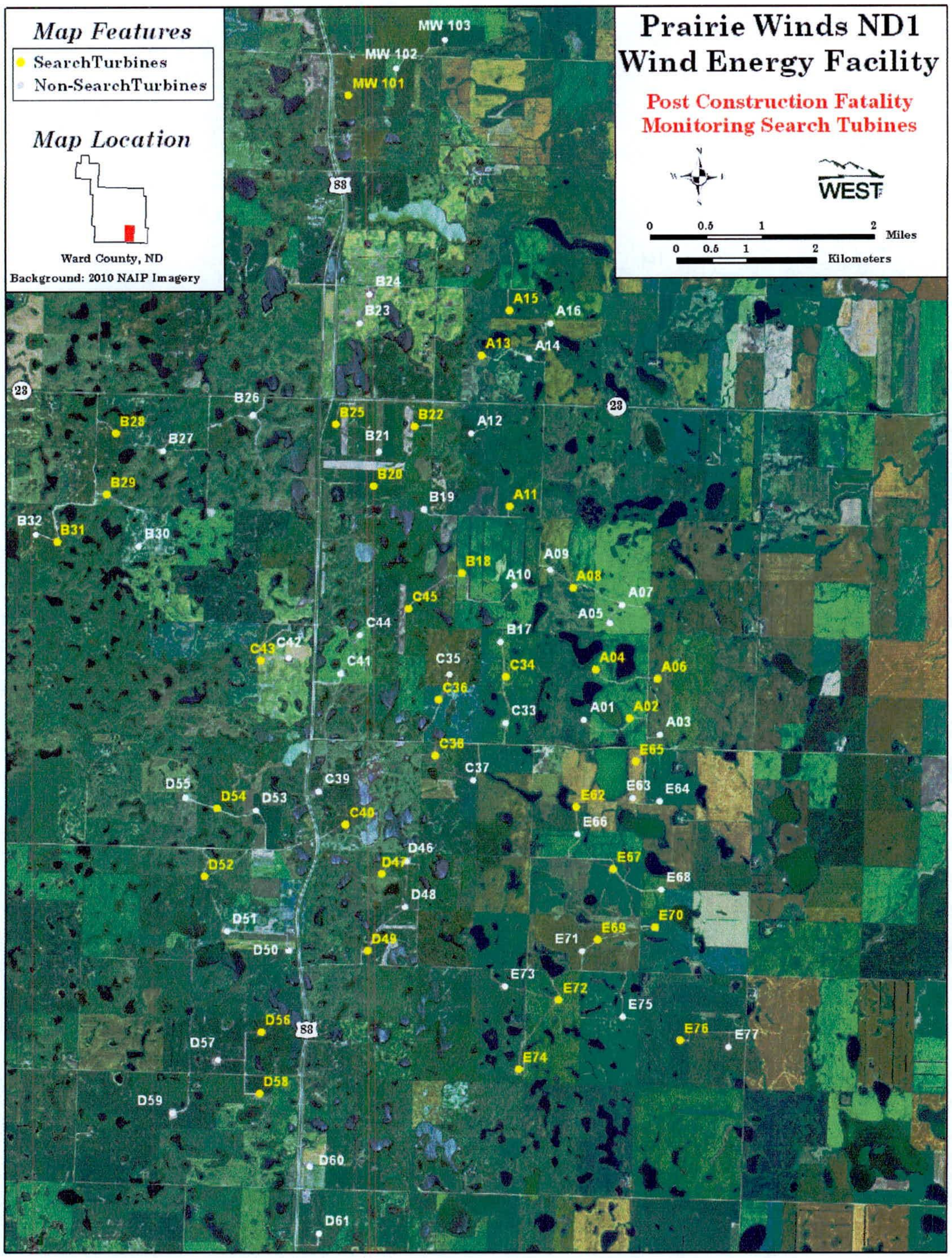

Figure 2.0-1. Location of the PrairieWinds ND1 (2011) Wind Energy Facility and turbines.

3.0 STUDY AREA

The PWND1 falls within the Northwestern Glaciated Plains Ecoregion, which covers the northern tip of Montana, northwestern corner and central regions of North Dakota, and the central regions of South Dakota (Bryce et al. 1996, USEPA 2007). The Northwestern Glaciated Plains Ecoregion is a transitional region between the intensive dryland farming to the east and the predominance of cattle ranching and farming to the west. Pocking this ecoregion is a moderately high concentration of semi-permanent and seasonal wetlands. Typical vegetation includes western wheatgrass (*Pascopyrum smithii*), bluestem (*Andropogon gerardii*), needle and thread (*Hesperostipa comata*), green needle (*Nassella viridula*), and needle grass (*Achnatherum* spp.). Topography in the region is rolling, with elevations in the PWND1 ranging from 1,900-2,300 ft (579-701 m).

4.0 METHODS

Fatality monitoring at the PWND1 facility consisted of the following components:

(1) standardized carcass surveys of selected turbines,

(2) searcher efficiency trials to estimate the percentage of carcasses found by searchers, and

(3) carcass removal trials to estimate the length of time that a carcass remained in the field for possible detection.

Surveys were conducted from March through October 2011, a period corresponding to the likely spring and fall migration periods and summer breeding period for most birds and bats. All casualties located within areas surveyed, regardless of species, were recorded and a cause of death was determined if possible. The total number of bird and bat casualties (including dead and injured birds and bats) were estimated by adjusting for search frequency, removal bias (length of stay in the field), searcher efficiency bias (percent found), and area searched. For carcasses where the cause of death was not apparent, the assumption that the fatality was caused by a wind turbine collision was made for the analysis. This approach likely led to an overestimate of the true number of facility-related fatalities, but most wind energy facilities have used this conservative approach because of the relatively high costs associated with obtaining accurate estimates of natural or reference mortality (see Johnson et al. 2000a).

4.1 Sample Size, Search Area, and Search Frequency

Similar to 2010 surveys, 35 of the 80 turbines were selected for survey at the PWND1 site (Figure 2.0-1). Of these turbines, 26 turbines were located in tilled agricultural crops and nine turbines were in grassland. Square search plots were centered on each turbine, with the minimum distance searched in any direction equal to 100 m (328 ft). Transects were walked 10 m (33 ft) apart within each plot to sample the area under the structure (Figure 4.1-1). All 35 turbines were searched once every 14 days during spring migration (March 15-May15), summer breeding season (May 16 – August 15), and fall migration (August 16 – November 1). Once agricultural crops became too high to search effectively, only turbine pads and access roads, and other portions of the plots with low vegetation out to 100 m from the turbine were searched (Figure 4.1-2). This change in search area was accounted for in the analyses.

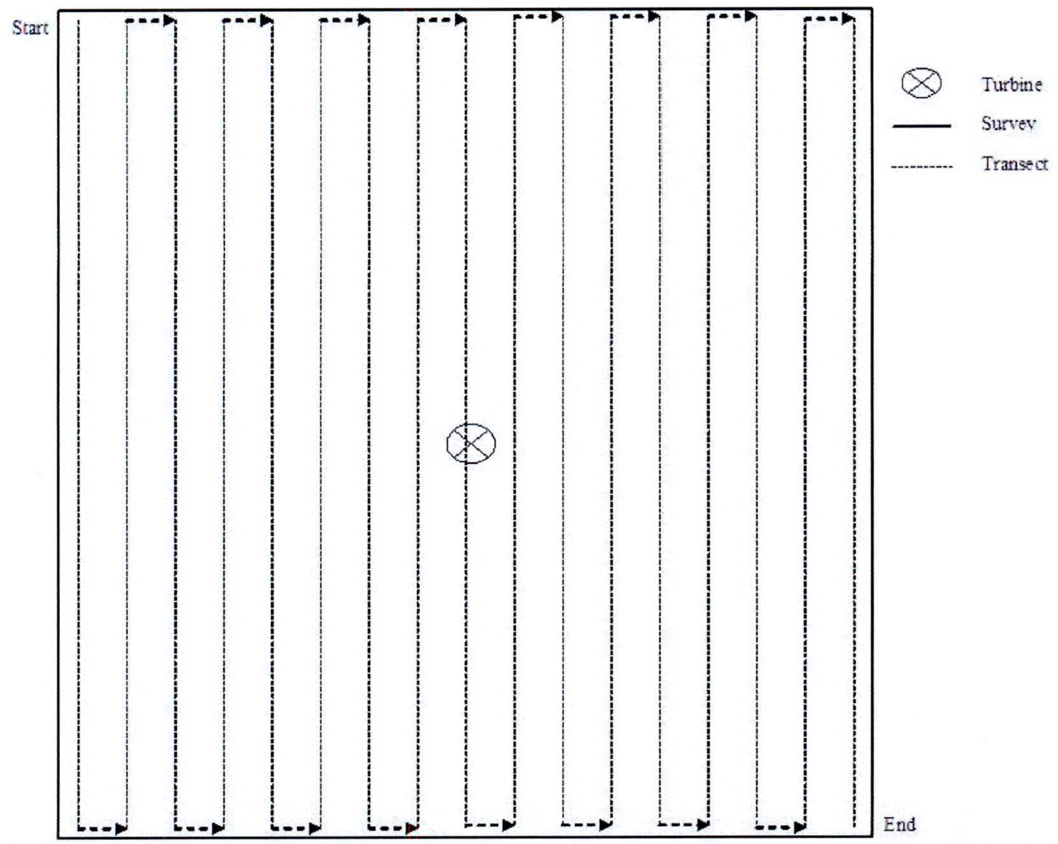

Figure 4.1-1. Example schematic of survey pattern (not to scale) for carcass search plots. Transects were placed 10 meters apart. Turbine pad and access road (not shown) were also included in the area searched.

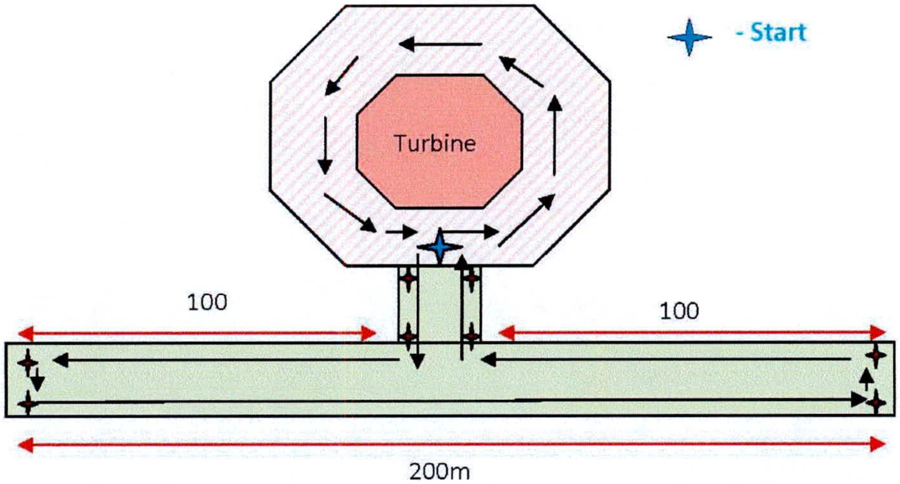

Figure 4.1-2. Example schematic of search area along road and turbine pad (not to scale) for carcass search plots when crops were too tall to effectively search entire plot. Area searched varied, but was measured at each turbine searched.

4.2 Standardized Carcass Searches

Carcass searching began on March 15, 2011. Thirty-five turbines were systematically searched for bird and bat casualties that were attributable to collision with the turbines. Personnel trained in proper search techniques conducted the carcass searches. Searchers walked at a casual walking rate of approximately 45-60 m per minute (about 148-197 ft per minute) along each 10-m transect, scanning both the turbine pad, road, and transects for casualties (Figure 4.1-1). The order that searches were performed was randomized so that each turbine was searched at various periods during the day.

The condition of each bird and bat carcass found was recorded using the following categories:

- Intact - a carcass that was completely intact, was not badly decomposed, and showed no sign of being fed upon by a predator or scavenger; or

- Scavenged/Dismembered - an entire carcass, which showed signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that was heavily infested by insects.

For bird carcasses, the following category was also used in addition to the two categories listed above:

- Feather Spot - 10 or more feathers found at one location, indicating predation or scavenging.

In addition to carcasses, any injured birds or bats observed in search plots or elsewhere in the study area were recorded and treated as a fatality for analysis purposes. All bat carcasses found were labeled with a unique number, bagged, and frozen for future reference and possible necropsy. A freezer tag documenting facility, date, observer, carcass identification number, time, species, and location (i.e. turbine number) was placed in the bag with the frozen carcass. Bird carcasses were recorded and left where found. For all casualties found, data recorded included species, sex and age when possible, date and time collected, Universal Transverse Mercator (UTM) location, condition (intact, scavenged, feather spot), distance and bearing to turbine, and any comments that may indicate cause of death or injury. All casualties located were photographed as found and plotted on a detailed map of the study area, showing the location of the wind turbines and associated facilities, such as overhead power lines.

Casualties found outside the formal search time but inside of search plots were treated following the above protocol as closely as possible. Bird and bat casualties found in non-search areas (e.g., near a PWND1 turbine not being searched) were coded as incidental discoveries and documented in a similar fashion as those found during standard searches, but these casualties were not included in the estimates of total fatalities.

4.3 Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of casualties that were found by the searchers. These trials were conducted in the same plots in which standardized searches occurred. Trials were conducted in each season of monitoring and for each searcher. Estimates of searcher efficiency were used to correct for detection bias by adjusting the total number of carcasses found for those missed by the searchers.

Searcher efficiency trials were conducted by placing "detection" carcasses in the same plots that were searched for carcasses. Efficiency trials commenced with the start of carcass searches and were conducted periodically throughout spring, summer, and fall. Searchers conducting carcass searches did not know when the trials were being conducted or the locations where the "detection" carcasses were placed in a search plot. A total of 60 searcher-efficiency trial carcasses for the entire study were used, with 31 small carcasses and 29 large carcasses. Small dark birds (e.g. house sparrows [*Passer domesticus*]) were used as a substitute for bat carcasses as bat carcasses were not available. Avian carcasses consisted of non-native/non-protected or commercially available species, such as house sparrows, rock pigeons (*Columba livia*), or game bird species. All "detection" carcasses were placed at random locations within areas being searched prior to the carcass search on the same day. Carcasses were dropped from waist height or higher and allowed to land in a random posture. Each trial carcass was discreetly marked (e.g., tape or thread on the leg of the carcass) so that it could be identified as a "detection" carcass after it was found. The number and location of the "detection" carcasses found during the carcass search was recorded. The number of carcasses available for detection during each trial was determined immediately after the trial by the person responsible for distributing the carcasses.

4.4 Carcass Removal Trials

The objective of carcass removal trials was to estimate the length of time avian and bat carcasses remained in the search area before being removed by scavengers or by other means. Carcass removal included removal by predation or scavenging, or removal by another means, such as being plowed in to a field. Carcass removal studies were conducted during each season concurrently with standardized carcass searching. Estimates of carcass removal were used to adjust carcass counts for removal bias.

Removal trial carcasses were placed at random locations at turbines that were not being searched as part of the carcass search protocol. The placed carcasses were located randomly within the plots (random distance and direction from turbine). Approximately 20 carcasses were placed during each season (three seasons) of the study, for a total of 60 carcasses for the entire study. Similar to searcher efficiency trials, both small carcasses (33 carcasses) and large carcasses (27 carcasses) were used. By spreading trials throughout the study period, the effects of varying weather, climatic conditions, and scavenger densities were taken into account. Bird carcasses used were similar to those used in the searcher efficiency trials. All trial carcasses were discreetly marked similar to other trial carcasses to avoid confusion with turbine fatalities. Major habitats represented around the turbines were included in these trials. Carcasses were dropped from waist height or higher and allowed to land in a random posture.

Personnel conducting carcass searches monitored the trial carcasses over a 30-day period according to the following schedule as closely as possible. Carcasses were checked every day for the first four days, and then on Days 7, 10, 14, 20, and 30. Experimental carcasses not removed by scavengers were left at the location until the end of the carcass removal trial. At the end of the 30-day period, any remaining evidence of the carcass was removed.

4.5 Statistical Methods for Fatality Estimates

Estimates of facility-related fatalities are based on:

(1) Observed number of carcasses found during standardized searches during the monitoring period for which the cause of death was likely facility-related;

(2) Non-removal rates, expressed as the estimated average probability a carcass was expected to remain in the study area and be available for detection by the searchers during removal trials;

(3) Searcher efficiency, expressed as the proportion of placed carcasses found by searchers during searcher efficiency trials; and

(4) Proportion of the area searched around each turbine.

The number of bird and bat fatalities attributable to operation of the PWND1 were recorded. All carcasses located within areas surveyed, regardless of species, were recorded and, if possible, a cause of death was determined based on a cursory field necropsy. Total number of bird and bat carcasses was estimated by adjusting for removal, searcher efficiency bias, and area searched.

4.5.1 Definition of Variables

The following variables are used in the equations below:

- c_i the number of carcasses detected at plot i for the study period of interest (e.g., one monitoring year), for which the cause of death was either unknown or was attributed to the facility
- n the number of search plots
- k the number of turbines searched (including the turbines centered within each search plot)
- $\bar{c}$ the average number of carcasses observed per turbine per monitoring year
- s the number of carcasses used in removal trials

- s_c the number of carcasses in removal trials that remained in the study area after 30 days
- *se* standard error (square of the sample variance of the mean)
- t_i the time (in days) a carcass remained in the study area before it was removed, as determined by the removal trials
- $\bar{t}$ the average time (in days) a carcass remained in the study area before it was removed, as determined by the removal trials
- d the total number of carcasses placed in searcher efficiency trials
- p the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials
- I the average interval between standardized carcass searches, in days
- A proportion of the search area of a turbine actually searched
- $\hat{\pi}$ the estimated probability that a carcass was both available to be found during a search and was found, as determined by the removal trials and the searcher efficiency trials
- m the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency bias

4.5.2 Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A} \qquad (1)$$

4.5.3 Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remained in the study area before it was removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \qquad (2)$$

4.5.4 Estimation of Searcher Efficiency Rates

Searcher efficiency rates are expressed as *p*, the proportion of trial carcasses that were detected by searchers in the searcher efficiency trials. These rates were estimated by carcass size and season.

4.5.5 Estimation of Facility-Related Fatality Rates

The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \tag{3}$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency bias was pooled across the study to estimate $\hat{\pi}$.

$\hat{\pi}$ is calculated as follows:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(\frac{I}{\bar{t}}\right) - 1}{\exp\left(\frac{I}{\bar{t}}\right) - 1 + p} \right].$$

This formula has been independently verified by Shoenfeld (2004). The final reported estimates of *m* and associated standard errors and 90 percent confidence intervals were calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics.

For each bootstrap sample, $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$, and *m* were calculated. A total of 5,000 bootstrap samples were used. The reported estimates are the mathematical means of the 5,000 bootstrap estimates. The standard deviation of the bootstrap estimates is the estimated standard error. The lower fifth and upper ninety-fifth percentiles of the 5,000 bootstrap estimates are estimates of the lower limit and upper limit of 90 percent confidence intervals.

The formula that WEST used for these analyses has been used widely and is relatively unbiased under most conditions. It is sensitive, however, to deviations from the assumption that carcass persistence is low relative to search interval.

5.0 DISPOSITION OF DATA AND REPORTING STANDARDS

This monitoring study provides information on fatalities and total bird and bat mortality associated with development of the PWND1 and the data used to evaluate the overall impacts of the facility on birds and bats. The final disposition of data from the study is with Basin, the facility owner, and includes the data forms and electronic data files. During the study, the raw data forms were housed with the contractor conducting the study, and individual bat carcasses collected during the study were housed in a freezer at the PWND1.

6.0 RESULTS

Surveys were conducted from March through October 2011 at the PWND1. All casualties (including dead and injured birds and bats) located within areas surveyed, regardless of species, were recorded and a cause of death or injury determined, if possible. Results of the standardized carcass searches for birds and bats, searcher efficiency trials, and carcass removal trials, as well as the adjusted fatality estimates for birds and bats, are discussed in the sections below.

6.1 Search Area and Habitat

Total area searched (acres), percent area searched as a function of the maximum search area, and the proportion of detection types within each search plot were calculated for each plot. The proportion of area searched was similar for distances of 20 m (66 ft) to 100 m (330 ft) from the turbine in cropland habitats, but generally decreased with increased distances from turbines (Table 6.1-1a). The percent of area searched varied from less than 1% at 150 m (492 ft) from the turbine to 90% searched at 10 m from the turbine within cropland habitats (Figure 6.1-1a). For grassland turbines, area searched was similar for distances searched from 10 m to 100 m, but generally decreased with increased distances (Table 6.1-1b). The percent area searched ranged from approximately 23% for the zero m to 10 m band around the turbines to less than 1% for the 140 m (459 ft) to 150 m band (Figure 6.1-1b).

Table 6.1-1a. Proportion of the area searched in 10-meter distance bands in croplands at the PrairieWinds ND1 (2011) Wind Project during surveys from March 15 to October 29, 2011.

Distance (Meters)	Total Acres	Acres Searched	Percent Searched
10	2.70	2.44	90.37
20	8.11	6.39	78.79
30	13.53	10.49	77.53
40	18.98	14.61	76.98
50	24.42	18.58	76.09
60	29.85	22.44	75.18
70	35.28	26.21	74.29
80	40.72	30.01	73.70
90	46.16	33.70	73.01
100	51.59	37.31	72.32
110	57.02	25.88	45.39
120	62.45	15.63	25.03
130	67.90	8.97	13.21
140	73.32	3.40	4.64
150	78.76	0.13	0.17

Table 6.1-1b. Proportion of the area searched in 10-meter distance bands in grasslands at the PrairieWinds ND1 (2011) Wind Project during surveys from March 15 to October 29, 2011.

Distance (Meters)	Total Acres	Acres Searched	Percent Searched
10	8.11	1.88	23.18
20	13.53	2.81	20.77
30	18.98	3.70	19.49
40	24.42	5.07	20.76
50	29.85	6.30	21.11
60	35.28	7.44	21.09
70	40.72	8.38	20.58
80	46.16	9.45	20.47
90	51.59	10.48	20.31
100	57.02	11.44	20.06
110	62.45	7.88	12.62
120	67.90	4.65	6.85
130	73.32	2.62	3.57
140	78.76	0.99	1.26
150	2.70	0.02	0.74

6.2 Standardized Carcass Surveys

Thirty-five of the 80 turbines (representing approximately 44% of the total number of turbines) were searched. During the study, all 35 turbines were searched every 14 days, except during the last survey, in which only 17 of the 35 turbines were searched because the last survey period was only a 7–day span (Figure 2.0-1). Overall, a total of 27 birds and 10 bats were found during standardized carcass surveys, with six additional bird fatalities found incidentally inside of search plots and 12 bird fatalities found incidentally outside of search plots (Table 6.2-1 and Table 6.2-2, respectively). The number, species, location, other characteristics of the bird and bat fatalities, and the fatality estimates adjusted for searcher efficiency and carcass removal biases are discussed below. Bird and bat carcasses found off survey plots were excluded from analysis of estimated total mortality.

Table 6.2-1. Summary of bird casualties and the percent composition of casualties discovered at the PrairieWinds ND1 (2011) Wind Resource Area from March 15 to October 29, 2011.

	Scheduled Searches		Incidental (on plot)		Incidental (off plot)		All Fatalities	
Species	Total	% Comp.	Total	% Comp.	Total	% Comp.	Total	% Comp.
mallard	8	29.6	2	33.3	6	50.0	16	35.6
dark-eyed junco	2	7.4	1	16.7	0	0	3	6.7
gadwall	2	7.4	0	0	0	0	2	4.4
red-winged blackbird	1	3.7	0	0	1	8.3	2	4.4
ring-necked pheasant	0	0	0	0	2	16.7	2	4.4
unidentified duck	2	7.4	0	0	0	0	2	4.4
unidentified passerine	2	7.4	0	0	0	0	2	4.4
American coot	0	0	0	0	1	8.3	1	2.2
blue-winged teal	1	3.7	0	0	0	0	1	2.2
Brewer's blackbird	1	3.7	0	0	0	0	1	2.2
canvasback	0	0	1	16.7	0	0	1	2.2
chipping sparrow	1	3.7	0	0	0	0	1	2.2
eared grebe	0	0	1	16.7	0	0	1	2.2

Table 6.2-1. Summary of bird casualties and the percent composition of casualties discovered at the PrairieWinds ND1 (2011) Wind Resource Area from March 15 to October 29, 2011.

Species	Scheduled Searches Total	Scheduled Searches % Comp.	Incidental (on plot) Total	Incidental (on plot) % Comp.	Incidental (off plot) Total	Incidental (off plot) % Comp.	All Fatalities Total	All Fatalities % Comp.
eastern kingbird	1	3.7	0	0	0	0	1	2.2
horned lark	1	3.7	0	0	0	0	1	2.2
mourning dove	0	0	0	0	1	8.3	1	2.2
red-tailed hawk	0	0	1	16.7	0	0	1	2.2
unidentified dove	1	3.7	0	0	0	0	1	2.2
unidentified large bird	1	3.7	0	0	0	0	1	2.2
unidentified raptor	1	3.7	0	0	0	0	1	2.2
upland sandpiper	1	3.7	0	0	0	0	1	2.2
Virginia rail	0	0	0	0	1	8.3	1	2.2
western grebe	1	3.7	0	0	0	0	1	2.2
Overall Birds	**27**	**100**	**6**	**100**	**12**	**100**	**45**	**100**

Table 6.2-2. Summary of bat casualties and the percent composition of casualties discovered at the PrairieWinds ND1 (2011) Wind Resource Area from March 15 to October 29, 2011.

Species	Scheduled Searches Total	Scheduled Searches % Comp.	Incidental (on plot) Total	Incidental (on plot) % Comp.	Incidental (off plot) Total	Incidental (off plot) % Comp.	All Fatalities Total	All Fatalities % Comp.
unidentified bat	5	50.0	0	0	0	0	5	50.0
hoary bat	3	30.0	0	0	0	0	3	30.0
little brown bat	2	20.0	0	0	0	0	2	20.0
Overall Bats	**10**	**100**	**0**	**0**	**0**	**0**	**10**	**100**

6.2.1 Bird Fatalities

6.2.1.1 Characteristics of Bird Fatalities

During the survey period, a total of 45 bird fatalities, consisting of 18 identified species and five unidentified species, were found at the PWND1 (Table 6.2-1, Figures 6.2-1a and 6.2-1b). Of these, 12 fatalities were of large identified bird species, and four were of large unidentified bird species, six were of small identified bird species and one was of a small unidentified bird species (Table 6.2-1). Mallards (*Anas platyrhynchos*) were the most common carcass found during both scheduled searches and incidentally (Table 6.2-1). No other species had more than two individuals found during scheduled carcass searches or found incidentally (Table 6.2-1).

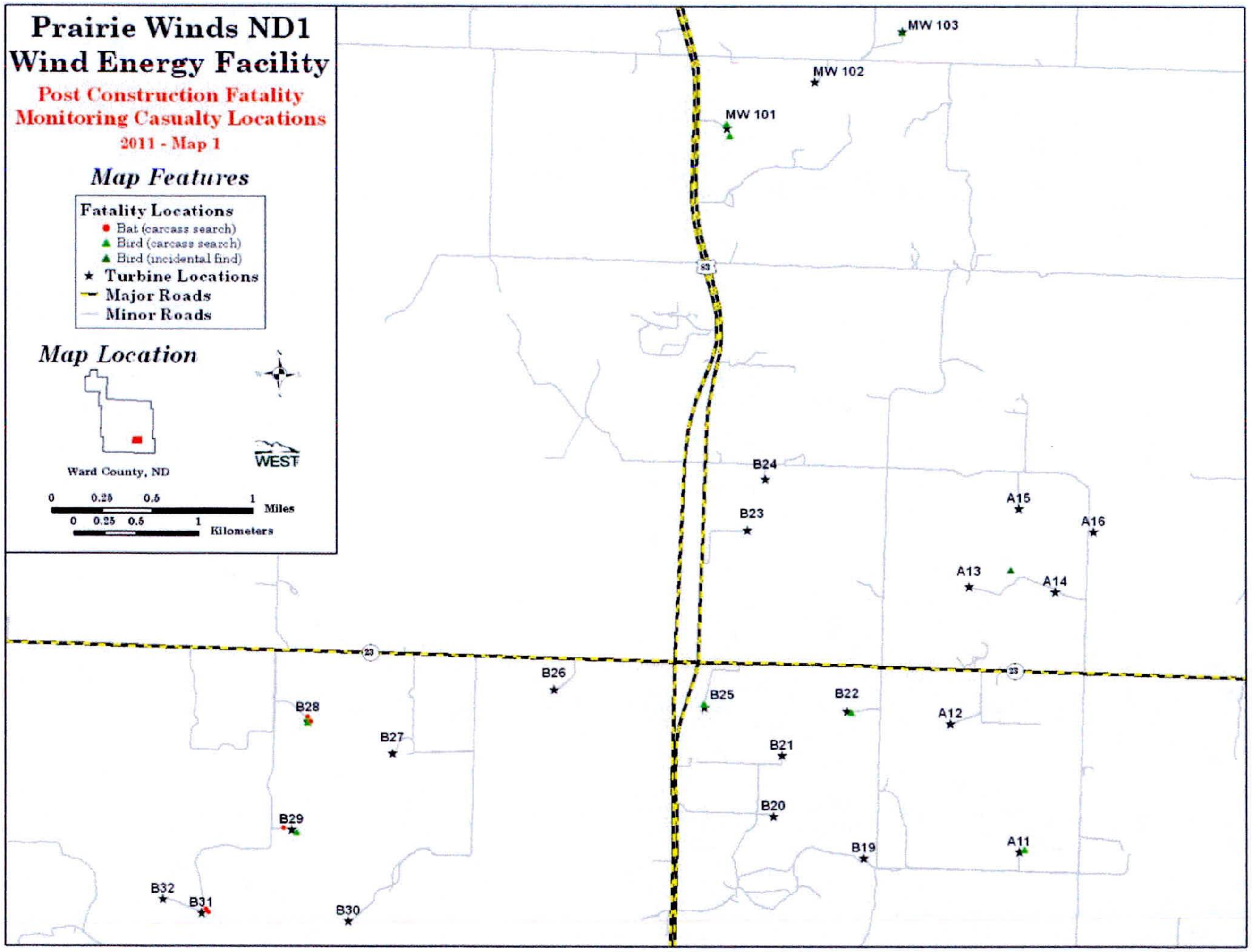

Figure 6.2-1a. Location of avian and bat fatalities within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011 (Map 1 – northern turbines).

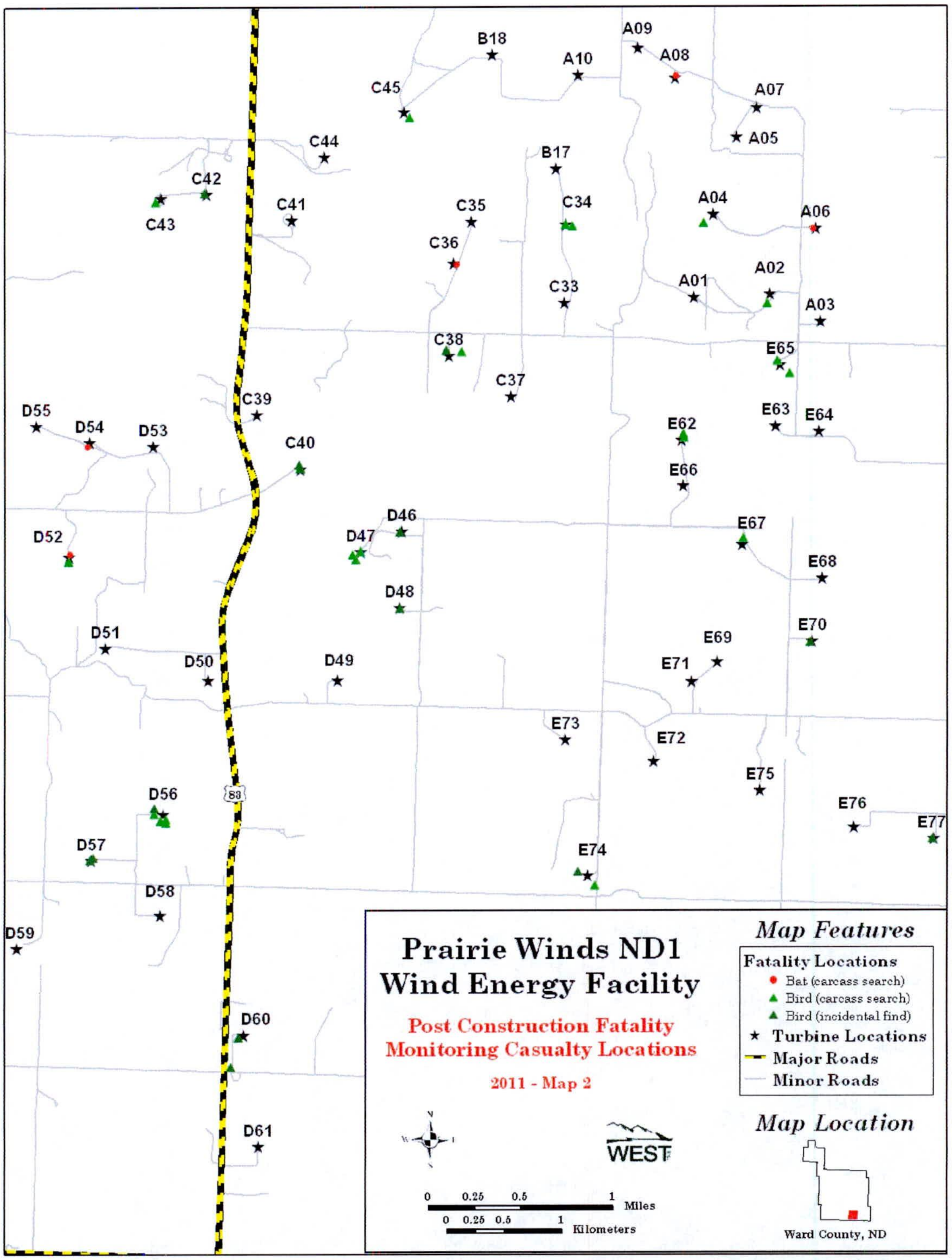

Figure 6.2-1b. Location of avian and bat fatalities within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011 (Map 2 – southern turbines).

6.2.1.2 Distribution of Bird Fatalities: Temporal Patterns

Fatalities were found during all three seasons (Table 6.2-3, Figure 6.2-2). Fatalities were similar during spring (42.4% of total fatalities) and summer (42.4% of total fatalities) and became less frequent in fall (15.2% of total fatalities).

Table 6.2-3. Seasonal distribution of bird fatalities found during carcass searches and as incidental finds within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

Season	Dates	Bird Fatalities	Percent Composition
Spring	3/15/2011 – 5/22/2011	14	42.4
Summer	5/23/2011 – 8/15/2011	14	42.4
Fall	8/16/2011 – 10/29/2011	5	15.2
Overall		**33**	**100**

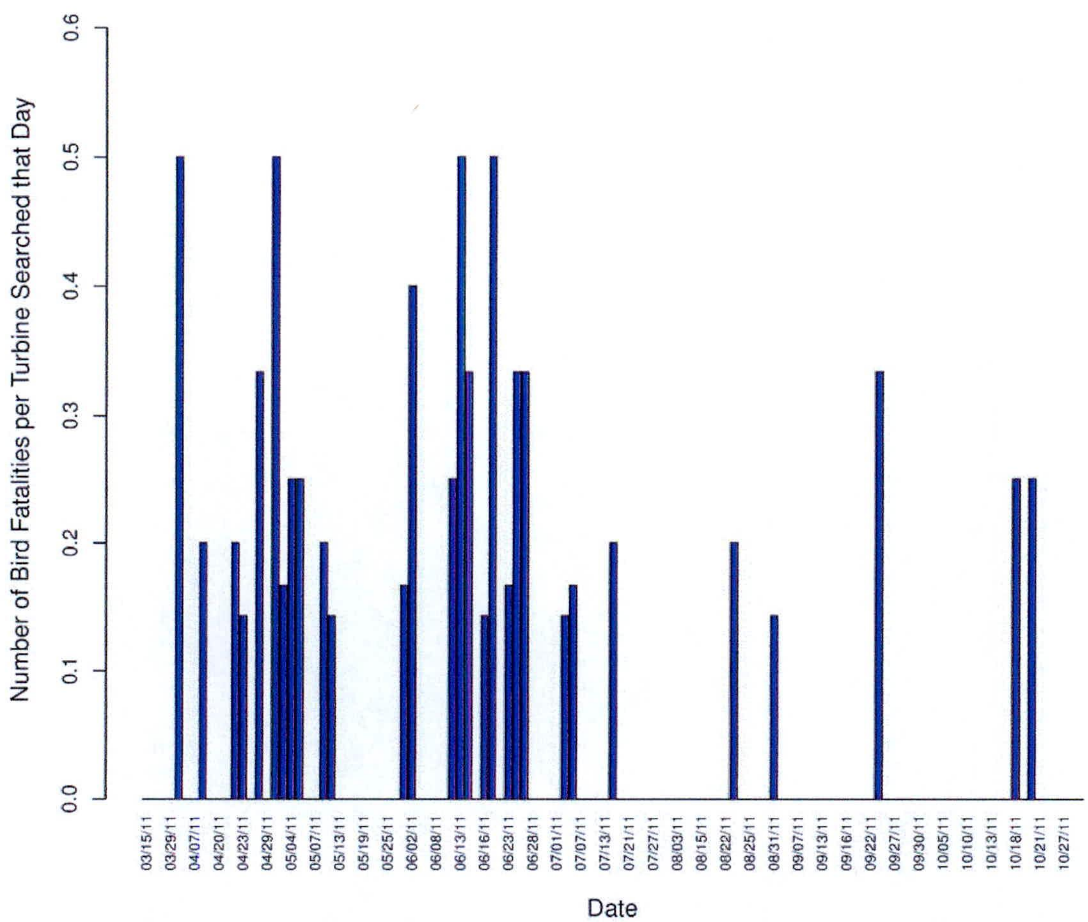

Figure 6.2-2. Temporal distribution of bird fatalities found during the survey period March 15 - October 29, 2011, at the PrairieWinds ND1 (2011) Wind Facility.

6.2.1.3 Distribution of Bird Fatalities: Spatial Patterns and Turbines

Bird fatalities were located at 20 of the 35 turbines, with turbine D56 having the greatest number of fatalities recorded (five fatalities; Figure 6.2-3). Bird fatalities per turbine ranged from zero to five fatalities (Figure 6.2-3), with an average of 0.94 birds found per turbine. Fatalities were located throughout the entire project, with slightly more found in the central part of the PWND1 (Figures 6.2-1a and 6.2-1b).

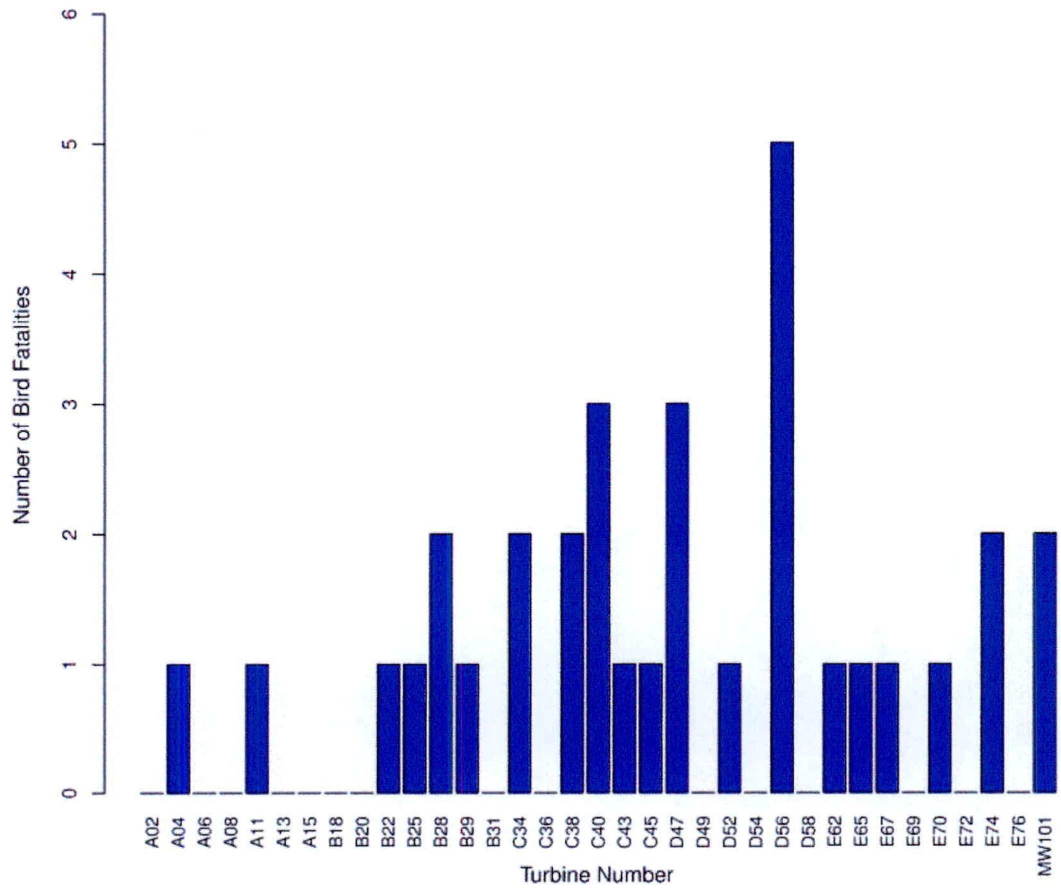

Figure 6.2-3. Spatial distribution, by turbine location, of bird fatalities within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

6.2.1.4 Distribution of Fatalities: Distance from Turbine

Slightly more than half (55.5 %) of all bird fatalities were found 50 m (164 ft) or less from the turbine, followed by about 33.3% found between 51 m (167 ft) and 90 m (297 ft), and the remaining 11.2% found greater than 91 m (300 ft) from the turbine Table 6.2-4). However, the findings do not account for detection and scavenging bias, or the searched area, which may vary as a function of distance from turbine.

Table 6.2-4. Distribution of bird casualties by distance (meters) from turbines at the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

Distance to Turbine (Meters)	Percent Bird Casualties
0 – 10	20.0
11 – 20	4.4
21 – 30	8.9
31 – 40	13.3
41 – 50	8.9
51 – 60	15.6
61 – 70	2.2
71 – 80	11.1
81 – 90	4.4
91 – 100	0
101 – 110	2.2
111 - 120	6.7
> 120	2.2

6.2.2 *Bat Fatalities*

6.2.2.1 Characteristics of Bat Fatalities

A total of 10 bat fatalities were found at the PWND1 over the course of the survey period (Table 6.2-2). All bat fatalities were found during searches within the search plots (Table 6.2-2). Two different bat species were identified at the PWND1, hoary bat (*Lasiurus cinereus*) and little brown bat (*Myotis lucifugus*; Table 6.2-2).

6.2.2.2 Distribution of Bat Fatalities: Temporal Patterns

The majority of bat fatalities were found during fall (60.0%), while the remaining 40.0% of fatalities were recorded during summer (Table 6.2-5; Figure 6.2-4). The majority of bat fatalities were collected between August 10 and August 31, 2011 (Figure 6.2-4). No bat carcasses were found before June 24 or after October 13, 2011 (Figure 6.2-4).

Table 6.2-5. Seasonal distribution of bat fatalities found during carcass searches and as incidental finds within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

Season	Dates	Bat Fatalities	Percent Composition
Spring	3/15/2011 – 5/22/2011	0	0
Summer	5/23/2011 – 8/15/2011	4	40.0
Fall	8/16/2011 – 10/29/2011	6	60.0
Overall		**10**	**100**

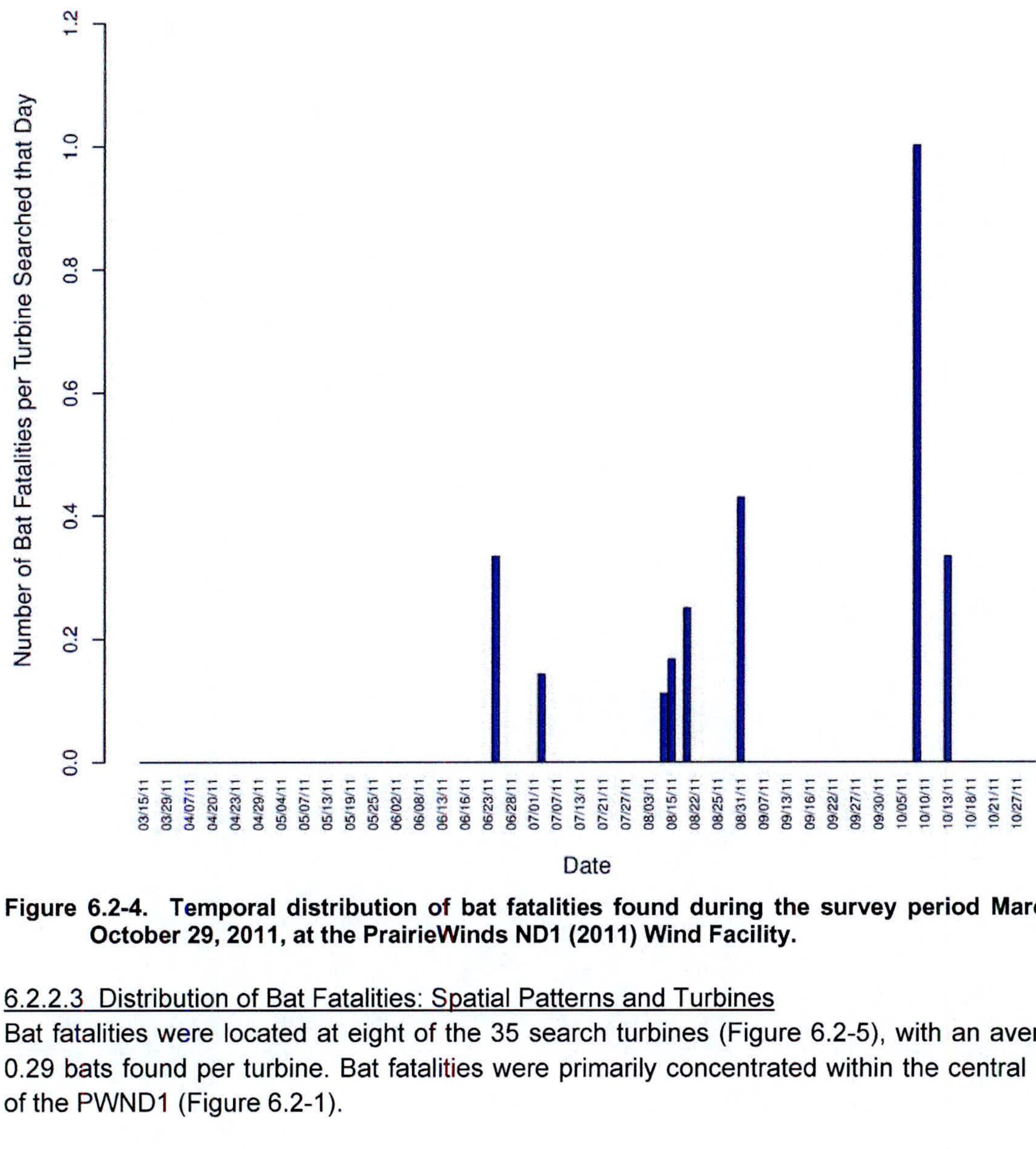

Figure 6.2-4. Temporal distribution of bat fatalities found during the survey period March 15 - October 29, 2011, at the PrairieWinds ND1 (2011) Wind Facility.

6.2.2.3 Distribution of Bat Fatalities: Spatial Patterns and Turbines

Bat fatalities were located at eight of the 35 search turbines (Figure 6.2-5), with an average of 0.29 bats found per turbine. Bat fatalities were primarily concentrated within the central portion of the PWND1 (Figure 6.2-1).

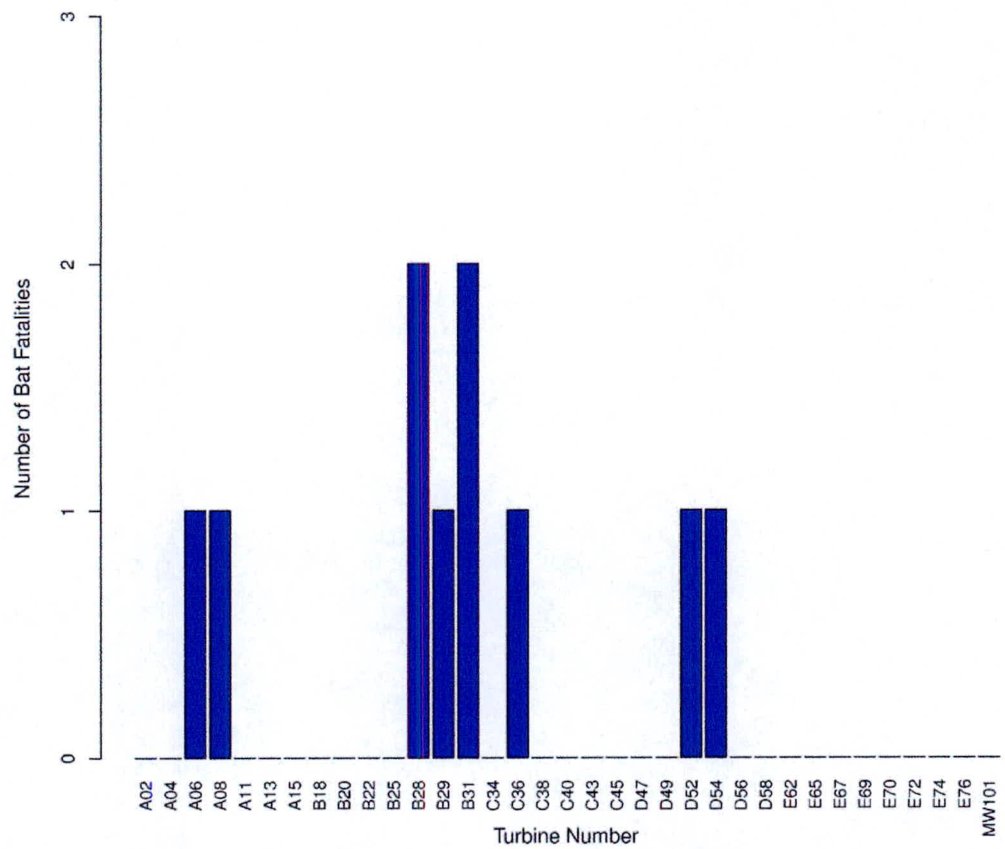

Figure 6.2-5. Spatial distribution, by turbine location, of bat fatalities within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

6.2.2.4 Distribution of Fatalities: Distance from Turbine

The majority (77.8%) of all fatalities were found greater than 10 m but less than 50 m from the turbine, with the remaining 20.0% split between 10 m (33 ft) or less from the turbine or greater than 50 m from the turbine (Table 6.2-6). However, these percentages do not account for detection and scavenging bias, or the searched area, which may vary as a function of distance from turbine.

Table 6.2-6. Distribution of bat casualties by distance (meters) from turbines at the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011.

Distance to Turbine (Meters)	Percent Bat Casualties
0 – 10	10.0
11 – 20	30.0
21 – 30	0
31 – 40	20.0
41 – 50	30.0
51 – 60	0
61 – 70	10.0

6.3 Searcher Efficiency Trials

A total of 31 small and 29 large birds were used during the searcher efficiency trials at the PWND1 (Table 6.3-1). Overall searcher efficiency for large bird carcasses was estimated to be 75.9% for all trials and 25.8% for small birds (Table 6.3-1). Bat carcasses were not available for trials, so small bird estimates were used for bats.

Table 6.3-1. Searcher efficiency at the PrairieWinds ND1 (2011) Wind Facility as a function of date and size class from March15 to October 29, 2011.

Size	Date	Number Placed	Number Available	Number Found	Percent Found
	4/12/2011	6	6	1	16.7
	6/9/2011	6	6	3	50.0
	6/10/2011	4	4	2	50.0
	6/28/2011	4	4	0	0
Small Birds	10/6/2011	2	2	0	0
	10/19/2011	3	3	0	0
	10/20/2011	1	1	1	100.0
	10/27/2011	3	3	0	0
	10/28/2011	2	2	1	50.0
Total Small Birds		**31**	**31**	**8**	**25.8**
	4/12/2011	6	6	4	66.7
	6/9/2011	6	6	6	100.0
	6/10/2011	4	4	3	75.0
	6/28/2011	2	2	1	50.0
Large Birds	10/6/2011	2	2	1	50.0
	10/19/2011	3	3	1	33.3
	10/20/2011	1	1	1	100.0
	10/27/2011	3	3	3	100.0
	10/28/2011	2	2	2	100.0
Total Large Birds		**29**	**29**	**22**	**75.9**

6.4 Carcass Removal Trials

Overall, a total of 60 bird carcasses were placed in the PWND1 during the monitoring period, including 33 large birds and 27 small birds. By Day 4, approximately 80% of small birds remained and 50% remained by Day 14 (Figure 6.4-1). For large birds, approximately 85% of the large birds remained by Day 4, and nearly 75% remained by Day 14 (Figure 6.4-1). By the end of the monitoring period, approximately 35% of small birds remained while about 40% of large birds remained (Figure 6.4-1).

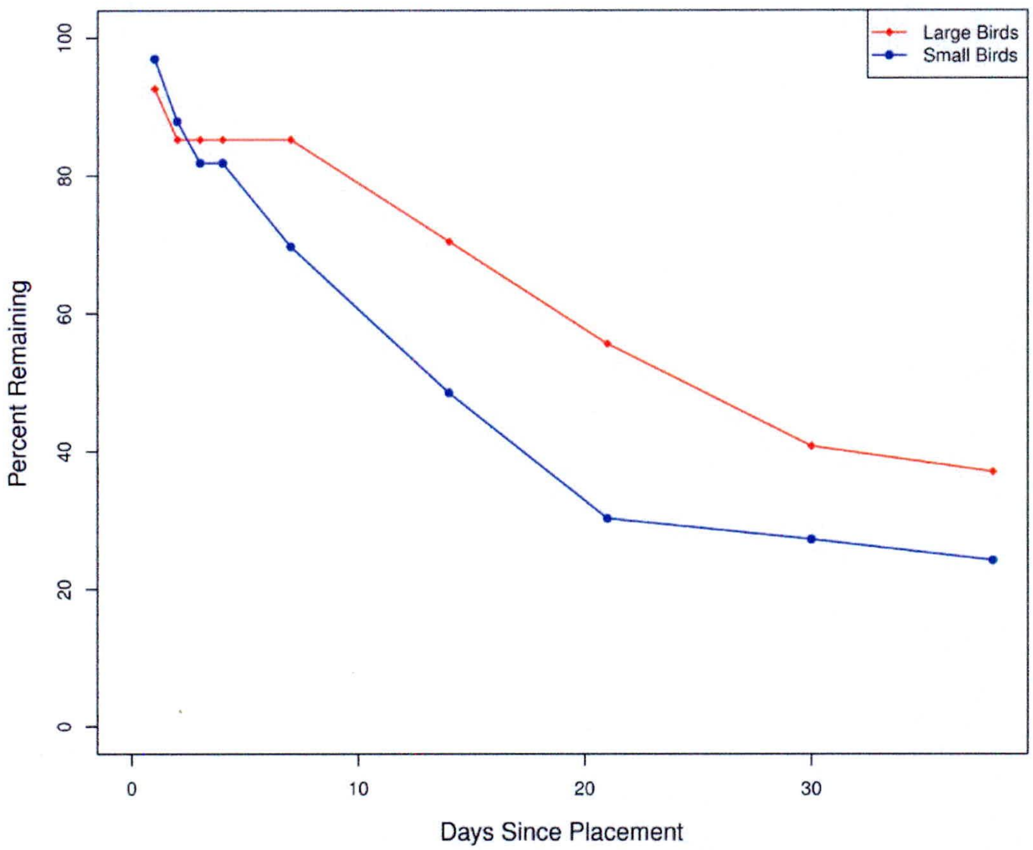

Figure 6.4-1. Scavenger removal rates for large and small birds within the PrairieWinds ND1 (2011) Wind Facility from March 15 – October 29, 2011. Small bird scavenging rates also represent scavenging rates for bats.

6.5 Adjusted Fatality Estimates

Fatality estimates, standard errors, and confidence intervals (CI) were calculated for birds (Tables 6.5-1) and bats (Tables 6.5-2). The fatality estimates are adjusted based on the corrections for carcass removal, observer detection bias, and the proportion of the plot searched. Estimates were calculated for the spring, summer, and fall seasons and for large and small birds.

6.5.1 Birds

The estimated average probability a small bird casualty would remain until a scheduled search and would be found ranged from 0.27 to 0.28 over the three seasons (Appendix A). All confidence intervals were the same regardless of season (CI; 0.14-0.34; Appendix A).

The probability of large bird (e.g., raptor or waterbird) casualties remaining and being found were all higher than for small birds, but again, the range in the estimated average probabilities over the three seasons was narrow (0.73 to 0.74; Appendix A). The CIs for all seasons were the same (0.61-0.83; Appendix A).

The overall adjusted estimated number of small bird fatalities per turbine was greatest during the spring season; with an adjusted estimate of 0.66 (CI: 0.19-1.52) small bird fatalities per turbine (Table 6.5-1). The late summer season had the lowest estimated small bird fatalities at zero, followed by early summer at 0.10 (CI: 0-0.35). For large birds, estimated fatalities per turbine were highest in early summer at 0.47 (CI: 0.30-0.69; Table 6.5-1). The lowest estimated large bird fatalities occurred during early fall at zero, followed by late fall at 0.08 (CI: 0-0.19; Table 6.5-1).

For the three season study period, the overall adjusted fatality rate per turbine for all birds was 2.34 (CI: 1.56-3.79) fatalities per turbine (Table 6.5-1) or 1.56 birds per MW. Additionally, the overall adjusted fatality rates per turbine for raptors and waterfowl were considerably lower with 0.08 (CI: 0.00-0.19) and 0.66 (CI: 0.40-0.96) fatalities per turbine (Table 6.5-1), or 0.05 and 0.44 birds per MW, respectively.

6.5.2 Bats

The estimated average probability a bat casualty would remain until a scheduled search and would be found ranged from 0.27 to 0.28 over the three seasons (Appendix A). All confidence intervals were the same regardless of season (CI; 0.14-0.43; Appendix A).

Early fall had the highest adjusted estimated number of bat fatalities per turbine at 1.52 (CI: 0.38-3.68; Table 6.5-2). On the other hand, the spring season had zero estimated bat fatalities per turbine (Table 6.5-2). The overall adjusted bat fatality estimate was 2.09 (CI: 0.90-4.43) bat fatalities per turbine (Table 6.5-2), or 1.39 bat fatalities per MW.

Table 6.5-1. Bootstrap point estimates (mean) and lower and upper limits of 90 percent confidence intervals for seasonal bird fatality rate estimation at the PrairieWinds ND1 (2011) Wind Facility from March 15 to October 29, 2011.

Seasonal Adjusted Fatality Estimates (fatalities/turbine)															
	Spring (3/15/11-5/10/11)			Early Summer (5/11/11-7/3/11)			Late Summer (7/4/11-8/14/11)			Early Fall (8/15/11-9/11/11)			Late Fall (9/12/11-10/31/11)		
		90% CI			90% CI			90% CI			90% CI			90% CI	
	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul
Large Bird	0.24	0.05	0.47	0.47	0.30	0.69	0.15	0.05	0.29	0.00	--	--	0.08	0.00	0.19
Small Bird	0.66	0.19	1.52	0.10	0.00	0.35	0.00	--	--	0.52	0.00	1.45	0.11	0.00	0.35

Overall Adjusted Fatality Estimates (fatalities/turbine)			
		90% Bootstrap Confidence Limits	
	Mean	Lower Limit	Upper Limit
Large Bird	**0.95**	**0.63**	**1.32**
Small Bird	**1.39**	**0.65**	**2.78**
All Birds	**2.34**	**1.56**	**3.79**
Raptors	**0.08**	**0.00**	**0.19**
Waterfowl	**0.66**	**0.40**	**0.96**

Table 6.5-2. Bootstrap point estimates (mean) and lower and upper limits of 90 percent confidence intervals for seasonal bat fatality rate estimation at the PrairieWinds ND1 (2011) Wind Facility from March 15 to October 29, 2011.

Seaonal Adjusted Fatality Estimates (fatalities/turbine)															
	Spring (3/15/11-5/10/11)			Early Summer (5/11/11-7/3/11)			Late Summer (7/4/11-8/14/11)			Early Fall (8/15/11-9/11/11)			Late Fall (9/12/11-10/31/11)		
		90% CI			90% CI			90% CI			90% CI			90% CI	
	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul
Bats	0.00	--	--	0.10	0.00	0.34	0.27	0.00	0.73	1.52	0.38	3.68	0.21	0.00	0.58

Overall Adjusted Fatality Estimates (fatalities/turbine)			
		90% Bootstrap Confidence Limits	
	Mean	Lower Limit	Upper Limit
Bats	**2.09**	**0.90**	**4.43**

7.0 DISCUSSION

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson et al. (2005), and accounted for search interval, total area searched, proportion of area searched at specific distances from the turbine, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change through time at a given location and must be accounted for when attempting to estimate fatality rates. This was accounted for by conducting scavenging trials for small and large birds throughout each search period. The scavenging and efficiency rates for bats were considered to be the same as that of small birds given that no bat carcasses available for testing. Searcher efficiency trials were also conducted throughout each search period within different plot conditions to account for any biases. As vegetation density or height increased, the level of difficulty in detection rates also increased.

Separate fatality rate estimates were calculated for small birds, large birds, and bats based on ground cover type, search interval, and season. For both birds and bats, confidence intervals overlapped fatality estimates (see Tables 6.5-1 and 6.5-2), indicating that the estimates were consistent regardless of season.

7.1 Bird Fatalities

During the study period, 33 bird fatalities were found during scheduled carcass searches and incidentally (within the search plot) and 12 were found incidentally outside of search plots. Of the identifiable birds found, none were species protected under threatened or endangered species legislation (e.g., ESA 1973).

Bird fatality rates at other sites with publically-available data across North America exhibit a wide range of mortality, from 0.15 birds/MW/study period at Buffalo Gap II facility in Texas (Tierney 2009) to 11.02 birds/MW/study period at the Buffalo Mountain facility in Tennessee (Nicholson et al. 2005; Table 7.1-1). Within the Midwest, bird estimates ranged from 0.42 fatalities/MW/study period at the Top of Iowa facility (Jain 2005) to 8.25 fatalities/MW/study period at the Wessington Springs Facility in South Dakota (Derby et al. 2010f; Table 7.1-1). The estimated bird fatality rate for the PWND1 of 1.56 bird fatalities/MW/study period in 2011 was similar to the estimated fatality rate for 2010 (1.48 bird fatalities/MW/study period (Derby et al. 2011b) and ranked 35th when compared to these other studies at wind energy facilities across North America (Figure 7.1-1). The estimated total bird fatality at the PWND1 falls within the range of other studies at Midwestern projects, ranking 17th (Table 7.1-1).

Raptor fatality rates at other sites with publicly-available data across North America exhibit a relatively small range of mortality, from zero birds/MW/study period at several studies at wind energy facilities to 0.59 birds/MW/study period at the Munnsville facility in New York (Stantec 2009b; Table 7.1-2). The estimated raptor fatality rate of 0.05 bird fatalities/MW/study period at the PWND1 in 2011 was identical to the estimated raptor fatality rate for 2010 (Derby et al.

2011b) and ranked 19th when compared to these other wind energy facilities in eastern North America (Figure 7.1-2).

Table 7.1-1. Wind energy facilities in North America with comparable and publicly-available fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
PrairieWinds ND1, ND (2011)	**1.56**	**80**	**120**
PrairieWinds ND1, ND (2010)	**1.48**	**80**	**120**
Midwest			
Wessington Springs, SD	8.25	34	51
Blue Sky Green Field, WI	7.17	88	145
Cedar Ridge, WI (2009)	6.55	41	67.6
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN	5.59	33	49.5
Buffalo Ridge I, SD (2010)	5.06	24	50.4
Buffalo Ridge, MN (Phase I; 1996)	4.14	73	25
Winnebago, IA	3.88	10	20
Cedar Ridge, WI (2010)	3.72	41	68
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	3.14	73	25
Ripley, Ont (2008)	3.09	38	76
Buffalo Ridge, MN (Phase I; 1997)	2.51	73	25
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
Kewaunee County, WI	1.95	31	20.46
NPPD Ainsworth, NE	1.63	36	20.5
Elm Creek, MN	1.55	67	100
Buffalo Ridge, MN (Phase I; 1999)	1.43	73	25
Top of Iowa, IA (2004)	0.81	89	80
Grand Ridge, IL	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Northeast			
Mount Storm, WV (2009)	5.73	132	264
Maple Ridge, NY (2007)	3.44	195	321.75
Lempster, NH (2009)	3.38	12	24
Casselman, PA (Spring & Fall 2008)	3.13	23	34.5
Noble Bliss, NY (2008)	2.86	67	100
Mountaineer, WV (2003)	2.69	44	66
Stetson Mountain, ME (2009)	2.68	38	57
Noble Ellenburg, NY (2009)	2.66	54	80
Lempster, NH (2010)	2.64	12	24
Mount Storm, WV (2010)	2.60	132	264
Noble Bliss, NY (2009)	2.28	67	100
Noble Clinton, NY (2008)	2.17	67	100
Maple Ridge, NY (2008)	2.07	195	321.75
Noble Altona, NY	1.84	65	97.5
Mars Hill, ME (2008)	1.76	28	42
Noble Wethersfield, NY	1.70	84	126
Mars Hill, ME (2007)	1.67	28	42
Noble Chateaugay, NY	1.66	71	106.5
Munnsville, NY (2008)	1.48	23	34.5
Noble Ellenburg, NY (2008)	1.40	54	80
Cohocton/Dutch Hill, NY (2009)	1.39	50	125
Cohocton/Dutch Hills, NY (2010)	1.32	50	125
Noble Clinton, NY (2009)	1.11	67	100

Table 7.1-1. Wind energy facilities in North America with comparable and publicly-available fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Southeast			
Buffalo Mountain, TN (2000-2003)	11.02	3	1.98
Buffalo Mountain, TN (2005)	1.10	18	28.98
Southern Plains			
Buffalo Gap I, TX	1.32	67	134
Barton Chapel, TX	1.15	60	120
Buffalo Gap II, TX	0.15	155	233
Southwest			
Dry Lake I, AZ	2.22	30	63
Rocky Mountains			
Foote Creek Rim, WY (Phase I; 1999)	3.40	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.42	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	69	41.4
Summerview, Alb (2006)	1.06	39	70.2
California			
Pine Tree, CA	8.30	90	135
Shiloh I, CA	6.96	100	150
Dillon, CA	4.71	45	45
Diablo, CA	4.29	31	20.46
High Winds, CA (2004)	1.62	90	162
High Winds, CA (2005)	1.10	90	162
Alite, CA	0.55	8	24
Pacific Northwest			
Leaning Juniper, OR	6.66	67	100.5
Biglow Canyon, OR (Phase II; 2009/2010)	5.53	65	150
Tuolumne (Windy Point I), WA	3.20	62	136.6
Stateline, OR/WA (2002)	3.17	454	263
Klondike II, OR	3.14	50	75
Klondike III (Phase I), OR	3.02	125	223.6
Hopkins Ridge, WA (2008)	2.99	87	156.6
Klondike IIIa (Phase II), OR	2.80	51	76.5
Nine Canyon, WA	2.76	37	48.1
Stateline, OR/WA (2003)	2.68	454	263
Combine Hills, OR	2.56	41	41
Big Horn, WA	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Hay Canyon, OR	2.21	48	100.8
Elkhorn, OR (2010)	1.95	61	101
Pebble Springs, OR	1.93	47	98.7
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA	1.55	127	229
Goodnoe, WA	1.40	47	94
Hopkins Ridge, WA (2006)	1.23	83	150
Stateline, OR/WA (2006)	1.23	454	263
Klondike, OR	0.95	16	24
Vansycle, OR	0.95	38	24.9
Elkhorn, OR (2008)	0.64	61	101
Marengo I, WA (2009)	0.27	78	140.4
Marengo II, WA (2009)	0.16	39	70.2

A=number of bird fatalities/MW/year

Table 7.1-1. Wind energy facilities in North America with comparable and publicly-available fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW

Table 7.1-1 (*continued*). Wind energy facilities in North America with comparable and publicly-available fatality data for all bird species.

Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
PrairieWinds ND1, ND (2011)	This study		
PrairieWinds ND1, ND (2010)	Derby et al. 2011b		
Alite, CA	Chatfield et al. 2010	Klondike III, OR	Gritski et al. 2010
Barton Chapel, TX	WEST 2011	Klondike IIIa, OR	Gritski et al. 2011
Big Horn, WA	Kronner et al. 2008	Leaning Juniper, OR	Kronner et al. 2007
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Lempster, NH (2009)	Tidhar et al. 2010
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Lempster, NH (2010)	Tidhar et al. 2011
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Maple Ridge, NY (07)	Jain et al. 2009a
Blue Sky Green Field, WI	Gruver et al. 2009	Maple Ridge, NY (08)	Jain et al. 2009d
Buffalo Gap I, TX	Tierney 2007	Marengo I, WA (09)	URS Corporation 2010b
Buffalo Gap II, TX	Tierney 2009	Marengo II, WA (09)	URS Corporation 2010c
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Mars Hill, ME (07)	Stantec 2008
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Mars Hill, ME (08)	Stantec 2009a
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Moraine II, MN	Derby et al. 2010d
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Mount Storm, WV (10)	Young et al. 2010a, 2011
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Mountaineer, WV	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Nine Canyon, WA	Erickson et al. 2003b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Altona, NY	Jain et al. 2011b
Buffalo Ridge I, SD (10)	Derby et al. 2010b	Noble Bliss, NY (08)	Jain et al. 2009e
Casselman, PA (Spring & Fall 08)	Arnett et al. 2009	Noble Bliss, NY (09)	Jain et al. 2010a
Cedar Ridge, WI (09)	BHE Environmental 2010	Noble Chateaugay, NY	Jain et al. 2011c
Cedar Ridge, WI (10)	BHE Environmental 2011	Noble Clinton, NY (08)	Jain et al. 2009c
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Noble Clinton, NY (09)	Jain et al. 2010b
Cohocton/Dutch Hill, NY (10)	Stantec 2011	Noble Ellenburg, NY (08)	Jain et al. 2009b
Combine Hills, OR	Young et al. 2006	Noble Ellenburg, NY (09)	Jain et al. 2010c
Diablo, CA	WEST 2006, 2008	Noble Wethersfield, NY	Jain et al. 2011a
Dillon, CA	Chatfield et al. 2009	NPPD Ainsworth, NE	Derby et al. 2007
Dry Lake I, AZ	Thompson et al. 2011	Pebble Springs, OR	Gritski and Kronner 2010b
Elkhorn, OR (2008)	Jeffrey et al. 2009b	Pine Tree, CA	BioResource Consultants 2010
Elkhorn, OR (2010)	Enk et al. 2011b	Ripley, Ont (08)	Jacques Whitford 2009
Elm Creek, MN	Derby et al. 2010c	Rugby, ND	Derby et al. 2011a
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003b	Shiloh I, CA	Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003b	Stateline, OR/WA (02)	Erickson et al. 2004
Foote Creek Rim, WY (Ph. I; 01-02)	Young et al. 2003b	Stateline, OR/WA (03)	Erickson et al. 2004
Goodnoe, WA	URS Corporation 2010a	Stateline, OR/WA (06)	Erickson et al. 2007
Grand Ridge, IL	Derby et al. 2010g	Stetson Mountain, ME (09)	Stantec 2009c
Hay Canyon, OR	Gritski and Kronner 2010a	Summerview, Alb (2006)	Brown and Hamilton 2006
High Winds, CA (2004)	Kerlinger et al. 2006	Top of Iowa, IA (03)	Jain 2005
High Winds, CA (2005)	Kerlinger et al. 2006	Top of Iowa, IA (04)	Jain 2005
Hopkins Ridge, WA (2006)	Young et al. 2007	Tuolumne (Windy Point I), WA	Enz and Bay 2010
Hopkins Ridge, WA (2008)	Young et al. 2009c	Vansycle, OR	Erickson et al. 2000b
Kewaunee County, WI	Howe et al. 2002	Wessington Springs, SD	Derby et al. 2010f
Klondike, OR	Johnson et al. 2003b	Wild Horse, WA	Erickson et al. 2008
Klondike II, OR	NWC and WEST 2007	Winnebago, IA	Derby et al. 2010e

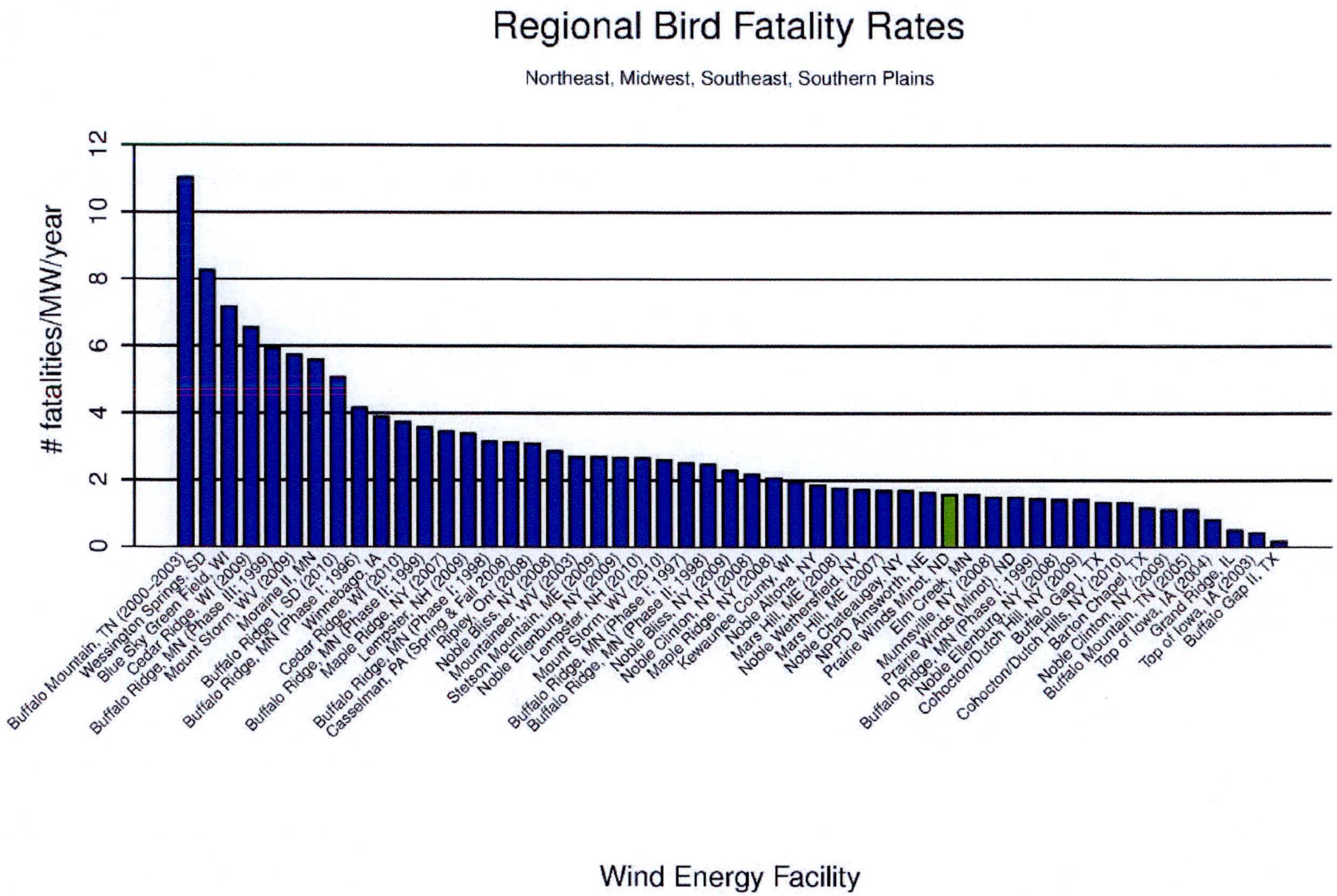

Figure 7.1-1. Comparable fatality rates for all birds (number of birds per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America. PrairieWinds ND1 Wind Facility (2011) data is highlighted in green.

Figure 7.1-1 (*continued*). Comparable fatality rates for all birds (number of birds per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America.

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND (2011)	This study				
PrairieWinds ND1, ND (2010)	Derby et al. 2011b				
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Noble Bliss, NY (08)	Jain et al. 2009e	NPPD Ainsworth, NE	Derby et al. 2007
Wessington Springs, SD	Derby et al. 2010f	Mountaineer, WV (03)	Kerns and Kerlinger 2004	Elm Creek, MN	Derby et al. 2010c
Blue Sky Green Field, WI	Gruver et al. 2009	Stetson Mountain, ME (09)	Stantec 2009c	Munnsville, NY (08)	Stantec 2009b
Cedar Ridge, WI (09)	BHE Environmental 2010	Noble Ellenburg, NY (09)	Jain et al. 2010c	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Lempster, NH (2010)	Tidhar et al. 2011	Noble Ellenburg, NY (08)	Jain et al. 2009b
Mount Storm, WV (09)	Young et al. 2009a, 2010b	Mount Storm, WV (10)	Young et al. 2010a, 2011	Cohocton/Dutch Hill, NY (09)	Stantec 2010
Moraine II, MN	Derby et al. 2010d	Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Buffalo Gap I, TX	Tierney 2007
Buffalo Ridge I, SD (10)	Derby et al. 2010b	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Cohocton/Dutch Hill, NY (10)	Stantec 2011
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Noble Bliss, NY (09)	Jain et al. 2010a	Barton Chapel, TX	WEST 2011
Winnebago, IA	Derby et al. 2010e	Noble Clinton, NY (08)	Jain et al. 2009c	Noble Clinton, NY (09)	Jain et al. 2010b
Cedar Ridge, WI (10)	BHE Environmental 2011	Maple Ridge, NY (08)	Jain et al. 2009d	Buffalo Mountain, TN (05)	Fiedler et al. 2007
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Kewaunee County, WI	Howe et al. 2002	Top of Iowa, IA (04)	Jain 2005
Maple Ridge, NY (07)	Jain et al. 2009a	Noble Altona, NY	Jain et al. 2011b	Grand Ridge, IL	Derby et al. 2010g
Lempster, NH (2009)	Tidhar et al. 2010	Mars Hill, ME (08)	Stantec 2009a	Top of Iowa, IA (03)	Jain 2005
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Noble Wethersfield, NY	Jain et al. 2011a	Buffalo Gap II, TX	Tierney 2009
Casselman, PA (Spring & Fall 08)	Arnett et al. 2009	Mars Hill, ME (07)	Stantec 2008		
Ripley, Ont (08)	Jacques Whitford 2009	Noble Chateaugay, NY	Jain et al. 2011c		

Table 7.1-2. Wind energy facilities in North America with comparable and publicly-available use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1, ND (2011)	**n/a**	**0.08**	**80**	**120**
PrairieWinds ND1, ND (2010)	**n/a**	**0.05**	**80**	**120**
	Midwest			
Buffalo Ridge, MN (Phase I; 1996)	n/a	0.47	73	25
Moraine II, MN	n/a	0.37	33	49.5
Winnebago, IA	n/a	0.27	10	20
Buffalo Ridge I, SD (2010)	n/a	0.20	24	50.4
NPPD Ainsworth, NE	n/a	0.06	36	20.5
Kewaunee County, WI	n/a	0	31	20.46
Buffalo Ridge, MN (Phase I; 1997)	n/a	0	73	25
Buffalo Ridge, MN (Phase I; 1998)	n/a	0	73	25
Buffalo Ridge, MN (Phase I; 1999)	n/a	0	73	25
Wessington Springs, SD	0.23	0	34	51
Grand Ridge, IL	0.20	0	66	99
Elm Creek, MN	n/a	0	67	100
Buffalo Ridge, MN (Phase III; 1999)	n/a	0	138	103.5
Buffalo Ridge, MN (Phase II; 1998)	n/a	0	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	n/a	0	143	107.25
Blue Sky Green Field, WI	n/a	0	88	145
	Northeast			
Munnsville, NY (2008)	n/a	0.59	23	34.5
Noble Ellenburg, NY (2009)	n/a	0.49	54	80
Noble Ellenburg, NY (2008)	n/a	0.32	54	80
Noble Clinton, NY (2008)	n/a	0.29	67	100
Maple Ridge, NY (2007)	n/a	0.25	195	321.75
Noble Clinton, NY (2009)	n/a	0.24	67	100
Noble Bliss, NY (2009)	n/a	0.18	67	100
Noble Bliss, NY (2008)	n/a	0.10	67	100
Mount Storm, WV (2010)	n/a	0.10	132	264
Maple Ridge, NY (2008)	n/a	0.03	195	321.75
Lempster, NH (2009)	n/a	0	12	24
Lempster, NH (2010)	n/a	0	12	24
Casselman, PA (Spring & Fall 2008)	n/a	0	23	34.5
Mars Hill, ME (2007)	n/a	0	28	42
Mars Hill, ME (2008)	n/a	0	28	42
Noble Altona, NY	n/a	0	65	97.5
Mount Storm, WV (2009)	n/a	0	132	264
	Southeast			
Buffalo Mountain, TN (2000-2003)	n/a	0	3	1.98
Buffalo Mountain, TN (2005)	n/a	0	18	28.98
	Southern Plains			
Barton Chapel, TX	n/a	0.25	60	120
Buffalo Gap I, TX	n/a	0.1	67	134
Buffalo Gap II, TX	n/a	0	155	233
	Southwest			
Dry Lake I, AZ	0.13	0	30	63

Table 7.1-2. Wind energy facilities in North America with comparable and publicly-available use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Rocky Mountains				
Summerview, Alb (2006)	n/a	0.11	39	70.2
Foote Creek Rim, WY (Phase I; 1999)	0.55	0.08	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	n/a	0.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	n/a	0	69	41.4
California				
Shiloh I, CA	n/a	0.42	100	150
Diablo, CA	2.16	0.40	31	20.46
Pine Tree, CA	n/a	0.13	90	135
Alite, CA	n/a	0.12	8	24
Dillon, CA	n/a	0	45	45
Pacific Northwest				
Tuolumne (Windy Point I), WA	0.77	0.29	62	136.6
Goodnoe, WA	n/a	0.17	47	94
Leaning Juniper, OR	0.52	0.16	67	100.5
Klondike III (Phase I), OR	n/a	0.15	125	223.6
Hopkins Ridge, WA (2006)	0.70	0.14	83	150
Biglow Canyon, OR (Phase II; 2009/2010)	n/a	0.14	65	150
Big Horn, WA	0.51	0.11	133	199.5
Stateline, OR/WA (2006)	n/a	0.11	454	263
Stateline, OR/WA (2002)	0.48	0.09	454	263
Stateline, OR/WA (2003)	n/a	0.09	454	263
Elkhorn, OR (2010)	n/a	0.08	61	101
Hopkins Ridge, WA (2008)	n/a	0.07	87	156.6
Wild Horse, WA	0.29	0.07	127	229
Klondike II, OR	0.50	0.06	50	75
Klondike IIIa (Phase II), OR	n/a	0.06	51	76.5
Elkhorn, OR (2008)	1.07	0.06	61	101
Marengo II, WA (2009)	n/a	0.05	39	70.2
Pebble Springs, OR	n/a	0.04	47	98.7
Biglow Canyon, OR (Phase I; 2009)	n/a	0.04	76	125.4
Nine Canyon, WA	0.35	0.03	37	48.1
Biglow Canyon, OR (Phase I; 2008)	n/a	0.03	76	125.4
Klondike, OR	0.50	0	16	24
Vansycle, OR	0.66	0	38	24.9
Combine Hills, OR	0.75	0	41	41
Hay Canyon, OR	n/a	0	48	100.8
Marengo I, WA (2009)	n/a	0	78	140.4

A=number of raptors/plot/20min survey
B=number of fatalities/MW/year

Table 7.1-2 (*continued*). Wind energy facilities in North America with comparable and publicly-available use and fatality data for raptors, by geographic region.

Data from the following sources:

Facility	Use Estimate	Fatality Estimate	Facility	Use Estimate	Fatality Estimate
PrairieWinds ND1, ND (2011)		This study			
PrairieWinds ND1, ND (2010)		Derby et al. 2011b			
Alite, CA		Chatfield et al. 2010	Klondike II, OR	Johnson 2004	NWC and WEST 2007
Barton Chapel, TX		WEST 2011	Klondike III (Phase I), OR		Gritski et al. 2010
Big Horn, WA	Johnson and Erickson 2004	Kronner et al. 2008	Klondike IIIa (Phase II), OR		Gritski et al. 2011
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009a	Leaning Juniper, OR	Kronner et al. 2005	Kronner et al. 2007
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Lempster, NH (09)		Tidhar et al. 2010
Biglow Canyon, OR (Phase II; 09/10)		Enk et al. 2011a	Lempster, NH (10)		Tidhar et al. 2011
Blue Sky Green Field, WI		Gruver et al. 2009	Maple Ridge, NY (07)		Jain et al. 2009a
Buffalo Gap I, TX		Tierney 2007	Maple Ridge, NY (08)		Jain et al. 2009d
Buffalo Gap II, TX		Tierney 2009	Marengo I, WA (09)		URS Corporation 2010b
Buffalo Mountain, TN (00-03)		Nicholson et al. 2005	Marengo II, WA (09)		URS Corporation 2010c
Buffalo Mountain, TN (05)		Fiedler et al. 2007	Mars Hill, ME (07)		Stantec 2008
Buffalo Ridge, MN (Phase I; 1996)		Johnson et al. 2000a	Mars Hill, ME (08)		Stantec 2009a
Buffalo Ridge, MN (Phase I; 1997)		Johnson et al. 2000a	Moraine II, MN		Derby et al. 2010d
Buffalo Ridge, MN (Phase I; 1998)		Johnson et al. 2000a	Mount Storm, WV (09)		Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase I; 1999)		Johnson et al. 2000a	Mount Storm, WV (10)		Young et al. 2010a, 2011
Buffalo Ridge, MN (Phase II; 1998)		Johnson et al. 2000a	Munnsville, NY (08)		Stantec 2009b
Buffalo Ridge, MN (Phase II; 1999)		Johnson et al. 2000a	Nine Canyon, WA	Erickson et al. 2001	Erickson et al. 2003b
Buffalo Ridge, MN (Phase III; 1999)		Johnson et al. 2000a	Noble Altona, NY		Jain et al. 2011b
Buffalo Ridge I, SD (10)		Derby et al. 2010b	Noble Bliss, NY (08)		Jain et al. 2009e
Casselman, PA (Spring & Fall 08)		Arnett et al. 2009	Noble Bliss, NY (09)		Jain et al. 2010a
Combine Hills, OR	Young et al. 2003c	Young et al. 2006	Noble Clinton, NY (08)		Jain et al. 2009c
Diablo, CA	WEST 2006	WEST 2006, 2008	Noble Clinton, NY (09)		Jain et al. 2010b
Dillon, CA		Chatfield et al. 2009	Noble Ellenburg, NY (08)		Jain et al. 2009b
Dry Lake, AZ	Thompson et al. 2011	Thompson et al. 2011	Noble Ellenburg, NY (09)		Jain et al. 2010c
Elkhorn, OR (08)	WEST 2005	Jeffrey et al. 2009b	NPPD Ainsworth, NE		Derby et al. 2007
Elkhorn, OR (10)		Enk et al. 2011b	Pebble Springs, OR		Gritski and Kronner 2010b
Elm Creek, MN		Derby et al. 2010c	Pine Tree, CA		BioResource Consultants 2010
Foote Creek Rim, WY (Phase I; 99)	Johnson et al. 2000b	Young et al. 2003b	Shiloh I, CA		Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 00)		Young et al. 2003b	Stateline, OR/WA (02)	Erickson et al. 2003a	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)		Young et al. 2003b	Stateline, OR/WA (03)		Erickson et al. 2004
Goodnoe, WA		URS Corporation 2010a	Stateline, OR/WA (06)		Erickson et al. 2007
Grand Ridge, IL	Derby et al. 2009	Derby et al. 2010g	Summerview, Alb (06)		Brown and Hamilton 2006
Hay Canyon, OR		Gritski and Kronner 2010a	Tuolumne (Windy Point I), WA	Johnson et al. 2006	Enz and Bay 2010
Hopkins Ridge, WA (06)	Young et al. 2003a	Young et al. 2007	Vansycle, OR	WCIA and WEST 1997	Erickson et al. 2000b
Hopkins Ridge, WA (08)		Young et al. 2009c	Wessington Springs, SD	Derby et al. 2008	Derby et al. 2010f
Kewaunee County, WI		Howe et al. 2002	Wild Horse, WA	Erickson et al. 2003c	Erickson et al. 2008
Klondike, OR	Johnson et al. 2002	Johnson et al. 2003b	Winnebago, IA		Derby et al. 2010e

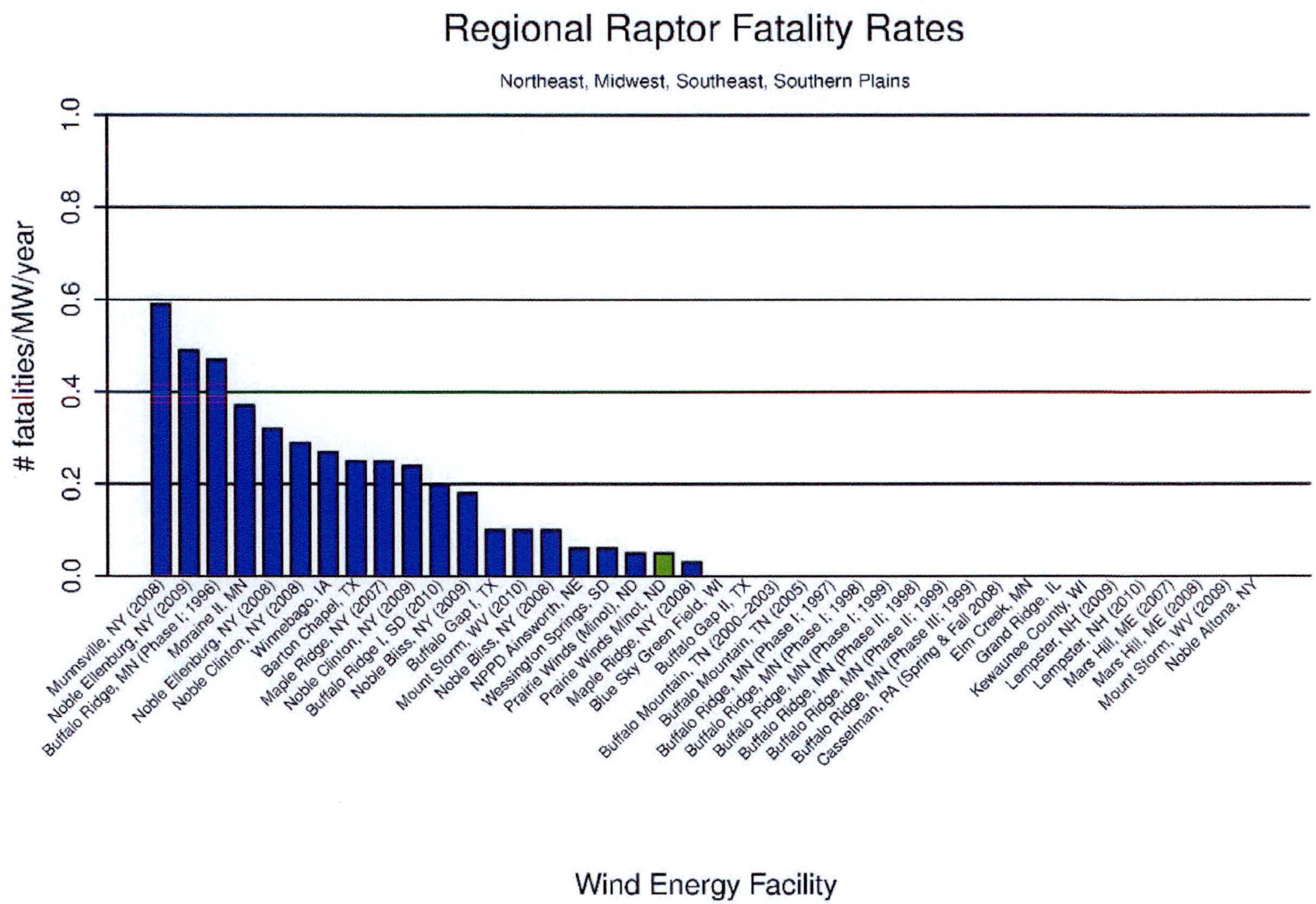

Figure 7.1-2. Comparable fatality rates for raptors (number of raptors per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America. PrairieWinds ND1 Wind Facility (2011) data is highlighted in green.

Figure 7.1-2 (*continued*). Comparable fatality rates for raptors (number of raptors per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America.

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND (2011)	This study				
PrairieWinds ND1, ND (2010)	Derby et al. 2011b				
Munnsville, NY (08)	Stantec 2009b	Mount Storm, WV (10)	Young et al. 2010a, 2011	Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a
Noble Ellenburg, NY (09)	Jain et al. 2010c	Noble Bliss, NY (08)	Jain et al. 2009e	Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	NPPD Ainsworth, NE	Derby et al. 2007	Casselman, PA (Spring & Fall 08)	Arnett et al. 2009
Moraine II, MN	Derby et al. 2010d	Wessington Springs, SD	Derby et al. 2010f	Elm Creek, MN	Derby et al. 2010c
Noble Ellenburg, NY (08)	Jain et al. 2009b	Maple Ridge, NY (08)	Jain et al. 2009d	Grand Ridge, IL	Derby et al. 2010g
Noble Clinton, NY (08)	Jain et al. 2009c	Blue Sky Green Field, WI	Gruver et al. 2009	Kewaunee County, WI	Howe et al. 2002
Winnebago, IA	Derby et al. 2010e	Buffalo Gap II, TX	Tierney 2009	Lempster, NH (09)	Tidhar et al. 2010
Barton Chapel, TX	WEST 2011	Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Lempster, NH (10)	Tidhar et al. 2011
Maple Ridge, NY (07)	Jain et al. 2009a	Buffalo Mountain, TN (05)	Fiedler et al. 2007	Mars Hill, ME (07)	Stantec 2008
Noble Clinton, NY (09)	Jain et al. 2010b	Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mars Hill, ME (08)	Stantec 2009a
Buffalo Ridge I, SD (10)	Derby et al. 2010b	Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Noble Bliss, NY (09)	Jain et al. 2010a	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Noble Altona, NY	Jain et al. 2011b
Buffalo Gap I, TX	Tierney 2007	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a		

7.2 Bat Fatalities

During this study, a total of 10 bat fatalities were found, with the majority of those found during the fall. No fatalities were located during the spring season. This is consistent with other fatality studies in the US which have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005, Arnett et al. 2008).

Bat fatality estimates from other wind energy studies across North America ranged from 0.10 to 39.70 bat fatalities/MW/study period (Tierney 2007, Fiedler et al. 2007; Table 7.2-1). The estimated bat fatality rate of 1.39 bat fatalities/MW/study period at the PWND1 in 2011 was slightly lower than the 2010 estimated fatality rate of 2.13 bat fatalities/MW/study period. Furthermore, the estimated bat fatality rate for 2011 ranked 53rd when compared to other studies at wind energy facilities in eastern North America (Figure 7.2-1).

Generally, the highest fatality estimates for bats have come from the eastern US, particularly from the Appalachian region, where fatality estimates have ranged as high as 39.70 bat fatalities per MW (Fiedler et al. 2007), and from eastern portions of the Midwest and parts of the Northeast (Table 7.2-1). In the Midwest, fatality estimates for bats from wind energy facilities studied between 1998 and 2010 ranged between 0.16 and 30.61 bat fatalities per MW (Derby et al. 2010b, BHE Environmental 2010; Table 7.2-1). Overall bat mortalities at PWND1 were within the range found at other sites in the Midwest and lower than many recent studies from the region, with most of those studies coming from the eastern side of the Midwest.

Similar to 2010, the majority of bat fatalities identified at the PWND1 were composed of one migratory tree bat (hoary bat); which is one of the most frequently found species at most other wind energy facilities in the Midwest (Jain 2005, Gruver et al. 2009). Based on the timing of fatalities for hoary bat and the lack of forest cover that might provide habitat for resident bats, most of the fatalities were likely of migratory bats, which is typically the case at other wind energy facilities in North America (Johnson 2005, Arnett et al. 2008).

Table 7.2-1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1, ND (2011)	**n/a**	**n/a**	**1.39**	**80**	**120**
PrairieWinds ND1, ND (2010)	**n/a**	**n/a**	**2.13**	**80**	**120**
	Midwest				
Cedar Ridge, WI (2009)	9.97 [C,D,E]	7/16/07-9/30/07	30.61	41	67.6
Blue Sky Green Field, WI	7.70 [F]	7/24/07-10/29/07	24.57	88	145
Cedar Ridge, WI (2010)	9.97 [C,D,E]	7/16/07-9/30/07	24.12	41	68
Forward Energy Center, WI	6.97	8/5/08-11/08/08	18.17	86	129
Top of Iowa, IA (2004)	35.70	5/26/04-9/24/04	10.27	89	80
Crystal Lake II, IA	n/a	n/a	7.42	80	200
Top of Iowa, IA (2003)	n/a	n/a	7.16	89	80
Kewaunee County, WI	n/a	n/a	6.45	31	20.46
Ripley, Ont (2008)	n/a	n/a	4.67	38	76
Winnebago, IA	n/a	n/a	4.54	10	20
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.20 [D]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.20 [D]	6/15/01-9/15/01	3.71	138	103.5
Crescent Ridge, IL	n/a	n/a	3.27	33	54.45
Buffalo Ridge, MN (Phase III; 1999)	n/a	n/a	2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)	n/a	n/a	2.59	143	107.25
Moraine II, MN	n/a	n/a	2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)	n/a	n/a	2.16	143	107.25
Grand Ridge, IL	n/a	n/a	2.10	66	99
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.90 [D]	6/15/02-9/15/02	1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.90 [D]	6/15/02-9/15/02	1.64	143	107.25
Elm Creek, MN	n/a	n/a	1.49	67	100
Wessington Springs, SD	n/a	n/a	1.48	34	51
NPPD Ainsworth, NE	n/a	n/a	1.16	36	20.5
Buffalo Ridge, MN (Phase I; 1999)	n/a	n/a	0.74	73	25
Cedar Ridge, WI (2009)	9.97	7/16/07-9/30/07	0.16	24	50.4

Table 7.2-1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
	Northeast				
Mountaineer, WV (2003)	n/a	n/a	31.69	44	66
Mountaineer, WV (2004)	38.3 [E]	8/1/04-9/14/04	25.17	44	66
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	24.32	132	264
Noble Wethersfield, NY	n/a	n/a	16.30	84	126
Mount Storm, WV (2010)	36.67[H]	4/18/10-10/15/10	15.18	132	264
Casselman, PA (Spring & Fall 2008)	n/a	n/a	12.61	23	34.5
Maple Ridge, NY (2006)	n/a	n/a	11.21	120	198
Cohocton/Dutch Hills, NY (2010)	n/a	n/a	10.32	50	125
Maple Ridge, NY (2007)	n/a	n/a	9.42	195	321.75
Cohocton/Dutch Hill, NY (2009)	n/a	n/a	8.62	50	125
Noble Bliss, NY (2008)	n/a	n/a	7.80	67	100
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Wolfe Island, Ont (July-December 2009)	n/a	n/a	6.42	86	197.8
Maple Ridge, NY (2008)	n/a	n/a	4.96	195	321.75
Noble Clinton, NY (2009)	1.9 [C]	8/1/09-09/31/09	4.5	67	100
Noble Altona, NY	n/a	n/a	4.34	65	97.5
Noble Ellenburg, NY (2009)	16.1 [C]	8/16/09-09/15/09	3.91	54	80
Noble Bliss, NY (2009)	n/a	n/a	3.85	67	100
Lempster, NH (2010)	n/a	n/a	3.57	12	24
Noble Ellenburg, NY (2008)	n/a	n/a	3.46	54	80
Noble Clinton, NY (2008)	2.1 [C]	8/8/08-09/31/08	3.14	67	100
Lempster, NH (2009)	n/a	n/a	3.11	12	24
Mars Hill, ME (2007)	n/a	n/a	2.91	28	42
Noble Chateaugay, NY	n/a	n/a	2.44	71	106.5
Munnsville, NY (2008)	n/a	n/a	1.93	23	34.5
Stetson Mountain, ME (2009)	28.5; 0.3 [G]	7/10/09-10/15/09	1.40	38	57
Mars Hill, ME (2008)	n/a	n/a	0.45	28	42
	Southeast				
Buffalo Mountain, TN (2005)	n/a	n/a	39.70	18	28.98
Buffalo Mountain, TN (2000-2003)	23.70[E]	n/a	31.54	3	1.98
	Southern Plains				
Barton Chapel, TX	n/a	n/a	3.06	60	120
Buffalo Gap II, TX	n/a	n/a	0.14	155	233
Buffalo Gap I, TX	n/a	n/a	0.10	67	134
	Southwest				
Dry Lake, AZ	8.8	4/29/10-11/10/10	4.29	30	63
	Rocky Mountains				
Summerview, Alb (2008)	7.65[D]	07/15/06-07-09/30/06-07	11.42	39	70.2
Judith Gap, MT (2006/2007)	n/a	n/a	8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)	n/a	n/a	3.97	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2 [D,E]	6/15/01-9/1/01	1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2 [D,E]	6/15/00-9/1/00	1.05	69	41.4

Table 7.2-1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
	California				
Shiloh I, CA	n/a	n/a	3.92	100	150
High Winds, CA (2004)	n/a	n/a	2.51	90	162
Dillon, CA	n/a	n/a	2.17	45	45
High Winds, CA (2005)	n/a	n/a	1.52	90	162
Alite, CA	n/a	n/a	0.24	8	24
	Pacific Northwest				
Biglow Canyon, OR (Phase II; 2009/2010)	n/a	n/a	2.71	65	150
Nine Canyon, WA	n/a	n/a	2.47	37	48.1
Stateline, OR/WA (2003)	n/a	n/a	2.29	454	263
Elkhorn, OR (2010)	n/a	n/a	2.14	61	101
Biglow Canyon, OR (Phase I; 2008)	n/a	n/a	1.99	76	125.4
Leaning Juniper, OR	n/a	n/a	1.98	67	100.5
Big Horn, WA	n/a	n/a	1.90	133	199.5
Combine Hills, OR	n/a	n/a	1.88	41	41
Pebble Springs, OR	n/a	n/a	1.55	47	98.7
Hopkins Ridge, WA (2008)	n/a	n/a	1.39	87	156.6
Elkhorn, OR (2008)	n/a	n/a	1.26	61	101
Vansycle, OR	n/a	n/a	1.12	38	24.9
Klondike III (Phase I), OR	n/a	n/a	1.11	125	223.6
Stateline, OR/WA (2002)	n/a	n/a	1.09	454	263
Stateline, OR/WA (2006)	n/a	n/a	0.95	454	263
Tuolumne (Windy Point I), WA	n/a	n/a	0.94	62	136.6
Klondike, OR	n/a	n/a	0.77	16	24
Hopkins Ridge, WA (2006)	n/a	n/a	0.63	83	150
Biglow Canyon, OR (Phase I; 2009)	n/a	n/a	0.58	76	125.4
Hay Canyon, OR	n/a	n/a	0.53	48	100.8
Klondike II, OR	n/a	n/a	0.41	50	75
Wild Horse, WA	n/a	n/a	0.39	127	229
Goodnoe, WA	n/a	n/a	0.34	47	94
Marengo II, WA (2009)	n/a	n/a	0.27	39	70.2
Marengo I, WA (2009)	n/a	n/a	0.17	78	140.4
Klondike IIIa (Phase II), OR	n/a	n/a	0.16	51	76.5

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F= Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently
G = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle
H = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer and fall seasons

Table 7.2-1 (*continued*) Wind energy facilities in North America with mortality data for bat species.
Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
PrairieWinds ND1, ND (2011)		This study			
PrairieWinds ND1, ND (2010)		Derby et al. 2011b			
Alite, CA		Chatfield et al. 2010	Klondike II, OR		NWC and WEST 2007
Barton Chapel, TX		WEST 2011	Klondike III, OR		Gritski et al. 2010
Big Horn, WA		Kronner et al. 2008	Klondike IIIa, OR		Gritski et al. 2011
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009a	Leaning Juniper, OR		Kronner et al. 2007
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Lempster, NH (2009)		Tidhar et al. 2010
Biglow Canyon, OR (Phase II; 09/10)		Enk et al. 2011a	Lempster, NH (2010)		Tidhar et al. 2011
Blue Sky Green Field, WI	Gruver 2008	Gruver et al. 2009	Maple Ridge, NY (2006)		Jain et al. 2007
Buffalo Gap I, TX		Tierney 2007	Maple Ridge, NY (2007)		Jain et al. 2009a
Buffalo Gap II, TX		Tierney 2009	Maple Ridge, NY (2008)		Jain et al. 2009d
Buffalo Mountain, TN (2000-03)	Fiedler 2004	Nicholson et al. 2005	Marengo I, WA (2009)		URS Corporation 2010b
Buffalo Mountain, TN (2005)		Fiedler et al. 2007	Marengo II, WA (2009)		URS Corporation 2010c
Buffalo Ridge, MN (Phase I; 99)		Johnson et al. 2000a	Mars Hill, ME (2007)		Stantec 2008
Buffalo Ridge, MN (Phase II; 98)		Johnson et al. 2000a	Mars Hill, ME (2008)		Stantec 2009a
Buffalo Ridge, MN (Phase II; 99)		Johnson et al. 2000a	Moraine II, MN		Derby et al. 2010d
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (Fall 08)	Young et al. 2009b	Young et al. 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (2009)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase III; 99)		Johnson et al. 2000a	Mount Storm, WV (2010)	Young et al. 2010a, 2011	Young et al. 2010a, 2011
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mountaineer, WV (2003)		Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mountaineer, WV (2004)	Arnett et al. 2005, Arnett pers. comm.	Arnett et al. 2005
Buffalo Ridge I, SD (2010)		Derby et al. 2010b	Munnsville, NY (2008)		Stantec 2009b
Casselman, PA (Spring & Fall 2008)		Arnett et al. 2009	Nine Canyon, WA		Erickson et al. 2003b
Cedar Ridge, WI (2009)	BHE Environmental 2008	BHE Environmental 2010	Noble Altona, NY		Jain et al. 2011b
Cedar Ridge, WI (2010)	BHE Environmental 2008	BHE Environmental 2011	Noble Bliss, NY (2008)		Jain et al.2009e
Cohocton/Dutch Hill, NY (09)		Stantec 2010	Noble Bliss, NY (2009)		Jain et al. 2010a
Cohocton/Dutch Hill, NY (10)		Stantec 2011	Noble Chateaugay, NY		Jain et al. 2011c
Combine Hills, OR		Young et al. 2006	Noble Clinton, NY (2008)	Reynolds 2010a	Jain et al. 2009c
Crescent Ridge, IL		Kerlinger et al. 2007	Noble Clinton, NY (2009)	Reynolds 2010a	Jain et al. 2010b
Crystal Lake II, IA		Derby et al. 2010a	Noble Ellenburg, NY (2008)		Jain et al. 2009b
Dillon, CA		Chatfield et al. 2009	Noble Ellenburg, NY (2009)	Reynolds 2010b	Jain et al. 2010c
Dry Lake I, AZ	Thompson et al. 2011	Thompson et al. 2011	Noble Wethersfield, NY		Jain et al. 2011a
Elkhorn, OR (2008)		Jeffrey et a. 2009b	NPPD Ainsworth, NE		Derby et al. 2007
Elkhorn, OR (2010)		Enk et al. 2011b	Pebble Springs, OR		Gritski and Kronner 2010b
Elm Creek, MN		Derby et al. 2010c	Ripley, Ont (2008)		Jacques Whitford 2009
Foote Creek Rim, WY (Phase I; 99)		Young et al. 2003b	Shiloh I, CA		Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (2002)		Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 2001-02)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (2003)		Erickson et al. 2004
Forward Energy Center, WI	Watt and Drake 2011	Grodsky and Drake 2011	Stateline, OR/WA (2006)		Erickson et al. 2007
Goodnoe, WA		URS Corporation 2010a	Stetson Mountain, ME (09)	Stantec 2009c	Stantec 2009c
Grand Ridge, IL		Derby et al. 2010g	Summerview, Alb (2008)	Baerwald 2008	Baerwald 2008
Hay Canyon, OR		Gritski and Kronner 2010a	Top of Iowa, IA (2003)		Jain 2005
High Winds, CA (2004)		Kerlinger et al. 2006	Top of Iowa, IA (2004)	Jain 2005	Jain 2005
High Winds, CA (2005)		Kerlinger et al. 2006	Tuolumne (Windy Point I), WA		Enz and Bay 2010
Hopkins Ridge, WA (2006)		Young et al. 2007	Vansycle, OR		Erickson et al. 2000a
Hopkins Ridge, WA (2008)		Young et al. 2009c	Wessington Springs, SD		Derby et al. 2010f
Judith Gap, MT		TRC 2008	Wild Horse, WA		Erickson et al. 2008
Kewaunee County, WI		Howe et al. 2002	Winnebago, IA		Derby et al. 2010e
Klondike, OR		Johnson et al. 2003a	Wolfe Island, Ont (Jul-Dec 09)		Stantec Ltd. 2010

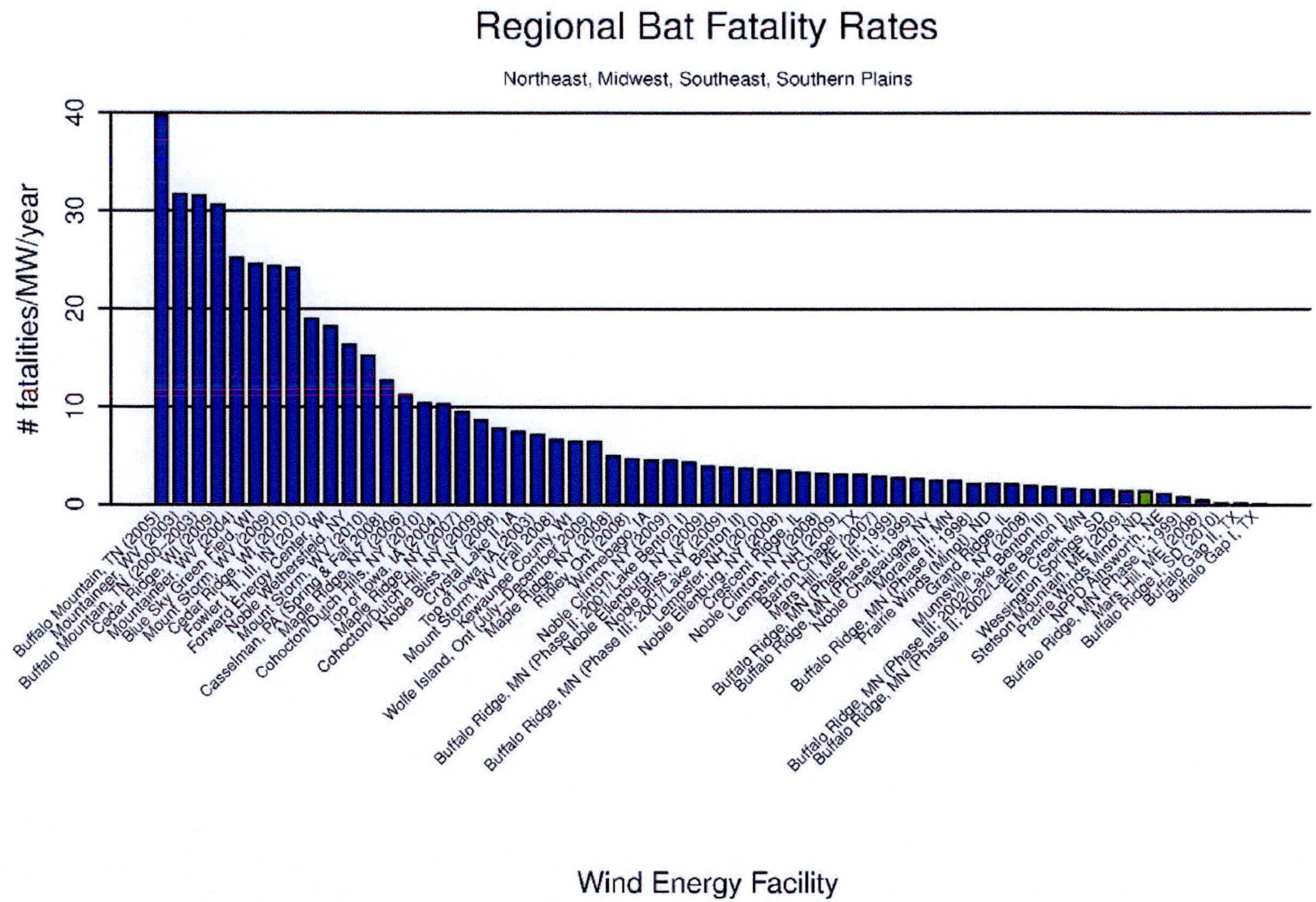

Figure 7.2-1. Comparable fatality rates for bats (number of bats per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America. PrairieWinds ND1 Wind Facility (2011) data is highlighted in green.

Figure 7.2-1 (*continued*). Comparable fatality rates for bats (number of bats per megawatt per year) from publicly-available studies at wind energy facilities in eastern North America..

Data from the following sources:

Facility, Location	Fatality Reference	Facility, Location	Fatality Reference	Facility, Location	Fatality Reference
PrairieWinds ND1, ND (2011)	This study				
PrairieWinds ND1, ND (2010)	Derby et al. 2011b				
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Crystal Lake II, IA	Derby et al. 2010a	Mars Hill, ME (07)	Stantec 2008
Mountaineer, WV (2003)	Kerns and Kerlinger 2004	Top of Iowa, IA (03)	Jain 2005	Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Mount Storm, WV (Fall 08)	Young et al. 2009b	Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a
Cedar Ridge, WI (2009)	BHE Environmental 2010	Kewaunee County, WI	Howe et al. 2002	Noble Chateaugay, NY	Jain et al. 2011c
Mountaineer, WV (2004)	Arnett et al. 2005	Wolfe Island, Ont (Jul-Dec 09)	Stantec Ltd. 2010	Moraine II, MN	Derby et al. 2010d
Blue Sky Green Field, WI	Gruver et al. 2009	Maple Ridge, NY (08)	Jain et al. 2009d	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a
Mount Storm, WV (09)	Young et al. 2009a, 2010b	Ripley, Ont (08)	Jacques Whitford 2009	Grand Ridge, IL	Derby et al. 2010g
Cedar Ridge, WI (09)	BHE Environmental 2010	Winnebago, IA	Derby et al. 2010e	Munnsville, NY (08)	Stantec 2009b
Fowler I, II, III, IN (10)	Good et al. 2011	Noble Clinton, NY (09)	Jain et al. 2010b	Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004
Forward Energy Center, WI	Grodsky and Drake 2011	Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004
Noble Wethersfield, NY	Jain et al. 2011a	Noble Ellenburg, NY (09)	Jain et al. 2010c	Elm Creek, MN	Derby et al. 2010c
Mount Storm, WV (10)	Young et al. 2010a, 2011	Noble Bliss, NY (09)	Jain et al. 2010a	Wessington Springs, SD	Derby et al. 2010f
Casselman, PA (Spring & Fall 08)	Arnett et al. 2009	Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Stetson Mountain, ME (09)	Stantec 2009c
Maple Ridge, NY (06)	Jain et al. 2007	Lempster, NH (10)	Tidhar et al. 2011	NPPD Ainsworth, NE	Derby et al. 2007
Cohocton/Dutch Hill, NY (10)	Stantec 2011	Noble Ellenburg, NY (08)	Jain et al. 2009b	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a
Top of Iowa, IA (04)	Jain 2005	Crescent Ridge, IL	Kerlinger et al. 2007	Mars Hill, ME (08)	Stantec 2009a
Maple Ridge, NY (07)	Jain et al. 2009a	Noble Clinton, NY (08)	Jain et al. 2009c	Buffalo Ridge I, SD (10)	Derby et al. 2010b
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Lempster, NH (09)	Tidhar et al. 2010	Buffalo Gap II, TX	Tierney 2009
Noble Bliss, NY (08)	Jain et al. 2009e	Barton Chapel, TX	WEST 2011	Buffalo Gap I, TX	Tierney 2007

8.0 CONCLUSIONS

The bird fatality rate at the PWND1 (1.56 birds/MW/study period or 2.34 birds/turbine/study period) was lower than the average but within the range for other facilities in the Midwest and within the overall range of projects with publically available data from across the nation.

Raptor fatality rates at the PWND1 (0.05 raptors/MW/study period or 0.08 raptors/turbine/study period) was on the lower end of the fatality range of other wind facilities with publically-available data across North America.

The bat fatality rate at the PWND1 (1.39 bats/MW/study period or 2.09 bats/turbine/study period) was found to be similar to or lower than most facilities in the west and Midwest and lower than most facilities in the east.

9.0 REFERENCES

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10.0 APPENDIX A

Seasonal Bird and Bat Fatality Rate Estimations at the PrairieWinds ND1 (2011) Wind Facility from March 15 through October 29, 2011

Appendix A1. Bootstrap point estimates (mean) and lower (ll) and upper (ul) limits of 90 percent confidence intervals (CI) for seasonal small and large bird fatality rate estimates at the PrairieWinds ND1 (2011) Wind Facility for studies conducted from March 15, to October 29, 2011.

	Spring (3/15/11-5/10/11)			Early Summer (5/11/11-7/3/11)			Late Summer (7/4/11-8/14/11)			Early Fall (8/15/11-9/11/11)			Late Fall (9/12/11-10/31/11)		
		90% CI			90% CI			90% CI			90% CI			90% CI	
	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul
Search Area Adjustment															
Large Bird	1.02	--	--	1.02	--	--	1.32	--	--	NA	--	--	1.02	--	--
Small Bird	1.04	--	--	1.04	--	--	NA	--	--	2.59	--	--	1.04	--	--
Average Search Interval															
Large Bird	14.95	--	--	13.98	--	--	14.13	--	--	14.14	--	--	14.18	--	--
Small Bird	14.95	--	--	13.98	--	--	14.13	--	--	14.14	--	--	14.18	--	--
Observer Detection															
Large Bird	0.76	0.62	0.90	0.76	0.62	0.90	0.76	0.62	0.90	0.76	0.62	0.90	0.76	0.62	0.90
Small Bird	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39
Average Removal Time															
Large Bird	33.88	22.64	52.93	33.88	22.64	52.93	33.88	22.64	52.93	33.88	22.64	52.93	33.88	22.64	52.93
Small Bird	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20
Observed Fatality Rates (fatalities/turbine/turbine type/season)															
Large Bird	0.17	0.03	0.32	0.34	0.23	0.49	0.09	0.03	0.17	0.00	--	--	0.06	0.00	0.11
Small Bird	0.17	0.06	0.29	0.03	0.00	0.09	0.00	--	--	0.06	0.00	0.11	0.03	0.00	0.09
Average Probability of Carcass Availability and Detected															
Large Bird	0.73	0.61	0.83	0.74	0.61	0.83	0.74	0.61	0.83	0.74	0.61	0.83	0.74	0.61	0.83
Small Bird	0.27	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43
Seasonal Adjusted Fatality Estimates (fatalities/turbine/study period)															
Large Bird	0.24	0.05	0.47	0.47	0.30	0.69	0.15	0.05	0.29	0.00	--	--	0.08	0.00	0.19
Small Bird	0.66	0.19	1.52	0.10	0.00	0.35	0.00	--	--	0.52	0.00	1.45	0.11	0.00	0.35

Overall Adjusted Fatality Estimates (fatalities/turbine/study period)

		90% Bootstrap Confidence Limits	
	Mean	**Lower Limit**	**Upper Limit**
Large Bird	**0.95**	**0.63**	**1.32**
Small Bird	**1.39**	**0.65**	**2.78**
All Birds	**2.34**	**1.56**	**3.79**
Raptors	**0.08**	**0.00**	**0.19**
Waterfowl	**0.66**	**0.40**	**0.96**

Appendix A2. Bootstrap point estimates (mean) and lower (ll) and upper (ul) limits of 90 percent confidence intervals (CI) for seasonal small and large bird fatality rate estimates at the PrairieWinds ND1 (2011) Wind Facility for studies conducted from March 15, to October 29, 2011.

	Spring (3/15/11-5/10/11)			Early Summer (5/11/11-7/3/11)			Late Summer (7/4/11-8/14/11)			Early Fall (8/15/11-9/11/11)			Late Fall (9/12/11-10/31/11)		
		90% CI			90% CI			90% CI			90% CI			90% CI	
	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul	mean	ll	ul
Search Area Adjustment															
Bats	1.02	--	--	1.02	--	--	1.31	--	--	2.99	--	--	1.02	--	--
Average Search Interval															
Bats	14.95	--	--	13.98	--	--	14.13	--	--	14.14	--	--	14.18	--	--
Observer Detection															
Bats	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39	0.26	0.13	0.39
Average Removal Time															
Bats	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20	19.08	13.37	27.20
Observed Fatality Rates (fatalities/turbine/turbine type/season)															
Bats	0.00	--	--	0.03	0.00	0.09	0.06	0.00	0.11	0.14	0.03	0.26	0.06	0.00	0.11
Average Probability of Carcass Availability and Detected															
Bats	0.27	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43	0.28	0.14	0.43
Adjusted Fatality Estimates (fatalities/turbine/study period)															
Bats	0.00	--	--	0.10	0.00	0.34	0.27	0.00	0.73	1.52	0.38	3.68	0.21	0.00	0.58

Overall Adjusted Fatality Estimates (fatalities/turbine/study period)

		90% Bootstrap Confidence Limits	
	Mean	**Lower Limit**	**Upper Limit**
Bats	**2.09**	**0.90**	**4.43**

RESPONSE #10

Basin Electric
Complaint Procedures

If Basin Electric receives a complaint, that complaint would be directed to the Property and Right of Way Department. Basin Electric will investigate the complaint and develop a response and course of action. Depending on the nature of the complaint, Property and Right of Way staff may need to contact the Project Manager or Facility Manager as appropriate. The complaint and resolution will be documented.