

EAGLE CONSERVATION PLAN FOR THE CEDAR CREEK WIND ENERGY PROJECT

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Appendix A: Wildlife Studies Conducted for the Cedar Creek Wind Project.

1.0 INTRODUCTION

Cedar Creek Wind Energy, LLC (Cedar Creek) has developed this Eagle Conservation Plan (ECP) that documents compliance with the regulatory requirements to support issuance of an Eagle Take Permit (ETP) covering non-purposeful take of bald and golden eagles from activities at the Cedar Creek Wind Energy Facility (Project). Cedar Creek submitted an application, along with this ECP, for a 30-year programmatic ETP for the Project on October 11, 2019.

This ECP follows U.S. Fish and Wildlife Service (USFWS) Region 6 Migratory Bird Management Office guidance for ECPs, dated July 23, 2019. Since the Project has been in operation since 2008, this ECP documents potential risks to bald and golden eagles from Project operations, and implementation of conservation measures designed to avoid or reduce risk to eagles to the maximum degree practicable relative to the magnitude of impacts to eagles. Finally, the ECP documents monitoring procedures and adaptive management for impacts to eagles during operation of the Project.

In addition to this ECP, the Project has developed an Avian Protection Plan, updated in May 2014, based on the Land-Based Wind Energy Guidelines (WEG; USFWS 2012).

1.1 Project Background

The Project is located in northern Weld County, Colorado, approximately five miles (mi; eight kilometers [km]) east of Grover, Colorado (Figure 1.1). The overall Project area is 31,670-acres (12,816-hectares [ha]; Figure 1.2), but Project infrastructure physically impacts approximately 118 acres (48 ha; Table 1.1). The Project layout is located mostly on private land, though there are some parcels of state land managed by the State of Colorado (Figure 1.1). While the Project is located within the nominal boundary of the Pawnee National Grassland, no Project facilities are located on federal lands. Construction began in late 2006 and was completed in late 2007. All 274 turbines were erected and online by January 1, 2008. Electricity generated is sold to Public Services Company of Colorado under a Power Purchase Agreement, which expires in November 2027.

The Project includes 221 1-megawatt (MW) Mitsubishi turbines and 53 1.5-MW General Electric turbines. The Mitsubishi MWT-1000A turbines have a nameplate rating of 1,000 kilowatts (kW; 1 MW), and have a 201-foot (ft; 61.4-meter [m]) rotor diameter with a rotor swept area of approximately 31,872 ft² (2,961 m²). The Mitsubishi turbine nacelles are mounted on towers with a hub height of 197 or 226 ft (60 or 69 m), and the maximum rotor tip height above ground is 276 ft (84 m), while the minimum tip height above ground is 72 ft (22 m). The GE Energy 1.5SLE 60Hz turbines have a nameplate rating of 1,500 kW (1.5 MW), with a rotor diameter of 77 m. The GE Energy turbines have hub heights of 80 m. The Project as a whole includes associated infrastructure such as access roads, underground collector lines, a substation at the beginning of the generation-tie (gen-tie) line, and an operations and management facility. The gen-tie line is 76.2 mi (122 km) in length and runs south to Keenesburg, Colorado.

Table 1.1 Project Infrastructure and Land Impacts, Cedar Creek Wind Project.

Component	Number	Acres (ac) or Miles (mi) of Extent	Other
Wind Turbines	274	85.1 ac	
O&M Building	1	2.5 ac	
Substation	1	4.0 ac	
MET Tower	2	0.1 ac	Unguyed
Collection Lines	n/a	65.2 mi	Underground
Collection Lines	n/a	17.2 mi	Overhead
Transmission Lines	n/a	76.2 mi	Outside wind project
Access Roads	n/a	51.1 mi	

n/a indicates not applicable

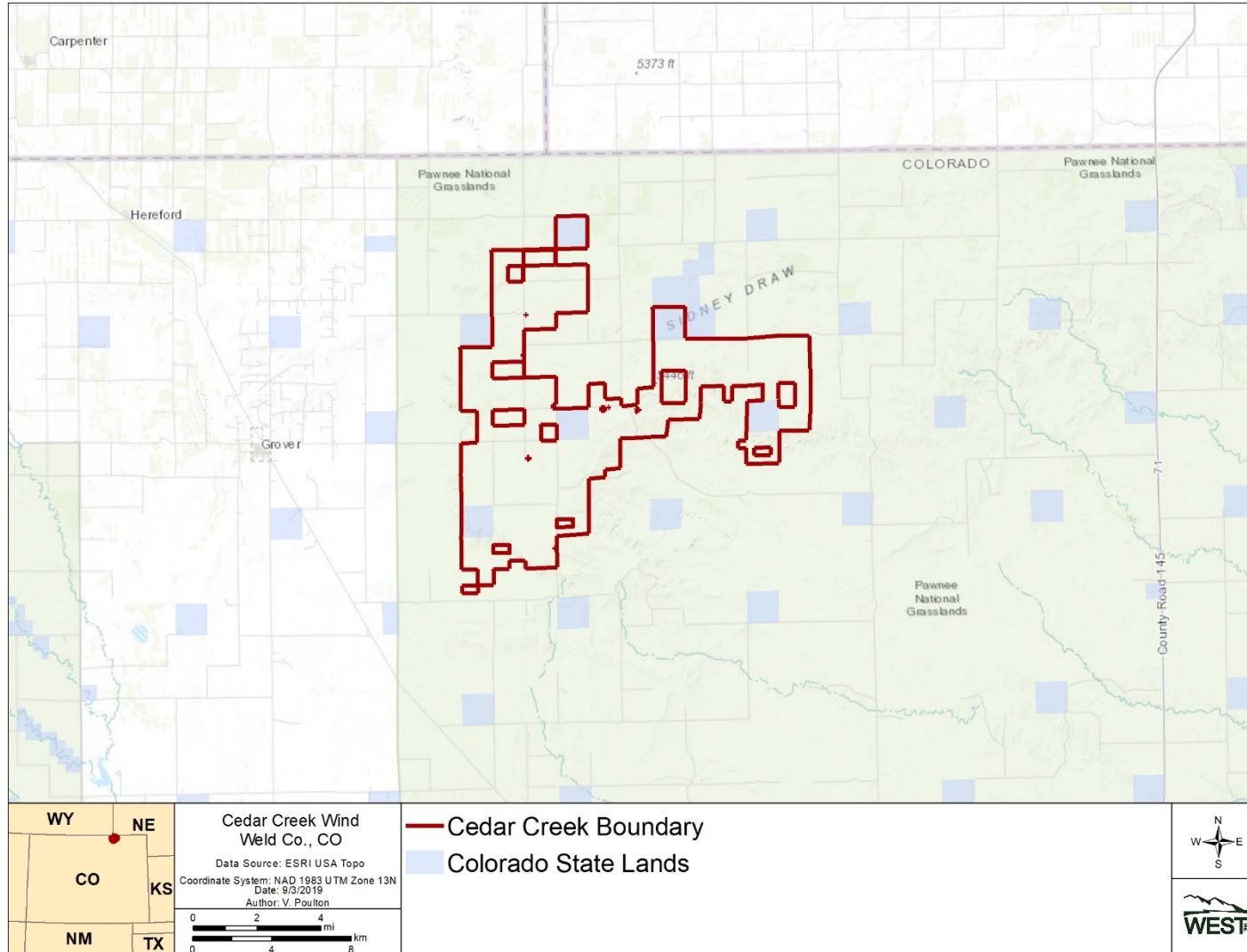


Figure 1.1. General location of the Cedar Creek Wind Energy Project in Weld County, Colorado.

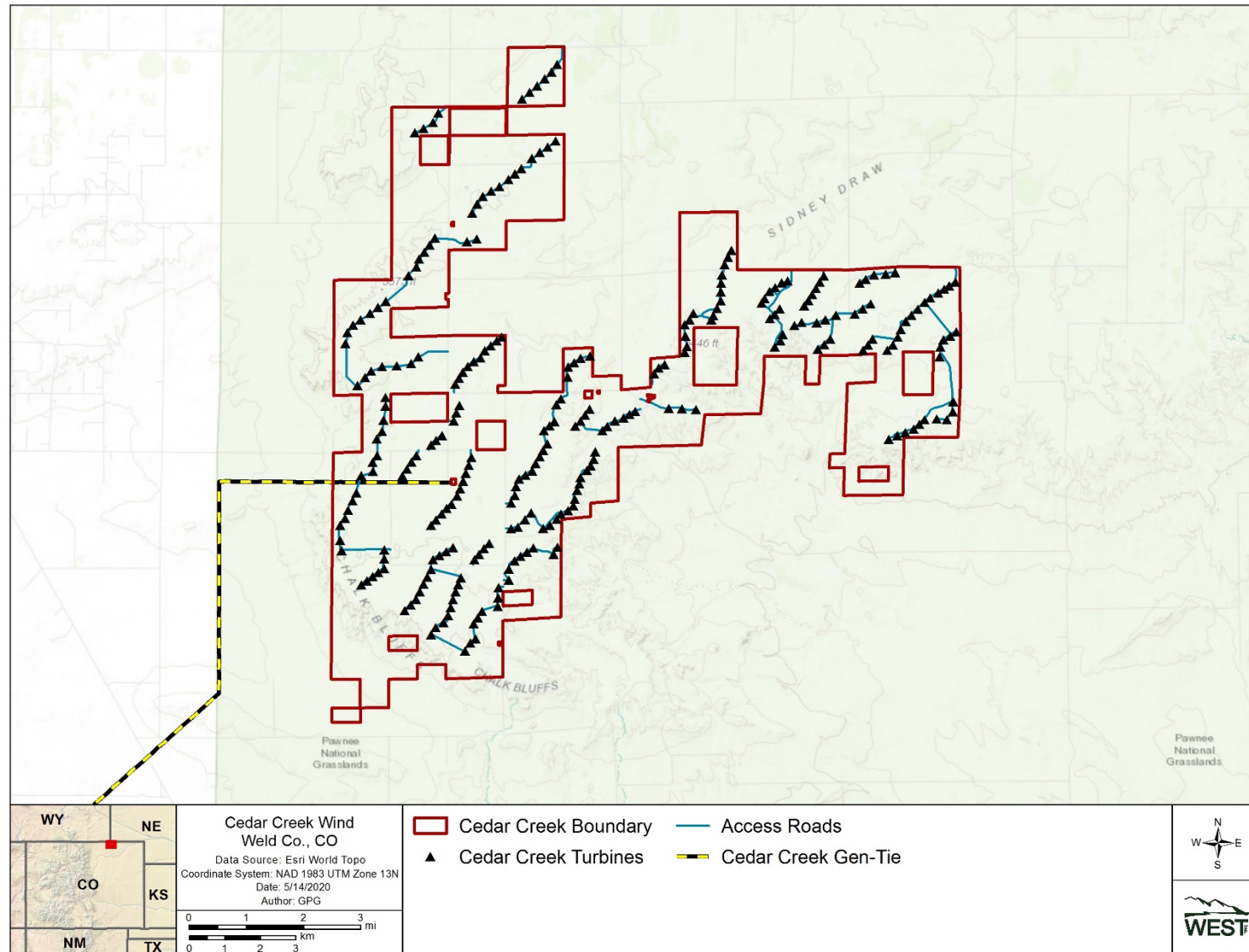


Figure 1.2. Layout of the Cedar Creek Wind Energy Project.

1.2 Environmental Setting

The Project is located on approximately 31,670 acres (48.5 square miles) in the high-altitude plains east of the Rocky Mountains. Elevations within the Project boundary range from approximately 1,700 to 1,524 m (5,575 to 5,000 ft; Figures 1.2 and 1.3). The facility is located on a broad plateau. Topography on the top of the plateau where many of the turbines are located is flat to rolling, while the edges of the plateau are relatively steep and defined, especially along the western and southwestern edges of the Project. The western and southwestern edges of the plateau contain some chalk bluffs and scattered limber pine (*Pinus flexilis*) and juniper (*Juniperus scopulorum*) woodlands. The only water bodies within the site are intermittent drainages (Sidney Draw) and livestock ponds and tanks.

Land use in the Project area is a mosaic of native short-grass prairie used to graze livestock, active agriculture, and areas that formerly were tilled but have been re-seeded with grass species. Land is a mixture of state- and privately owned land and is relatively undeveloped, with the exception of a few rural homes, missile sites, a few existing radio towers, and local power and telephone lines. Of 274 turbines, 21 are on state land and 253 are on privately owned land. The dominant land uses for the area are cattle grazing, wheat production, and wind power development.

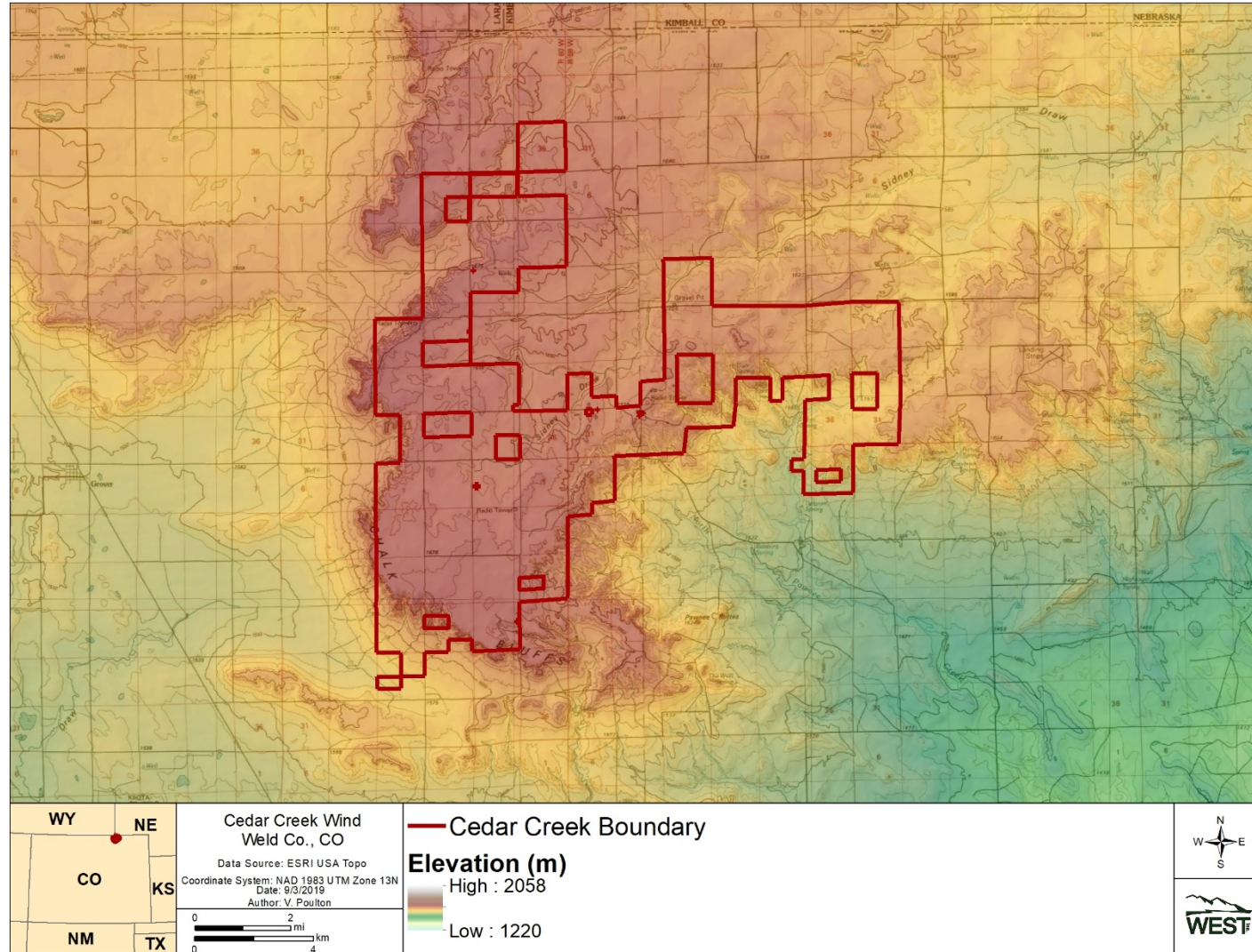


Figure 1.3. Digital elevation map of the Cedar Creek Wind Energy Project.

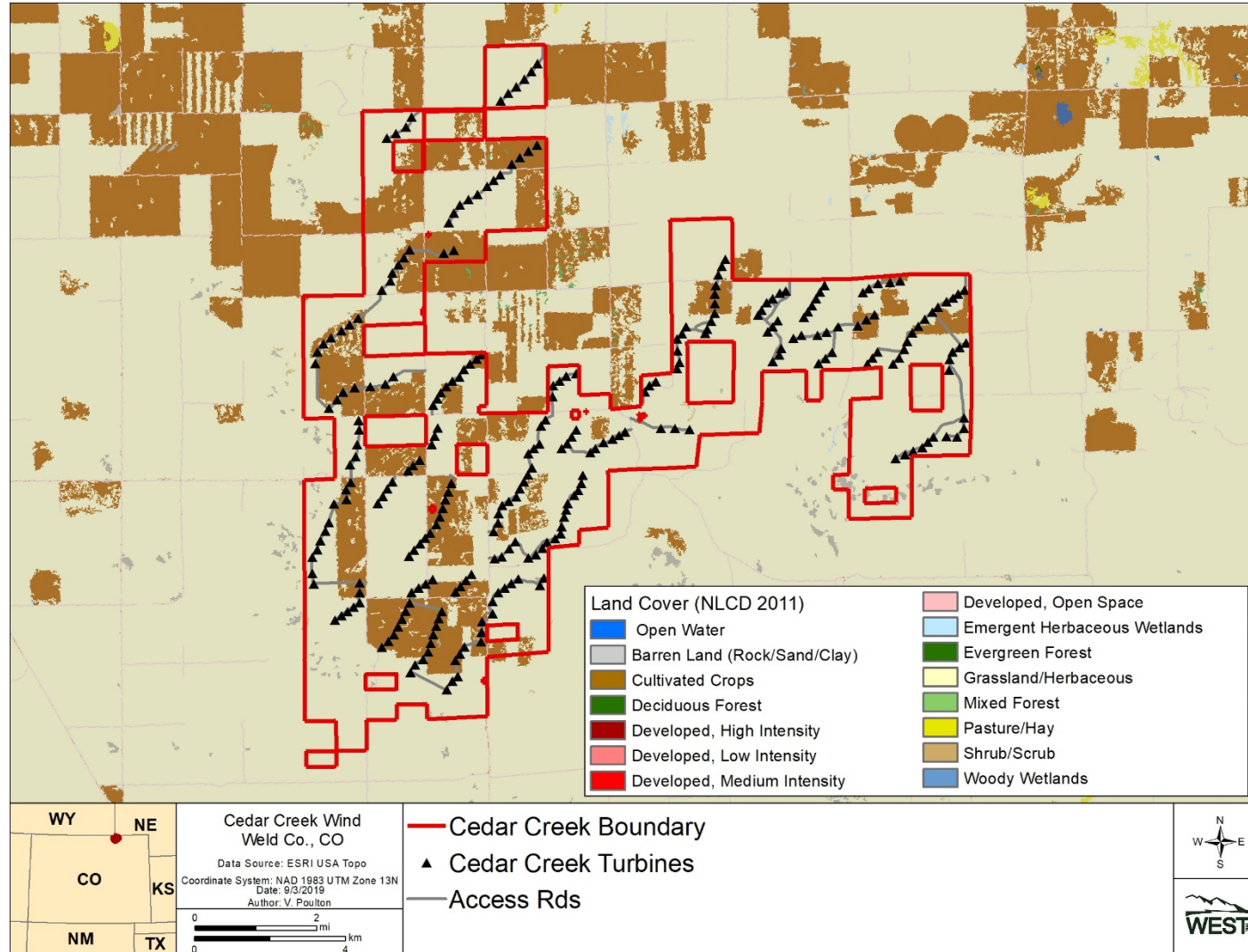


Figure 1.4. Land cover for the Cedar Creek Wind Energy Project.

1.3 Agency Communication

Cedar Creek engaged in an extensive consultation process with the USFWS and Colorado Parks and Wildlife (CPW; formerly known as Colorado Department of Wildlife [CDOW]) concerning the proposed Project.

In a letter dated March 23, 2005, Cedar Creek (through its consultant, Western EcoSystems Technology, Inc. [WEST]) sought USFWS comments on the Potential Impact Index (PII) evaluation for the proposed Cedar Creek Wind Project, which included a comparison of likely impacts at the Project with the likely impacts at other “reference sites” (in this case, the Pawnee National Grassland and the Rocky Mountain Arsenal).

As part of the Project’s application for Weld County permits, the CDOW stated in a letter dated June 25, 2006, that staff had reviewed the Project’s application and consulted with biologists, staff from the USFWS, staff from the Colorado State Land Board (CLSLB), and biologists from the Colorado Natural Area Program of Colorado State Parks. The USFWS also commented on the Project in a letter dated July 12, 2006. The USFWS also requested in a July 24, 2006, letter that the Project (1) respect critical nesting periods during ground-breaking activities; and (2) reconsider the ten turbines then sited within 200 meters of the escarpment edge.

In response to these concerns, as documented in a letter from Cedar Creek to Troy Florian (CDOW) dated August 2, 2006, Cedar Creek conducted multiple meetings, discussions and site visits with CDOW and USFWS personnel, performed extensive preconstruction wildlife surveys on the proposed wind project site, and obtained recommendations from WEST. Based on conversations with CDOW and USFWS, Cedar Creek modified the facility design, including elimination of some turbine locations and incorporation of turbine setbacks from resources of concern, as documented in Section 3 of this ECP. Pre-construction wildlife studies for the Project followed CDOW recommendations. The protocols were based on the final wildlife study guidelines from the CDOW, correspondence received from the CDOW, and a meeting held with CDOW and USFWS officials on September 3, 2008. Protocols used in the study were approved by the USFWS in a letter dated February 3, 2009. CDOW also stated that they had no objections to the proposed protocols in e-mails dated December 12, 2008, and June 26, 2009.

Post-construction monitoring results were shared with the USFWS in 2010, and comments received from USFWS on resulted in conduct of some additional post-construction monitoring surveys. On June 13, 2012, Cedar Creek met with USFWS representatives to discuss the approach and proposed content of the Bird and Bat Conservation Strategy (BBCS), which was drafted in late 2012. Cedar Creek will to continue to coordinate with USFWS throughout the eagle permit process.

1.4 Endangered Species Act Compliance

Based on the Project location, baseline wildlife survey observations, available data, and discussions with USFWS, no impacts to federal listed endangered or threatened species are

anticipated. There is no designated critical habitat for federal listed species in the Project. No activities affect water sources in the North or South Platte River systems.

1.5 Department of Defense and Federal Aviation Administration Coordination

In a letter dated October 31, 2006, the Federal Aviation Administration (FAA) confirmed the Project turbines would not pose a hazard to air navigation.

2.0 POST-CONSTRUCTION MONITORING RESULTS

Standardized post-construction monitoring (PCM) for bird and bat carcasses was conducted by WEST for two years from 2008-2010, with shorter-term follow up PCM in late 2013, and for six months in 2014. Surveys for plains sharp-tailed grouse leks and raptor nests also were conducted in 2008. Survey reports are included as Appendices A1-A4. Results are summarized below.

2.1 Two Years Standard PCM

Standardized carcasses surveys were designed to search the wind-energy facility systematically for bird and bat casualties attributable to collision with Project facilities from January 2008 through January 2010 (See Appendix A1 for the full report). Sixty-nine turbines were searched in the first study year, and 68 turbines were searched in the second year (Figures 2.1a, 2.1b). Turbines within 400 m of the escarpment edge were considered to have higher potential for raptor and bat fatalities due to the relatively high density of raptor nests and the presence of potential roosting habitat for bats on the escarpment. As a result, greater search intensity was employed at these turbines. Approximately 50% of the 43 rim-edge turbines were sampled, and 20% of the remaining 231 non rim-edge turbines were sampled. Due to high scavenger rates early in the study, and the fact that raptors were identified as a focal concern, half of the sampled turbines (34) were searched by walking, and the remaining 35 turbines were searched using four-wheel ATVs at a higher search frequency. Walking searches were conducted approximately once every two weeks, while ATV surveys were conducted twice per week. Search plots 240 m on a side (120 m from the turbine) were established around each sampled turbine. Surveyors walked or drove parallel transects within the search plots while scanning the ground for carcasses of injured birds or bats. During the two-year study, 152 bird carcasses comprising 32 species were found. No federal-listed species were found during the fatality study. The most common species found was horned lark (66 individuals; 43.4% of carcasses), followed by mourning dove (17 individuals; 11.2% of carcasses) and western meadowlark (11 individuals; 7.2% of carcasses). All other bird species had six or fewer carcasses found. Six raptor species were recorded as finds or incidental finds during the study; American kestrel, Swainson's hawk, ferruginous hawk, northern harrier, golden eagle, and burrowing owl. No bird carcasses were found at met towers. The greatest number of bird carcasses found at a single turbine was five at C12 in 2008 (one sharp-tailed grouse, two mourning doves, one horned lark, and one western meadowlark), and six at C12 in 2009 (five horned lark, and one mourning dove). Bird carcasses were found throughout the year, but weekly carcasses peaked in late spring (May and June) of 2008, early spring (mid-March to early April) of 2009, and in late summer to fall of 2009.

Searcher efficiency trials were conducted to estimate the percentage of casualties found by searchers. A total of 388 bird carcasses (231 large birds, 157 small birds) was used during searcher efficiency trials. Overall observer detection rates across all seasons were 76.8% for large birds and 58.7% for small birds. For walking searcher efficiency trials, 112 large bird carcasses and 112 small bird carcasses were placed with resulting searcher efficiency rates of 80.2% and 58.7%, respectively.

For ATV searches, 119 large bird carcasses and 43 small bird carcasses were placed with resulting searcher efficiency rates of 73.5% and 58.1%, respectively. For rim edge turbines, 82.1% of 95 large birds and 65.5% of 58 small birds were detected, while for non-rim-edge turbines, 72.9% of 133 large birds and 54.3% of 94 small birds were detected.

The purpose of the carcass removal trials was to estimate the length of time that a carcass remained in the field for possible detection. A total of 249 carcasses (109 large birds, 110 small birds, and 30 bats) were placed in the project area during carcass removal trials. Overall, mean removal rates were 10.9 days for large birds and 10.4 days for small birds. Fatality estimates were adjusted for bias introduced by observer detection bias and carcass removal rates as determined by the searcher efficiency trials and carcass removal trials. The overall adjusted bird fatality estimates for both years combined was 2.07 birds/turbine/year for all birds, or 1.90/megawatt/year. For raptors it was 0.16 raptors/turbine/year or 0.15/megawatt/year).

Two golden eagle carcasses were found during the study. One golden eagle carcass was found during standardized searches at turbine G17 on April 2, 2009. One golden eagle carcass was found on July 10, 2009, near an overhead riser pole. All such poles in the Project (22 total) were retrofitted in a way mostly consistent with the Avian Power Line Interaction Committee (APLIC; 2006) guidelines after this carcass was discovered to reduce electrocution risk to birds. These retrofits included incorporation of covers on energized elements of the riser poles.

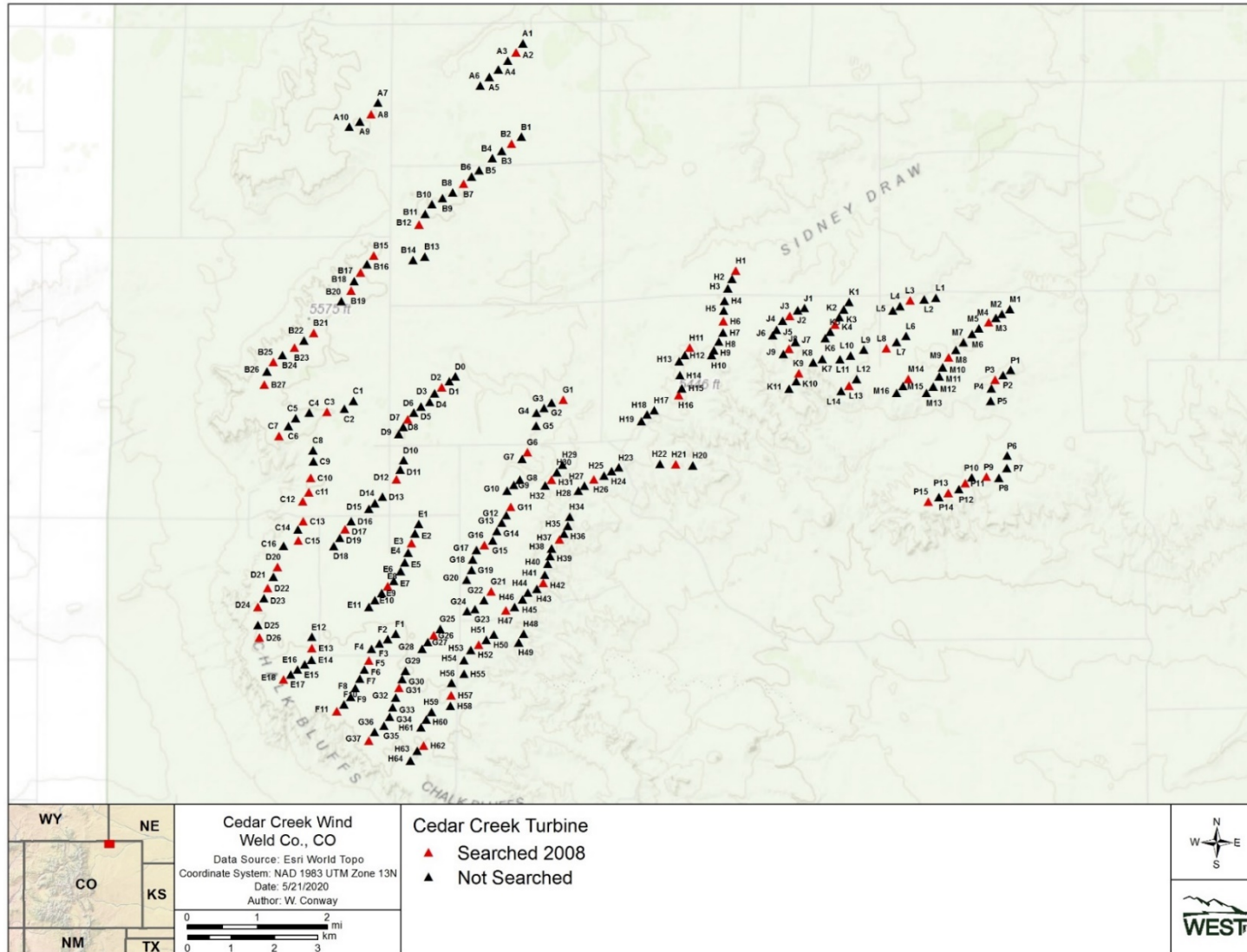


Figure 2.1a. Location of carcass search plots at the Cedar Creek Wind-Energy Project from January 2, 2008, to March 9, 2009.

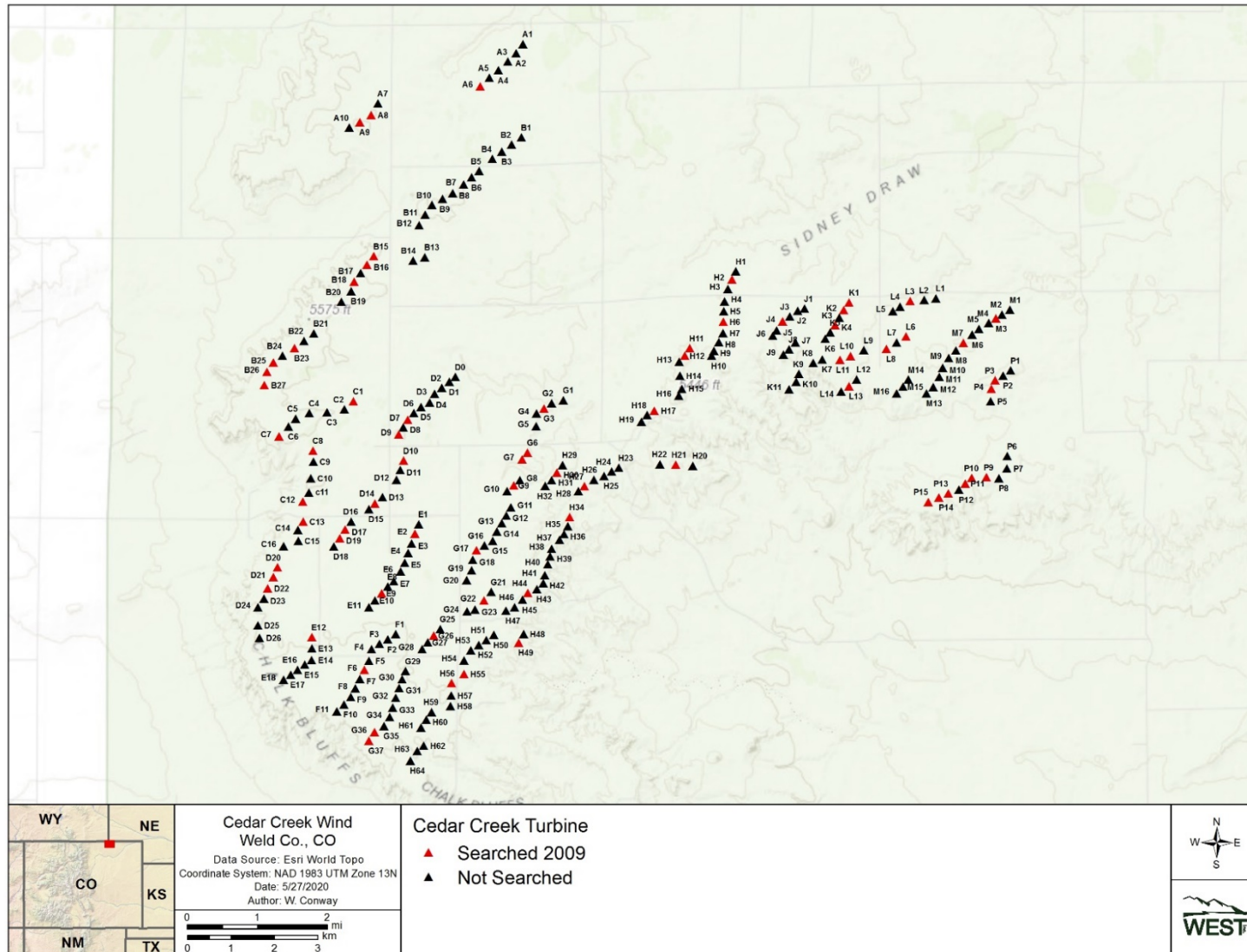


Figure 2.1b. Location of carcass search plots at the Cedar Creek Wind-Energy Project from March 10, 2009, to January 15, 2010.

2.2 One-Round Clearing Search

One search round of all 274 wind turbines at the Project was conducted by WEST in late 2013 (See Appendix A2 for the memo). The purpose of the clearing search was to check all turbines at the CCWP for carcasses, with a focus on golden eagles and other large-bodied raptors.

All Project turbines were searched during November 25-26 and December 2-3, 2013. Searches were conducted from a four-wheel drive all-terrain vehicle (ATV) or from a truck and on foot. Searchers spent 5-10 minutes at each turbine, driving around the turbine pad area, and driving or walking another loop around the turbine approximately 30-50 meters out from the turbine base. Binoculars were used to scan the ground around the turbine for carcasses.

Due to a winter storm in the area prior to searches, snow was present at most turbines that covered some to much of the searched area with 1-2 inches of snow. One bird carcass was found during the clearing search. The carcass was in an advanced state of decay – mostly bones and feathers – and was likely a red-tailed hawk. The red-tailed hawk was found at turbine G2 on December 2, 2013.

2.3 Six Months of Monthly Searches

During April – September 2014, WEST conducted monthly fatality monitoring at the Project (See Appendix A3 for the full report). Standardized carcass surveys were conducted once per month from April through September 2014. Square search plots were established around 82 turbines (Figure 2.2), which represented 30% of all Project turbines. Search plots were 240 x 240-m (787 x 787-ft) squares, centered on the turbine. A higher sampling rate was used for turbines along the escarpment edge (approximately 50% of searched turbines), similar to what was during the initial post-construction study during 2008-2010. To select turbine plots for searching, turbines were classified as near the escarpment (within 400 m [1,312 ft]) or away from the escarpment (more than 400 m [1,312 ft]), and random selections of 41 turbines were made within each group. Some search plots were dropped and others re-selected based on search conditions in the field. Plots were searched from a 4-wheel-drive all-terrain vehicle (ATV) or utility vehicle (UTV). Searchers drove slowly along transects spaced 30 m (98 ft) apart within each plot, scanning the ground on either side of each transect for carcasses or other evidence of carcasses (bones, feathers). Though the study focused on eagles, all carcasses detected were recorded.

Searcher efficiency bias trials were conducted during the six-month study. For searcher efficiency trials, 61 carcasses (31 large birds and 30 small birds) were placed on four dates. The overall searcher efficiency rate for small birds was 20.7%, and for large birds it was 55.6%. For carcass removal bias, carcass removal values from the two-year PCM effort at the Project (from March – November 2009 only, (39 large birds, 40 small birds) were used, thereby reducing the number of carcasses placed under turbines that could attract golden eagles for scavenging. Average removal time for small birds was 4.97 days and for large birds it was 4.25 days.

A total of 495 turbine searches were conducted at the 82 searched turbines. Five birds (mourning dove (*Zenaida macroura*), savannah sparrow (*Passerculus sandwichensis*), an unidentifiable

passerine, Swainson's hawk (*Buteo swainsoni*), and red-tailed hawk (*B. jamaicensis*) were found during standardized carcass surveys or incidentally. No eagle carcasses were detected. Overall fatality rates were not calculated due to low sample sizes and visibility conditions. Each bird was found at a different turbine, and four of the five birds were found at rim-edge turbines on the western side of the project. Four birds were found during searches in August and September, and one was found in April.

2.4 Plains Sharp-tailed Grouse Lek Surveys

To better understand the potential impacts of the project on plains sharp-tailed grouse, and to compare results to surveys conducted in 2006 and 2007, the Project contracted with WEST to conduct surveys for sharp-tailed grouse leks during the spring of 2008 (See Appendix A5 for the full report). The survey routes for grouse leks during 2008 were identical to routes used in 2007, and were located primarily along existing access roads for turbines. Surveys conducted during the spring of 2008 involved stopping and listening and looking for grouse leks at approximately 2,250-ft intervals. Existing lek locations also were visited two to four times to count the number of birds attending lek sites.

Five of the seven leks that were active in 2007 were inactive in 2008, and no new leks were identified. The five leks that were inactive in 2008 ranged from 355 – 2,722 m from turbine locations. Two of the leks that were inactive were located within 800 m of turbine locations (355 m and 662 m). The closest an active lek was located to a turbine was 1400 m.

2.5 Prey Distribution Mapping

Black-tailed prairie dog (BTPD) colonies in and around the adjacent Mountain Breeze and Panorama Projects were mapped during May 2018. The purpose of the survey was to understand where potential prey sources for golden eagles occur. Available BTPD colony data mapped by CPW in 2015 and from colonies recorded during raptor nest surveys conducted in March 2018 for the Project were used to target ground surveys. For ground surveys, a biologist drove on public roads in an attempt view mapped BTPD colonies. If the colony was visible, the biologist noted if the colony appeared to be active (had prairie dogs present) or not, if the mapped area appeared to be accurate or not, if there were changes in the active colony location, and if any sensitive species, including eagles or burrowing owls (*Athene cunicularia*), were seen in the area.

Two active BTPD colonies were recorded within the Project and one active colony was recorded adjacent to the western edge of the Project (Figure 2.2). Additionally, one inactive BTPD colony was recorded within the Project.

Potential big game and livestock sources of food (primarily via carrion) were mapped in 2020. Although a primary land use within the Project is rangeland grazing of livestock, there are no known concentrated animal feeding operations that may provide concentrated sources of livestock carcasses for scavenging eagles. The Project area does contain some water impoundments and stock tanks for livestock, which may provide concentrations of livestock carcasses to a lesser extent. Big game ranges mapped by CPW indicate that mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), and pronghorn (*Antilocarpa*

americana) winter range occurs over the entire Project, with a winter concentration area on the western side of the Project for mule deer (CPW 2020). A winter concentration area for pronghorn (Figure 2.2) is located outside the Project to the northeast. These winter ranges may produce episodic scavenging opportunities that draw eagles in to the Project depending on the severity of winter weather.

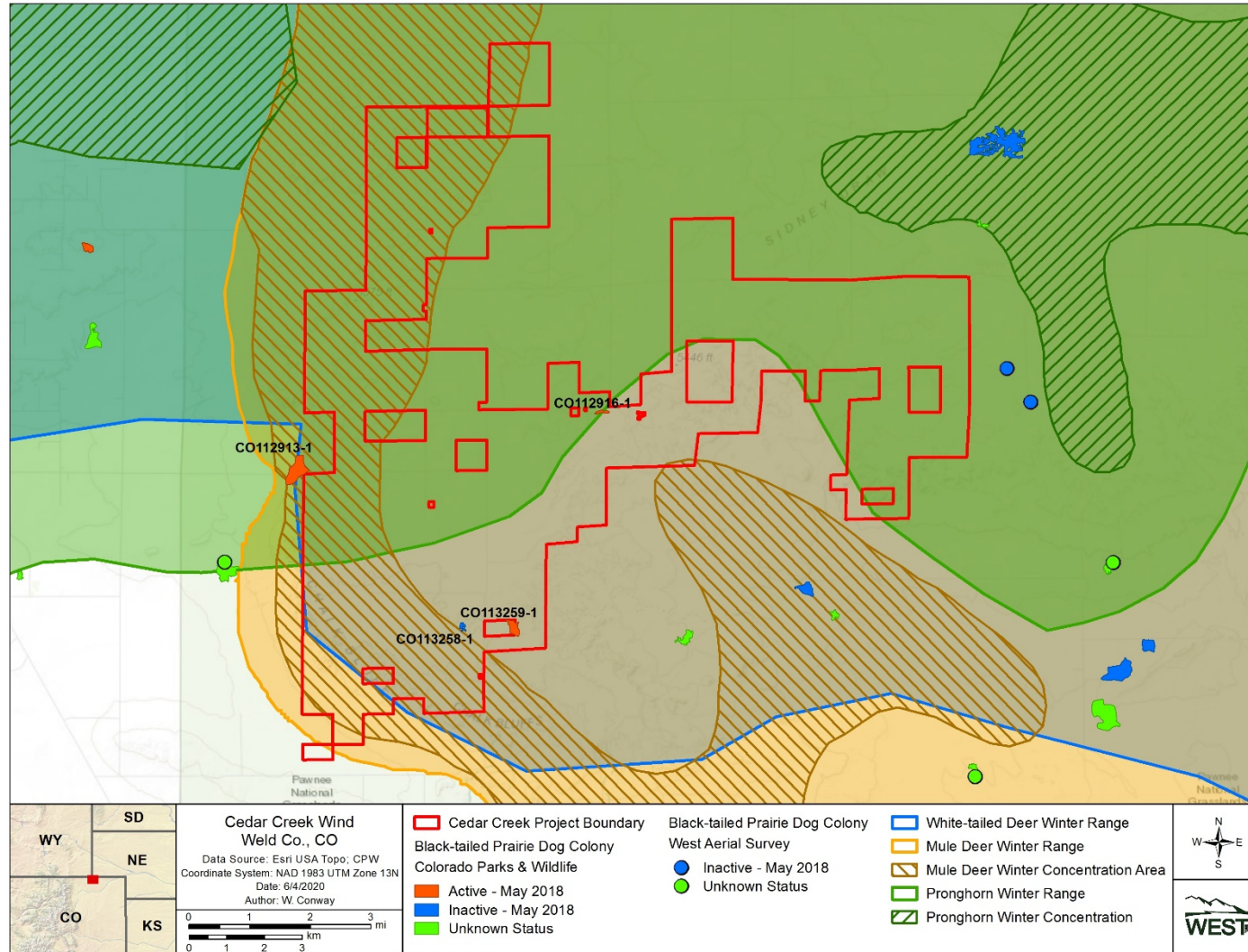


Figure 2.2. Potential Prey Resources within and Near the Cedar Creek Wind Project, Weld County, Colorado

2.6 Raptor Nest Surveys

To better understand the potential impacts of the project on nesting raptors, and to compare results to surveys conducted in 2006 and 2007, the Project contracted with WEST to conduct raptor nest surveys during the spring of 2008 (See Appendix A5 for the full report). Raptor nest surveys were conducted within ½ mile of turbines. The number of active raptor nests found during 2008 after Project construction (32) was comparable to the number of active nests found prior to construction in 2006 (35), despite reduced access during the 2008 surveys.

Forty-six percent of the nests visited in June had young present or adults defending nest sites. Some of the birds observed during the June visits appeared close to fledging from nests, and it is possible that some birds on other nests had already fledged prior to some visits to nests in late June. Surveys in 2006 did not include follow-up visits to nests in June, so it was unclear if the 46% nest success rate was typical for Cedar Creek.

3.0 AVOIDANCE AND MINIMIZATION OF RISKS DURING PROJECT PLANNING AND DESIGN

Based on data collected during pre-construction surveys and recommendations from USFWS and CPW, the Project was designed to minimize impacts to eagles and other wildlife while maximizing Project output and providing benefit to local landowners and communities. BMPs and conservation measures built into the Project during the pre-construction design phase are described in this section. BMPs and conservation measures to reduce potential risk to eagles at the Project during construction and operation of the Project are presented in Section 6.0.

Based on pre-construction studies and recommendations from USFWS and CPW, Cedar Creek eliminated over 30 high-production turbine locations and relocated more than 45 turbines to lower elevation, less productive sites in order minimize potential risks to wildlife resources on site. The following eagle avoidance and minimization measures also were incorporated into Project siting:

- Project facilities were located to avoid: (1) documented locations of eagle nests (2) areas of concentrated eagle use based on pre-construction surveys
- Turbines were located to avoid: (1) areas or features of the landscape known to attract eagles, and (2) potential eagle habitat using the following setbacks:
 - Minimum ½-mile (800-m) setback from all active and inactive golden eagle nests.
 - Minimum 164-ft (50-m) setback from the rim edge, regardless of nest locations.
 - Minimum ½-mile setback from sharp-tailed grouse lek locations (potential eagle prey concentrations), with the exception of three identified lek sites where, in lieu of instituting setbacks, the Project committed to conducting an extensive study to document the potential effects of the proposed project on sharp-tailed grouse.
- In addition to the above setbacks, and after substantial revisions to the proposed layout to accommodate them, CPW identified 14 turbines of concern based on proximity to the rim edge or raptor nests that were jointly reviewed by the Project and CPW resulting in an

agreement on relocating 13 out of the 14 turbines to minimize impacts to eagles and other raptors.

- Power lines associated with the Project that were placed underground prevent collisions by eagles.
- The amount of overhead line was minimized to the extent practicable to minimize the risks of collisions by eagles.
- Above-ground electrical collection and transmission structures were designed following the (APLIC 2006) guidelines for constructing raptor-safe power poles and overhead lines. In some cases, power poles were initially constructed incorrectly and these poles were retro-fitted to meet APLIC guidance.
- Cedar Creek minimized the number of permanent meteorological towers used on the site to the extent practicable to reduce the potential for perching by eagles.

4.0 ASSESSING BALD AND GOLDEN EAGLE RISK AND FATALITIES (STAGE 3)

Two golden eagle carcasses were found during standardized monitoring conducted during 2008-2010. Since that monitoring effort concluded, operational monitoring has detected five additional golden eagle carcasses, including an adult found at turbine L10 on April 19, 2010, an unknown age eagle found at turbine C16 on May 19, 2011, an adult at turbine J7 on June 3, 2011, an unknown age eagle between turbines H38 and H39 on April 14, 2015, and an unknown age eagle at turbine D5 on November 2, 2015 (Table 4.1). Locations of known golden eagle carcasses were spread throughout the Project. Most golden eagle carcasses were found in spring and summer (three in April, one each in May, June, and July), with one other reported in November (Figure 4.1).

No bald eagle carcasses have been found at the Project during standardized monitoring, incidentally, or by operational monitoring.

Table 4.1 Eagle Fatalities at Cedar Creek Wind Energy Project.

Species	Date Found	Injury/Fatality	Discovery Type
Golden Eagle	4/2/2009	Fatality	Scheduled
Golden Eagle	7/10/2009	Fatality	Incidental
Golden Eagle	4/19/2010	Fatality	Incidental
Golden Eagle	5/19/2011	Fatality	Incidental
Golden Eagle	6/3/2011	Fatality	Incidental
Golden Eagle	4/14/2015	Fatality	Incidental
Golden Eagle	11/2/2015	Fatality	Incidental

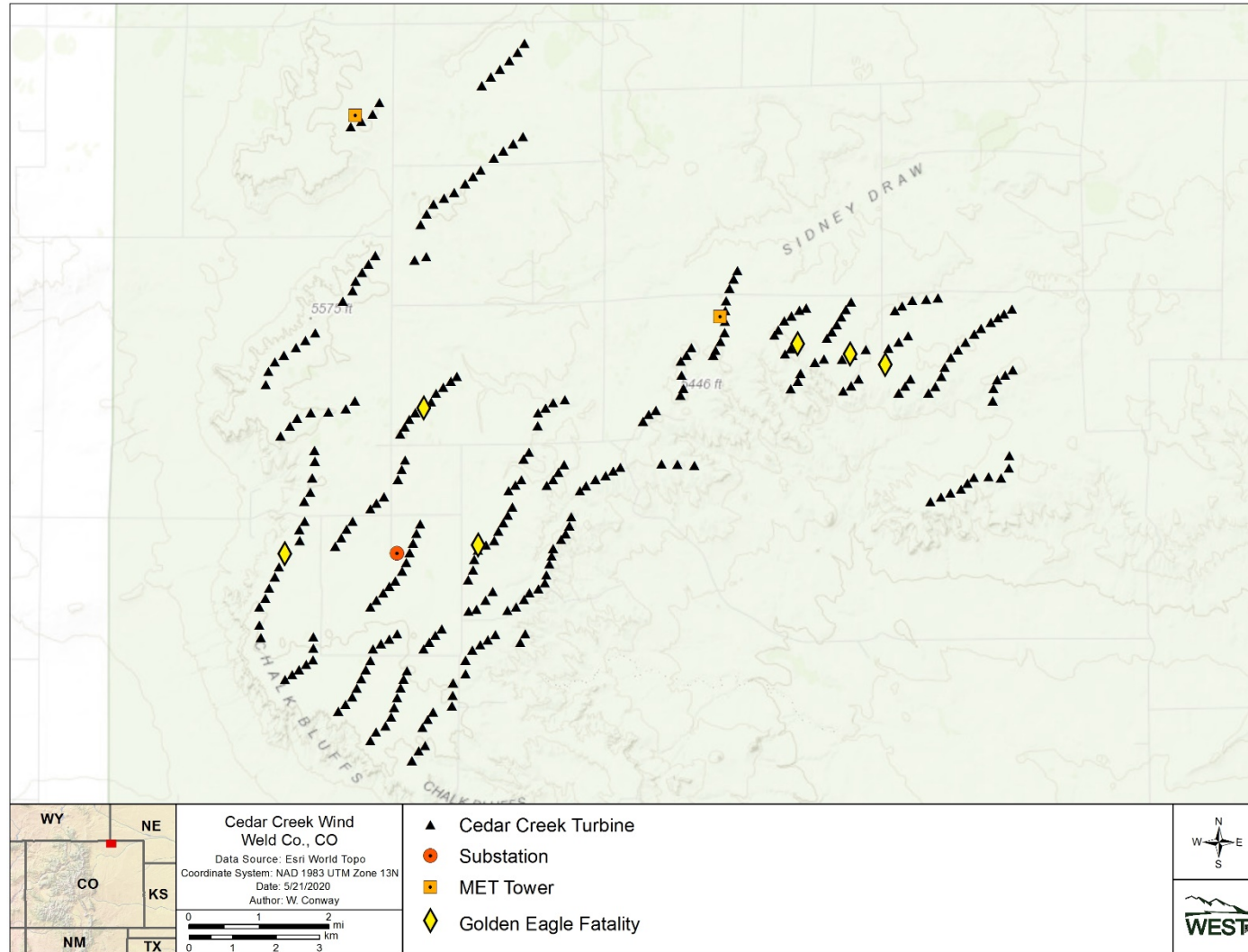


Figure 4.1 Golden Eagle Fatality Locations at the Cedar Creek Wind Energy Project.

5.0 ADDITIONAL AVOIDANCE AND MINIMIZATION OF RISKS, CONSERVATION MEASURES, AND COMPENSATORY MITIGATION

Conservation Measures and BMPs were implemented during construction of the Project to provide additional avoidance and minimization of risks to eagles.

5.1 During Operation

During Project operations, the following conservation measures and BMPs are implemented to provide additional avoidance and minimization of risks to eagles:

- Project personnel are trained annually on wildlife awareness, minimization of impacts to natural resources, and to facilitate employee understanding of their respective roles in ensuring compliance with the Project's permit conditions and commitments.
- Personnel, contractors, and visitors are instructed to avoid disturbing wildlife, especially during the breeding and wintering seasons.
- Fire hazards from vehicles and human activities will be reduced (e.g., spark arresters maintained on internal combustion engines and power equipment, metal parts maintained from dragging from vehicles, and use of caution with open flames and cigarettes).
- All carrion discovered on site during regular maintenance and monitoring activities, except carcasses used for searcher efficiency and carcass removal trials, are removed to avoid attracting bald eagles and other raptors. Upon discovery of wildlife or livestock carcasses, Cedar Creek will begin working with relevant landowners and ranchers within 24 hours to cover or remove wildlife or livestock carcasses.
- Travel is restricted to designated roads to prevent disturbance of eagles; no off-road travel is allowed except in emergencies. Service personnel limit, to the extent possible, their vehicle speed and on-site visit frequency and duration.
- Project personnel are advised regarding speed limits on roads (20 mph on construction access roads, 55 mph on County roads), being alert for wildlife, and using additional caution in low visibility conditions in order to minimize wildlife mortality due to vehicle collisions.
- Only native species were used in re-vegetating disturbances to minimize disruption of eagle habitat. All noxious weeds that appear within 600 ft (183 m) of the wind turbines and maintenance roads are monitored and reported to SLB staff, and treatment is conducted yearly for the duration of the lease.

5.2 Retrofitting, Repowering, and Decommissioning

Upon termination of operations, the Project will dismantle and remove from the site towers, turbine generators, transformers, overhead and underground cables, foundations, buildings and ancillary equipment to a depth of 4 feet. Access roads will be removed unless written approval is given by the affected landowner requesting that one or more roads, or portions thereof, be retained. Any agreement for removal to a lesser depth, or for no removal, will be recorded with the County and will show the locations of all foundations.

The Project will restore and reclaim the site to its pre-project topography and topsoil quality, with the goal to restore natural hydrology and plant communities to the greatest extent practical while minimizing new site disturbance and removal of native vegetation.

Some of the decommissioning BMPs that will be employed on the project to the extent practicable with the intent of meeting this goal include:

- Foundations should be removed and covered with soil to allow adequate root penetration for native plants, and so that subsurface structures do not substantially disrupt ground water movements;
- Overhead pole lines that are no longer needed should be removed;
- If topsoils are removed during decommissioning, they should be stockpiled and used as topsoil when restoring plant communities. Once decommissioning activity is complete, topsoils should be restored to assist in establishing and maintaining pre-construction native plant communities to the extent possible, consistent with landowner objectives;
- Soil should be stabilized and re-vegetated with native plants appropriate for the soil conditions and adjacent habitat, and of local seed sources where feasible, consistent with landowner objectives;
- Topsoil should be restored to assist in establishing and maintaining preconstruction native plant communities to the extent possible;
- Exposed soils (other than agricultural land) should be vegetated with native plants appropriate for the soil conditions and adjacent habitat using local seed sources;
- Surface water flows should be restored to pre-disturbance conditions, including removal of stream crossings, roads, and pads, consistent with storm water management objectives and requirements;
- Qualified experts should conduct surveys to detect invasive plants, and comprehensive approaches to controlling any plants detected should be implemented and maintained as long as necessary;
- Erosion control measures, following decommissioning, should be installed within disturbance areas with potential for erosion, consistent with storm water management requirements;
- Fencing installed for the project should be removed unless pertinent to existing landowner operations; and
- Petroleum product leaks and chemical releases should be remediated prior to completion of decommissioning.

5.3 Compensatory Mitigation

Since the Project was constructed and began operations prior to the publication of the eagle take rules in 2009, eagle take occurring at the Project is considered part of the environmental baseline take levels for the Final Environmental Assessment (USFWS 2009a) associated with the 2009 eagle take permit regulations (Eagle Permit Rule; see 50 CFR 22.26 and 22.27, 2009; USFWS 2009b). As such, the Project is not required to provide compensatory mitigation as long as the original Project infrastructure remains unchanged.

5.4 Cumulative Impacts

The USFWS has identified take rates of between 1% and 5% of the estimated total eagle population size at the local-area population scale (109-mile buffer surrounding the Project for golden eagles and 86 miles for bald eagles) as benchmarks, with 5% being at the upper end of what might be appropriate under the Bald and Golden Eagle Protection Act preservation standard — whether offset by compensatory mitigation or not (USFWS 2013).

6.0 POST-CONSTRUCTION MONITORING (STAGE 5)

After permit issuance, Cedar Creek will conduct post-construction monitoring (PCM) for the life of the Project to detect eagle carcasses at the Project. Cedar Creek proposes the approach described in this section; however, the methods will be revised in coordination with USFWS once official guidance for eagle PCM is finalized to make sure monitoring is consistent with the guidance. The PCM study methods will include standardized searches to look for eagle carcasses, consisting of visual scans at 100% of Project turbines every two to three months. Project operations personnel will conduct the visual scans after being trained in search methods and eagle identification by a third-party contractor. Visual scans have been demonstrated to be effective for detecting eagle carcasses out to 100-150 meters (Hallingstad et al. 2018) in vegetation similar to Cedar Creek; while allowing efficient coverage of the Project turbines in support of permit conditions.

Experimental bias trials will be conducted for two years after permit issuance, with at least one year of bias trials occurring within the first five years of permit issuance. Bias trials will be administered by a third-party contractor, and will be conducted throughout the year to measure rates of searcher efficiency (the proportion of available carcasses detected by searchers) and carcass persistence (the average length of time carcasses remain available to be found). Annual fatality rates for eagles will be estimated by a third-party contractor for the years in which bias trials are conducted. Annual fatality rates for eagles will be based on the number of carcasses detected, adjusted to account for the site-wide probability a carcass was detected. The evidence of absence (EoA; Dalthorp et al. 2014) framework, or other appropriate statistical models, will be used to calculate annual eagle fatality rates.

PCM methods will have the goal of achieving a g-value of at least 0.25 on average during the two years of experimental bias trials. The g-value describes the probability that a carcass will be found, and is a function of searcher efficiency, carcass persistence, and the searchable area around all turbines. The g-value can be evaluated based on bias trials, and if low searcher efficiency or short carcass persistence rates cause the calculated value of g to fall below 0.25, survey methods during the survey years with bias trials can be adjusted to raise the value of g, generally by increasing survey effort.

During years with no bias trials, PCM will be conducted approximately every two to three months as part of regularly scheduled turbine maintenance. PCM will be completed by Project staff, or by Project staff in combination with third party consultants. PCM will be completed in the most cost-

effective manner possible for the Project while still achieving an acceptable carcass detection level. Project personnel will be trained in proper scanning techniques and identification of eagle carcasses. Standard methods for documenting scans and reporting of finds will be developed and included in personnel training.

The PCM methods described in the section will be revised in coordination with USFWS to ensure they are consistent with national guidance when that guidance is finalized.

6.1 Reporting

All eagle carcasses will be reported to USFWS within 24 hours of discovery and positive identification. Field forms and photographs of all eagle carcasses will be reported to USFWS (Office of Law Enforcement, Ecological Services Field Offices, and Regional Migratory Bird Management Office) for their direction on collection and/or sending carcasses to the National Eagle Repository.

6.2 Wildlife Incident Reporting

Cedar Creek is committed to ongoing investigation of wildlife incidents involving company facilities and to work cooperatively with federal and state agencies in an effort to prevent and mitigate future bird and wildlife impacts. Cedar Creek implements a reporting system that is intended to remain active for the life of the Project. The reporting system is described in the Project BBCS and is intended to standardize and describe actions that should be taken by site personnel in response to a wildlife mortality or injury encountered at the Project as part of operational monitoring or incidentally to other activities on site. The reporting system also promotes accurate and timely reporting under permit requirements. The reporting system provides a means of documenting (and collecting if appropriate permits are obtained) mortalities at the Project to be used to inform Adaptive Management (see Section 7.0). USFWS will be contacted immediately for direction regarding any eagle found injured within the Project. Any incident (i.e. mortality or injury) involving a federally listed threatened or endangered species or a bald or golden eagle must be reported to the USFWS within 24 hours of identification (exclusive of weekends and holidays).

7.0 ADAPTIVE MANAGEMENT PROCESS

Eagle take occurring at the Project is considered part of the environmental baseline take levels for the Final Environmental Assessment (USFWS 2009a) associated with the 2009 eagle take permit regulations (Eagle Permit Rule; see 50 CFR 22.26 and 22.27, 2009; USFWS 2009b).; therefore, there are no triggers or take levels upon which to base adaptive management responses for this Project. For all eagle carcasses or injuries detected during standardized monitoring or incidentally, the incident will be reported promptly to the USFWS, and Project personnel will collect information about location and condition of the eagle. If conditions are present that pose elevated risk for eagles (e.g., presence of carrion or other concentrated prey source, dangerous electrical or other facility configurations), the Project will attempt to remove the source of risk, if practicable.

8.0 OTHER PERMITS

Once the eagle ITP is authorized, Cedar Creek will apply for a USFWS MBTA CFR 21.27 Special Purpose Utility (SPUT) Permit. The SPUT permit will be maintained over the life of the eagle ITP, and Cedar Creek will comply with the reporting requirements under MBTA 21.27. Additionally, the Project and/or its PCM contractor will obtain and maintain a Colorado scientific collection permit from CPW.

9.0 CONCLUSION

This document was written to provide guidance for all eagle avoidance, minimization, and monitoring efforts prior to, during, and after construction of the Project. The measures described in this document are intended to help avoid and minimize impacts to eagles, as well as to monitor potential impacts to eagles following implementation of the Project.

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Appendix A: Wildlife Studies Conducted for the Cedar Creek Wind Project.

**Avian and Bat Fatality Monitoring Study
Cedar Creek Wind-Energy Facility
Weld County, Colorado**

January 3, 2008 – January 15, 2010

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EXECUTIVE SUMMARY

Cedar Creek Wind Energy, LLC has developed a 300-megawatt wind power project in Weld County, Colorado, just east of the town of Grover. The project includes 221 1-megawatt Mitsubishi turbines, 53 1.5-megawatt General Electric turbines, and associated infrastructure. Construction began in late 2006 and was completed in late 2007. All 274 turbines were erected and online by January 1, 2008. Cedar Creek Wind Energy contracted Western Ecosystems Technology, Inc. to conduct a two-year post-construction fatality monitoring study to quantify impacts to birds and bats from operation of the Cedar Creek Wind-Energy Facility, thereby meeting agency requirements. Fatality monitoring was conducted at the facility from January 3, 2008 through January 15, 2010.

The primary objective of the monitoring study was to estimate the number of bird and bat casualties attributable to collision with wind turbines and meteorological towers for the entire facility on an annual basis. The monitoring study consisted of four components: 1) standardized carcass surveys of selected turbines; 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers; 3) carcass removal trials to estimate the length of time that a carcass remained in the field for possible detection; and 4) adjusted fatality estimates for bird and bat species calculated using the results from searcher efficiency trials and carcass removal trials to estimate the total number of bird and bat fatalities within the Cedar Creek Wind-Energy Facility.

The objective of the standardized carcasses surveys was to systematically search the wind-energy facility for bird and bat casualties that were attributable to collision with project facilities. Sixty-nine turbines were searched in 2008, and 68 turbines were searched in 2009. Turbines within 400 m of the escarpment edge were considered to have higher potential for raptor and bat fatalities due to the high density of raptor nests and the presence of potential roosting habitat for bats on the escarpment. As a result, greater search intensity was employed at these turbines. Approximately 50% of the 43 rim-edge turbines were sampled, and 20% of the remaining 231 non rim-edge turbines were sampled. Due to high scavenger rates early in the study, and the fact that raptors have been identified as a focal concern, half of the sampled turbines (34) were searched by walking, and the remaining 35 turbines were searched using four-wheel ATVs at a higher search frequency. Walking searches were conducted approximately once every two weeks while ATV surveys were conducted twice per week. Search plots 240 m on a side (120 m from the turbine) were established around each sampled turbine. Surveyors walked or drove parallel transects within the search plots while scanning the ground for fatalities or injured birds or bats.

During the two-year study, 152 bird fatalities comprising 32 species and 72 bat fatalities comprising four species were found. No federal- or state-listed species were found during the fatality study.

The most common species found was horned lark (66 individuals; 43.4% of fatalities), followed by mourning dove (17 individuals; 11.2% of fatalities) and western meadowlark (11 individuals; 7.2% of fatalities). All other bird species had six or fewer fatalities. Six raptor species were recorded as fatalities or incidental finds during the study; American kestrel, Swainson's hawk, ferruginous hawk, northern harrier, golden eagle, and burrowing owl. No bird fatalities were found at met towers. Few likely nocturnal migrant bird fatalities were found. The greatest

number of bird fatalities found at a single turbine was five at C12 in 2008 (one sharp-tailed grouse, two mourning doves, one horned lark, and one western meadowlark), and six at C12 in 2009 (five horned lark, and one mourning dove). This turbine is a rim edge turbine, but doesn't appear unique otherwise, and no raptors were found at or in the vicinity of this turbine. Bird fatalities tended to be concentrated in the southeast quadrant of the search plots and the distribution within search plots was significantly different than uniform (chi-square test, $p < 0.0018$), which may be explained by the general northwest prevailing wind direction for the site.. Bird fatalities were found at all distances from the turbines within the search plots, with the highest percentage of birds found within 20 m of the turbines. Bird fatalities were found throughout the year, but weekly fatalities peaked in late spring (May and June) of 2008, early spring (mid-March to early April) of 2009, and in late summer to fall of 2009.

The most common bat species found was hoary bat (44 individuals; 61.1% of fatalities), followed by silver-haired bat (22 individuals; 30.6% of fatalities). Two big brown bats and two little brown bats also were found. The greatest number of bat fatalities found at a single turbine for the two-year study was seven bat fatalities at turbine H49, which is located on the southeast edge of the project but doesn't appear to otherwise be unique in terms of factors such as topography or proximity to other features that might be attractive to bats. Most bat fatalities (92.9%) were found within 60 m of the turbine and significantly more bats were found in the northwest and northeast quadrants of plots (chi-square test, $p < 0.0016$).. Bat mortality was highest in the late summer and early fall, and all fatalities were found between April 9 and November 11.

The objective of the searcher efficiency trials was to estimate the percentage of casualties found by searchers. A total of 418 carcasses (231 large birds, 157 small birds, 30 bats) was placed in the project area during searcher efficiency trials. Overall observer detection rates across all seasons were 76.8% for large birds, 58.7% for small birds, and 26.7% for bats. For walking searcher efficiency trials, 112 large bird carcasses, 112 small bird carcasses, and 15 bat carcasses were placed with resulting searcher efficiency rates of 80.2%, 58.7%, and 33.3%, respectively. For ATV searches, 119 large bird carcasses, 43 small bird carcasses, and 15 bats were placed with resulting searcher efficiency rates of 73.5%, 58.1%, and 20.0%, respectively. For rim edge turbines, 82.1% of 95 large birds, 65.5% of 58 small birds, and 40.0% of five bats were detected, while for non-rim-edge turbines, 72.9% of 133 large birds, 54.3% of 94 small birds, and 24.0% of 25 bats were detected.

The purpose of the carcass removal trials was to estimate the length of time that a carcass remained in the field for possible detection. A total of 249 carcasses (109 large birds, 110 small birds, and 30 bats) were placed in the project area during carcass removal trials. Overall, mean removal rates were 10.9 days for large birds, 10.4 days for small birds, and 10.2 days for bats.

Fatality estimates were adjusted for bias introduced by observer detection bias and carcass removal rates as determined by the searcher efficiency trials and carcass removal trials. The overall adjusted bird fatality estimates for both years combined was 2.07 birds/turbine/year for all birds, or 1.90/megawatt/year. For raptors it was 0.16 raptors/turbine/year or 0.15/megawatt/year). For bats, the overall adjusted fatality estimates for both years combined was 1.61 bats/turbine/year or 1.47/megawatt/year.

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APPENDIX A – Avian and Bat Casualties Found During Fatality Monitoring at the Cedar
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INTRODUCTION

Cedar Creek Wind Energy operates a 300-megawatt (MW) wind power project in Weld County, Colorado, east of the town of Grover (Figure 1). The Cedar Creek Wind-Energy Facility (CCWEF) includes 221 1-MW Mitsubishi Turbines and 53 1.5-MW General Electric Turbines and associated infrastructure. Construction began in late 2006 and was completed in late 2007. All 274 turbines were erected and online by January 1, 2008. The GE turbines have tower heights of 80 meters (m), blade lengths of 37.5m, and extend to a maximum height of 118.5m with the blade extended. The Mitsubishi turbines have a tower height of 69m, blade length of 29.5m, and extend to a maximum height of 99.7m with the blade extended.

Cedar Creek Wind Energy and the Colorado Division of Wildlife (CDOW) conducted a number of meetings and discussions of wildlife issues in 2006, and CDOW was concerned about potential impacts to birds and bats. Turbine locations were set back from features such as raptor nests and the escarpment edge to reduce potential impacts to wildlife, especially raptors (Johnson et al. 2000). To document actual levels of fatalities, Cedar Creek Wind Energy contracted Western Ecosystems Technology, Inc. (WEST) to develop and implement a two-year post-construction fatality monitoring study to quantify direct impacts to birds and bats from operation of the CCWEF.

The monitoring study for the project consisted of the following components:

- 1) Standardized carcass searches of selected turbines or turbine strings in a rectangular plot centered on the turbine;
- 2) Searcher efficiency trials to estimate the percentage of carcasses found by searchers;
- 3) Carcass removal trials to estimate the length of time that a carcass remains in the field for possible detection;

This report presents the results from two years of fatality monitoring at the CCWEF from January 11, 2008 through January 15, 2010.

STUDY AREA

The CCWEF is located in a mosaic of native short-grass prairie, active agriculture, and areas that were formerly tilled but have been re-seeded with grass species. Land is a mixture of state- and privately-owned land and is relatively undeveloped, with the exception of a few rural homes, missile sites, a few existing radio towers, and local power and telephone lines. The dominant land uses for the area are cattle grazing, wheat production, and wind power development.

The facility is located on a broad plateau. Topography on the top of the plateau where many of the turbines are located is flat to rolling, while the edges of the plateau are relatively steep and defined, especially along the western and southwestern edges of the project area. The western and southwestern edges of the plateau contain some chalk bluffs and scattered limber pine (*Pinus flexilis*) and juniper (*Juniperus scopulorum*) woodlands.

The project area is relatively dry in nature, with an average rainfall of 12.9 inches per year. The region experiences relatively warm summers and cold winters, with average annual maximum temperature at 63.2 F and the minimum at 33.3 F. Elevations within the project area generally range from 5400 – 5600 ft above sea level.

METHODS

The primary objective of the monitoring study was to estimate the number of bird and bat casualties attributable to collisions with wind turbines for the entire facility on an annual basis. The monitoring study began after the wind-energy facility became fully operational and was conducted for two full years: January 11, 2008 through January 15, 2010. The methods for the fatality study were broken into four primary components: 1) standardized carcass surveys of selected turbines; 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers; 3) carcass removal trials to estimate the length of time that a carcass remained in the field for possible detection; and 4) adjusted total fatality estimates for bird and bat species calculated using the results from searcher efficiency trials and carcass removal trials.

Casualties were found under three different scenarios in the CCWEF: 1) during the standardized carcass surveys for the study; 2) while observers were on site, but not conducting a standardized search (i.e., an incidental find); and 3) by facility personnel or others on site for other purposes, such as turbine maintenance. Casualties found by study personnel regardless of timing (e.g., during a standard survey or not) were recorded by the methods described below. All casualties found within a search plot, even if outside of the standard survey period, were used to calculate adjusted annual fatality estimates under the assumption that these casualties would have been found during standardized surveys. Casualties found outside of search plots may be reported but were not recorded in adjusted annual fatality estimates.

All bird and bat casualties located within the search areas, regardless of species, were recorded and cause of death determined, if possible, based on field inspection of the carcass and proximity to turbines, powerlines, or roads. The total number of bird and bat carcasses was estimated by adjusting for search frequency, removal bias (length of stay in the field), searcher efficiency bias (percent found), and proportion of the survey plot searched. For carcasses where the cause of death was not apparent, it was assumed that the fatality was a wind turbine collision casualty. 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 relative high costs associated with obtaining accurate estimates of natural or reference mortality (see Johnson et al. 2000).

Standardized Carcass Surveys

The objective of the standardized carcasses surveys was to systematically search the wind-energy facility for bird and bat casualties that were attributable to collision with project facilities. Study personnel were trained in proper search techniques prior to conducting the carcass surveys.

Search Plots

Square plots 240 m (787 ft) on each side were established around 69 turbines (Figures 2a-b) so that searches were at least 120 m (394 ft) of the turbine (Figure 3). Studies at wind facilities with other large turbines (Johnson et al. 2003, Stantec Consulting Inc. 2009, TRC Corporation 2008), indicate most bird fatalities are found within an area that is roughly equivalent to the maximum distance of turbine height to ground, and most bat fatalities are found within $\frac{1}{2}$ the maximum distance of turbine height to ground (Erickson et al. 2003a, 2003b).

Turbines within 400 m of the escarpment edge were considered to have higher potential for raptor and bat fatalities due to the higher density of raptor nests in that area and presence of potential roosting habitat for bats on the escarpment. A stratified sampling design was implemented to ensure representation of turbines near the escarpment edge and away from the escarpment edge. Turbines were chosen systematically for searching so that the distribution of sampled turbines was even across the study area and included representative proportions of habitat types present in the area. Within the wind-energy facility, 43 turbines were located within 400 m of the escarpment edge. Between January 3 2008 and March 9, 2009, 23 of the escarpment edge turbines and 20% (46) of the remaining 231 turbines were selected for searching during 2008. Five of the turbines originally selected for searching were searched a few times and then replaced with other turbines due to swift fox dens or human structures in or near the search plot. A new set of search turbines was selected for 2009, but due to administration constraints, the new set of search turbines was not selected and implemented until March 19, 2009. Search turbines for 2009 were reselected from all available turbines, so some turbines searched in 2008 were also searched in 2009. In 2009, 68 turbines were searched, with 22 turbines on the escarpment edge and 46 turbines more than 400 m from the escarpment edge. Two met towers were also searched on foot in 2009.

Search Methods

Initially, in early 2008, all turbines were planned to be searched on 28-day intervals in winter (November 1 – February 28) and 14-day intervals in spring, summer, and fall (March 1 – October 31). Scavenger removal rates in early 2008 were high, especially for large birds, so the search schedule was adjusted so that half of the 69 sampled turbines were searched on foot, and the other half were searched two times per week using 4-wheel ATVs where the search focus was for large birds/raptors. Approximately half of the rim-edge and non-rim-edge turbines were searched on foot, and half were searched with ATVs. Surveyors walked or drove an ATV along parallel transects within each search plot while scanning the ground on either side of the transect line for casualties. Parallel transects were set approximately 20 m apart and were oriented based on topography surrounding the turbines. The surveyor walked at a rate of approximately 45-60 meters a minute along each transect taking approximately 60 - 90 minutes to search each turbine under normal walking conditions. Transects in ATV-searched plots were 30 m (98 ft) apart and the searcher scanned the whole plot with a focus on large birds.

Due to excessive snow cover, searches in January and February of 2008 were limited to turbines within 400 m of the rim edge.

Data Collection

The condition of each 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.
- Scavenged - 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.
- Feather Spot - 10 or more feathers or two or more primaries at one location indicating a bird fatality had been there.

All carcasses were labeled with a unique number, sealed in a plastic, and frozen for future reference and possible necropsy. A copy of the data sheet for each carcass was maintained, bagged and frozen with the carcass at all times. For all casualties found, data recorded included species, sex and age when possible, date and time collected, Global Positioning System (GPS) location, condition (intact, scavenged, feather spot), and any comments that indicated possible cause of death. All casualties 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 met towers.

Casualties observed in non-search areas (e.g., near a turbine not included in the search area) were defined as incidental discoveries and were documented in a similar fashion as those found during standard searches. Casualties found by maintenance personnel and others not conducting the formal searches were similarly documented and included in the overall dataset.

Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of casualties found by surveyors. Searcher efficiency trials were conducted in the same areas as carcass surveys and searcher efficiency was estimated by both the size of carcass and season. Estimates of searcher efficiency were used to correct for detection bias by adjusting the total number of carcasses found for those missed by searchers.

Personnel conducting carcass surveys did not know the location of the trial carcasses. Carcasses used for the trials were non-native/non-protected or commercially available species such as *Coturnix* quail, rock pigeon (*Columba livia*), mallard (*Anas platyrhynchos*), house sparrow (*Passer domesticus*), or European starling (*Sturnus vulgaris*). Due to the small number of bats available for trials, estimates for small birds were used as a surrogate for bats. All searcher efficiency trial carcasses were placed at random locations within the search area prior to that day's scheduled carcass survey. Carcasses were placed in a variety of postures to simulate a range of conditions. For example, birds were: 1) placed in an exposed posture (tossed randomly to one side); 2) partially hidden; or 3) mostly hidden to simulate a crippled bird (e.g., placed beneath vegetation). Each trial carcass was discreetly marked so that it could be identified as a study carcass after it was found.

A total of 229 bird carcasses (151 large birds and 78 small birds) were used in searcher efficiency trials between January 3, 2008 and March 9, 2009. Seventy-two large birds and 72 small birds were used for trials at turbines searched on foot, and 79 large birds and six small birds were used in searcher efficiency trials at turbines searched by ATV. Seventy-two large birds and 38 small birds were placed at rim edge turbines; 79 large birds and 40 small birds were placed at non-rim edge turbines.

Between March 10, 2009 and January 15, 2010, 30 bats, 80 large birds, and 79 small birds were used in searcher efficiency trials. Fifteen bats and 40 large birds each were used for turbines searched on foot and by ATV. Forty small birds were placed at foot-searched turbines and 39 were placed at ATV-searched turbines. For rim-edge turbines, five bats, 23 large birds, and 22 small birds were placed; for non-rim edge turbines, 25 bats, 57 large birds, and 57 small birds were used.

Carcass Removal Trials

The objective of carcass removal trials was to estimate the average length of time a carcass remained in the study area and was potentially detectable. Carcass removal included removal by predation or scavenging, or removal by other means such as being plowed into a field. Carcass removal studies were conducted during each season outside of the carcass search plots (i.e., near turbines that were not included in the standardized carcass survey plots). Estimates of carcass removal were used to adjust the total number of carcasses found for those removed from the study area, correcting for removal bias.

Trial carcasses were randomly placed at selected turbines within a plot the same size as search plots. Trial carcasses were placed in a variety of postures to simulate a range of conditions. For example, birds were: 1) placed in an exposed posture (tossed randomly to one side); 2) partially hidden; or 3) mostly hidden to simulate a crippled bird (e.g., placed beneath vegetation).

Personnel conducting carcass searches monitored the trial birds over a 40-day period, checking the carcasses every day for the first four days of the trial, and then on day seven, day 10, day 14, day 20, day 30, and day 40. This schedule varied somewhat depending on weather and coordination with the other survey work. Removal trial carcasses were marked discreetly (e.g., with dark electrical tape around one or both legs) for recognition by searchers and other personnel, and left at the location until the end of the carcass removal trial. At the end of the 40-day period, any remaining evidence of the carcass was removed.

Trials were spread throughout the year to incorporate the effects of varying weather conditions and scavenger densities. A total of 249 removal trial carcasses (109 large birds, 110 small birds, and 30 bats) were placed in the project area throughout the year. Species composition of bird carcasses was similar to that used for searcher efficiency trials. Bats used were found as fresh fatalities on site.

Statistical Methods

Estimates of facility-related fatalities were based on:

- (1) Observed number of carcasses found during standardized surveys during the first year of monitoring for which the cause of death was either unknown or probably 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, based on the carcass removal trials.
- (3) Searcher efficiency expressed as the proportion of planted carcasses found by searchers during searcher efficiency trials.

The number of bird and bat fatalities attributed to operation of the facility was based on the number of bird and bat fatalities found at the CCWEF. All carcasses located within areas surveyed, regardless of species and suspected cause of death, were recorded and, if possible, the cause of death determined based examination of the carcass. Total number of bird and bat carcasses was estimated by adjusting for removal and searcher efficiency bias as well as proportion of area searched.

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
$\bar{c}$	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

- $\hat{\pi}$ 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

Observed Number of Carcasses

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

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

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:

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

Estimation of Searcher Efficiency Trials

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

Estimation of Facility-Related Fatality Rates

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

$$m = \frac{\bar{c}}{\hat{\pi}} \quad (3)$$

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 were pooled across the study to estimate $\hat{\pi}$. $\hat{\pi}$ is calculated as follows:

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(\frac{I}{\bar{t}}\right) - 1}{\exp\left(\frac{I}{\bar{t}}\right) - 1 + p} \right] \text{ (Shoenfeld 2004)} \quad (4)$$

Separate estimates were obtained for migration seasons and other seasons. Then, final estimates were calculated by a weighted average of these estimates by length of season.

This formula (4) has been independently verified by Shoenfeld (2004). The final reported estimates of m and associated standard errors and 90% 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 1,000 bootstrap samples were used. The reported estimates are the mathematical means of the 1,000 bootstrap estimates. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals.

The above formula has been widely used 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 given consideration.

RESULTS

Standardized Carcass Surveys

Bird and bat fatalities as well as fatality estimates adjusted for searcher efficiency and carcass removal biases are discussed below. Results are presented separately for ATV searches and walking searches, and for rim-edge turbines and non rim-edge turbines, as well as for the facility as a whole. Records for all bird and bat fatalities are in Appendix A.

Bird Fatalities

During the course of the two-year study, 152 bird fatalities representing 32 species were found (Table 1). Searched turbines are listed in Table 2. Of the bird fatalities, 17 were found incidental to the standardized carcass surveys (Table 1). The locations of all bird fatalities are plotted in Figure 4. The most common bird species found was horned lark (*Eremophila alpestris*; 66 individuals; 43.4% of fatalities), followed by mourning dove (*Zenaida macroura*; 17 individuals; 11.2% of fatalities), and western meadowlark (*Sturnella neglecta*; 11 individuals; 7.2% of fatalities). All other bird species recorded had six or fewer fatalities, representing less than 5% of fatalities (Table 1). Six raptor species were recorded as fatalities or incidental finds during the study; American kestrel (*Falco sparverius*), Swainson's hawk (*Buteo swainsoni*), ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), golden eagle (*Aquila chrysaetos*), and burrowing owl (*Athene cunicularia*; Table 1). No bird fatalities were found at met towers.

The greatest number of bird fatalities found during scheduled searches at a single turbine was at turbine C12 with five fatalities in 2008 (one sharp-tailed grouse, two mourning doves, one horned lark, and one western meadowlark), and six in 2009 (five horned lark, and one mourning dove; Figures 5a-b). This turbine is a rim edge turbine, but did not have any raptor fatalities associated with it. Five turbines (C3, C10, C11, D9, L6) each had four recorded fatalities (Figure 5a-b). Bird fatalities tended to be concentrated in the southeast quadrant of the search plots and

the distribution within search plots was significantly different than uniform (chi-square test, $p < 0.0018$); 35.3% of fatalities were found in the southeast quadrant (Table 3). This may be due in part to the direction of the prevailing winds at Cedar Creek (northwest). Bird fatalities were also found at all distances from the turbines within the search plots, with the highest percentage of birds found within 20 m of the turbine and 12.0-14.0% found in 20-m increments away from the turbine base (Table 3; Figure 6). Bird fatalities were found throughout the year (Figure 7). Fatalities per week spiked in late spring (May and June) of 2008, early spring (mid-March to early April) of 2009, and in late summer to fall of 2009 (Figure 7).

Thirteen raptors were found during scheduled carcass searches and two were found incidentally. The raptors found during scheduled searches were three American kestrels, four Swainson's hawks, three northern harriers, one ferruginous hawk, one golden eagle, and one burrowing owl (feather spot; partial wing and feathers). One American kestrel and one golden eagle were found incidentally. The incidental golden eagle fatality was the result of electrocution at a riser pole. Of the raptors found during scheduled searches, six were found during walking surveys and seven were found by surveyors on ATVs.

Bat Fatalities

During the two-year study, 72 bat fatalities representing four species were found (Table 4). Of these 72 bat fatalities, five were found incidental to the standardized carcass surveys (Table 4). The locations of all bat fatalities are plotted in Figure 8. The most common bat species found was hoary bat (*Lasiurus cinereus*; 44 individuals; 61.1% of fatalities), followed by silver-haired bat (*Lasionycteris noctivagans*; 22 individuals; 30.6% of fatalities; Table 4). Two big brown bats (*Eptesicus fuscus*), two little brown bats (*Myotis lucifugus*), and two unidentified bats also were found (Table 4). No bat fatalities were found at met towers.

Bat fatalities were found throughout the study area (Figure 8). The greatest number of bat fatalities found at a single turbine was seven found at turbine H49 (Figure 8). Three of the fatalities at H49 occurred on August 25, 2009, and three more occurred in the 8 days following that date. H49 is located on the southeast edge of the project but doesn't appear to have unique identifiable characteristics that would associate with higher mortality. One turbine, L8, had three bat fatalities, eight turbines had two bat fatalities, and the rest had one or zero bat fatalities. Most bat fatalities were found in the northern half of search plots (38.9% in the northwest quadrant, 25.0% in the northeast quadrant; Table 4, chi-square test, $p < 0.0016$). Winds in the summer are variable but blow mostly from the south (T. Ryan, pers. comm.). The majority (93.1%) of bats were found within 60 m of the turbine (Table 4; Figure 9). Bat mortality was highest in the late summer and early fall, and all fatalities found between April 9 and November 11 (Figure 10).

Searcher Efficiency Trials

A total of 418 carcasses (231 large birds, 157 small birds, and 30 bats) was placed in the field during searcher efficiency trials over the two-year study period. Overall observer detection rates across all seasons were 76.8% for large birds, 58.69% for small birds, and 26.7% for bats (Table 5). Results of searcher efficiency trials were separated by search method (walking and ATV searches). For walking searcher efficiency trials, 112 large bird carcasses, 112 small bird carcasses, and 15 bats were placed with resulting searcher efficiency rates of 80.2%, 58.7%, and 33.3%, respectively. For ATV searches, 119 large bird carcasses, 43 small bird carcasses, and 15

bats were placed with resulting searcher efficiency rates of 73.5%, 58.1%, and 20.0%, respectively. For rim edge turbines, 82.1% of 95 large birds, 65.5% of 58 small birds, and 40.0% of five bats were detected, while for non-rim-edge turbines, 72.9% of 133 large birds, 54.3% of 94 small birds, and 24.0% of 25 bats were detected.

Carcass Removal Trials

A total of 249 carcasses (109 large birds, 110 small birds, and 30 bats) were placed in the project area during carcass removal trials over two years. Overall, mean removal rates were 10.9 days for large birds, 10.4 days for small birds, and 10.2 days for bats. Figure 11 shows the number of carcasses remaining on each day of the removal trials.

Adjusted Fatality Estimates

A summary of bird and bat fatalities used to calculate adjusted fatality estimates is shown in Tables 6a-c. Fatality estimates, standard errors, and confidence intervals were calculated for birds and bats and are presented separately for walking and ATV searches (Tables 7a-b and 8a-b). Since the searched turbine set wasn't changed until March 2009, the first year of study will be called "2008" in this report but refers to the time period January 3, 2008 – March 9, 2009. The "2009" study year refers to the time period March 10, 2009 – January 15, 2010. Fatality estimates are adjusted to correct for carcass removal and observer detection bias.

Birds

For ATV searches in 2008, the estimated average probability that a bird casualty would remain in the plot until a scheduled search and would be found was 0.67 for small birds, 0.76 for large birds, and 0.76 for raptors; in 2009 the probability was 0.78 for large birds and raptors and 0.69 for small birds (Tables 7a-b). For walking searches in 2008, the estimated average probability that a bird casualty would remain in the plot until a scheduled search and would be found was 0.31 for small birds and 0.40 for large birds and raptors, while in 2009 the probability was 0.35 for small birds and 0.45 for large birds and raptors (Tables 7a-b).

In 2008, the estimated number of bird fatalities with associated 90% confidence limits was 3.39 fatalities/turbine/study period (2.39, 4.69) for walking surveys and 1.76 fatalities/turbine/ study period (1.32, 2.30) for 4-wheel ATV surveys (Table 7a). In 2009, the estimated number of bird fatalities with associated 90% confidence limits was 2.00 fatalities/turbine/ study period (1.38, 2.68) for walking surveys and 1.36 fatalities/turbine/ study period (0.88, 1.97) for 4-wheel ATV surveys (Table 7b).

Fatality estimates were also calculated specifically for raptors. In 2008, the estimated number of raptor fatalities and associated 90% confidence interval was 0.13 fatalities/turbine/ study period (0, 0.30) for walking surveys and 0.18 fatalities/turbine/ study period (0.04, 0.33) for ATV surveys (Table 7a). In 2009, estimated raptor fatality rates were 0.25 fatalities/turbine/ study period (0.07, 0.46) for walking surveys and 0.08 fatalities/turbine/ study period (0, 0.17) for ATV surveys (Table 7b).

The overall adjusted fatality estimates for both years combined was 2.07 birds/turbine/year for all birds, or 1.90/MW/year. For raptors it was 0.16 raptors/turbine/year or 0.15/MW/year (Table 8).

Bats

Adjustments for carcass removal and observer detection bias for bats were made using the estimates for small birds and bats combined in 2008, and bats only in 2009. In 2008, the estimated average probability a bat casualty would remain until a scheduled search and would be found was 0.15 for ATV searches and 0.43 for walking surveys (Table 9a). In 2009, it was 0.45 for ATV surveys and 0.17 for walking surveys (Table 9b).

For walking surveys in 2008, the estimated number of bat fatalities with associated 90% confidence limits for the one-year study was 2.00 fatalities/turbine/study period (0.93, 4.62; Table 9a). For ATV surveys in 2008, bat fatalities per turbine per study period were estimated to be 1.13 (0.64, 2.22; Table 9a). In 2009, for walking surveys, the bat fatality rate was 1.29 bat fatalities/turbine/study period (0.52, 3.25), and for ATV surveys, the bat fatality rate in 2009 was estimated to be 1.94 fatalities/turbine/study period (1.09, 3.70; Table 9b).

The overall adjusted fatality estimates for bats for both years combined was 1.61 bats/turbine/year or 1.47/MW/year (Table 8).

Rim-Edge and Non-Rim-Edge Turbines

Adjusted fatality rates for 2008 walking surveys for birds were higher for rim-edge turbines than non-rim-edge turbines (4.39 fatalities/turbine/study period versus 2.95 fatalities/turbines/study period, respectively; Table 10a). Similarly, for ATV searches, bird fatality rate was higher at rim-edge turbines than at non-rim-edge turbines (2.98 fatalities/turbine/study period versus 1.07 fatalities/turbine/study period, respectively; Table 10a). Adjusted fatality rates for raptors indicated that approximately twice as many raptors were killed at rim-edge turbines in 2008, but the fatality rates were low overall (Table 10a).

In 2009, adjusted fatality rates for birds were lower for walking surveys at rim-edge turbines (1.24 fatalities/turbine/study period) than non-rim-edge turbines (2.45), but adjusted rates were higher for rim-turbines searched by ATV (1.82) compared to non-rim-edge turbines searched by ATV (1.15; Table 10b).

For raptors during both years of study, five were found at rim-edge turbines and 10 were found at non-rim edge turbines.

Adjusted fatality rates for 2008 walking surveys for bats indicated that fatality rates were higher at non rim-edge than at rim-edge turbines (2.10 fatalities/turbine/study period versus 1.55 fatalities/turbine/study period, respectively), but for ATV searches, bat fatalities appeared to be higher at rim-edge turbines (1.41 fatalities/turbine/study period versus 0.84 fatalities/turbine/study period, respectively; Table 10a; Figure 12a).

In 2009, adjusted fatality rates for bats were higher for walking surveys at rim-edge turbines (1.84 bat fatalities/turbine/study period) than non-rim-edge turbines (0.78), but adjusted rates were much higher for non-rim-turbines searched by ATV (2.27) compared to rim-edge turbines searched by ATV (1.28; Table 10b; Figure 12b).

DISCUSSION

Fatality Estimation

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson (2006), 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 site and must be accounted for when attempting to estimate fatality rates. We accounted for this by conducting scavenging trials throughout the year. We also estimated searcher efficiency rates throughout the year to account for any biases associated with changes in conditions.

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 casualties found within the standardized search plots during the study were included in the analysis. A few carcasses were found incidentally within a search plot during other activities on-site and it was assumed that these carcasses would have been found during scheduled carcass surveys. Second, it was assumed that all 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 fatalities were caused by predators, and some of the casualties included in the data pool potentially were due to natural causes (background mortality). The sharp-tailed grouse was only a feather spot and cause of death is unknown.

A few wind project studies have provided information on background mortality. During a four-year study at Buffalo Ridge (Minnesota), 2,482 fatality searches were conducted on study plots without turbines to estimate reference mortality in the study area, and 31 avian fatalities comprising 15 species were found (Johnson *et al.* 2000). Reference mortality consisted of eight upland gamebirds, seven doves, five sparrows, three waterfowl, three raptors, two blackbirds, one waterbird, one shorebird, and one unidentified bird. The exact cause of death of many birds found in reference plots could not be determined; however, most appeared to have been caused by predators or vehicles. Reference mortality was estimated to average 1.1 fatalities per plot per year, compared to 0.98, 2.27, and 4.45 fatalities per turbine search plot per year in the Phase 1, 2 and 3 wind plants, respectively (Johnson *et al.* 2000). Some pre-project carcass searches were conducted at a proposed wind project in Montana (Harmata *et al.* 1998). Three bird fatalities were found, two presumed raptor kills and another from an unknown cause during 8 searches of 5 transects, totaling 17.61 km per search. On average, approximately 2.4 km of transect is searched in every turbine search plot at CCWEF. Therefore, the amount of transect searched at the Montana site per search was equivalent to searching approximately 7 turbines at CCWEF. The background estimate for observed mortality would be approximately 0.4 per turbine plot per year, which is unadjusted for scavenging and searcher efficiency. This background mortality information from Minnesota and Montana suggest that the estimates of bird fatality rates likely include some avian fatalities not related to turbine collision, and this factor alone would lead to an over-estimate of true avian collision mortality at wind plants. However, avian behavioral changes after a wind facility is built (e.g., avoidance) are not calculated into the background fatality estimates at Buffalo Ridge and Montana. It is unlikely that any of the bat fatalities were

due to factors not related to interactions with wind turbines (Johnson et al. 2003a, Johnson et al. 2004). In addition, the large raptor fatalities are also likely wind turbine related, but songbird and small raptor fatalities like burrowing owls are much more uncertain as to the cause of death. Many of the fatalities of the smaller birds are only feather spots when the searchers find them.

The burrowing owl casualty found near a turbine was only a feather spot and wing. In the case of burrowing owls, other studies have suggested high uncertainty regarding cause of death for burrowing owls at a facility with high burrowing owl density (ICF Jones & Stokes 2009). In a detailed study of burrowing owl mortality at the Altamont Pass Wind Resource Area, very few fatality detections were intact carcasses with evidence suggesting wind turbines caused the death. One of the possible explanations was that some of the carcasses detected were due to predation rather than turbine collision and therefore intact carcasses never were available for detection.

There are some other potential negative biases. For example, no adjustments were made for fatalities possibly occurring outside of the square plot boundaries. Plot boundaries were established a minimum distance of 394 ft (120 m) from the turbines. The search plot distance for this study was selected based on results of other studies (Higgins et al. 1996; Young et al. 2003, 2005; Johnson et al. 2002b, 2003a, 2004; Erickson et al. 2004; Kerlinger et al. 2007) where a distance equal to the approximate height of the turbine appeared to capture a very large percentage of fatalities. Based on the distribution of fatalities as a function of distance from turbines (Figure 6), 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 bird fatality rates. The distribution of bat fatalities at CCWEF and at other facilities (e.g., Young et al. 2003, Erickson et al. 2004, Kerns and Kerlinger 2004, Johnson et al. 2004, Kerlinger et al. 2007) suggest bat casualties fall closer to turbines than bird casualties.

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, etc. *Coturnix* sp. quail, mallard, and rock pigeon were used to represent the range of bird fatalities expected. We feel this range 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. Additionally, a combination of small birds and bats were used to estimate scavenger removal rates for bats, whereas only small bird carcasses were used as surrogates to estimate searcher efficiency rates for bats. It is generally not practical or feasible to obtain many of the native bird species or bats in fresh condition for these trials.

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 would 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 access all wind turbine collisions. 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.

Bird Fatalities

Of the 152 birds fatalities found during the study, none were federally listed species. The burrowing owl is listed by the state of Colorado as threatened. Most birds are protected by the Migratory Bird Treaty Act, and golden eagles receive additional protections under the Bald and Golden Eagle Protection Act. One of the two golden eagle fatalities was due to electrocution, and CCWEF managers are retrofitting all such poles to reduce electrocution risk (T. Ryan, pers. comm.).

The estimated bird fatality rate for the two years of study (1.83 fatalities/MW/year) is comparable to other wind energy facilities in grassland and steppe regions of western North America. The range of annual overall bird fatality estimates at 13 western wind energy projects located in Washington, Oregon, Wyoming, Nebraska, Texas, and Alberta, Canada, ranged from 0.95 to 3.14 birds/MW/year (Erickson et al. 2000, 2003a, 2004, 2008b; Johnson et al. 2003b; Young et al. 2003, 2006, 2007; Brown and Hamilton 2006; Derby et al. 2007; NWC and WEST 2007; Tierney 2007; NWCC 2008).

Estimated avian fatality at the CCWEF falls within this range (Figure 13a) and it is unlikely that operation of this facility will result in any significant impacts to bird populations. The two most common fatalities, horned lark and western meadowlark, are the likely most common birds in the study area. Raptor fatality rates were also in the range of western wind-energy facilities (Figure 13b).

The CCWEF is in the USFWS Bird Conservation Region (BCR) 18 (Shortgrass Prairie) (USFWS 2008). Sixteen Birds of Conservation Concern (BCC) are listed in this BCR. BCCs are species that, without conservation efforts, may become candidates for listing under the Endangered Species Act (ESA 1973). The goal of the BCC list is to prevent the need for listing, but no additional regulatory protection is given to BCC species. Four BCC species were found as fatalities during two years of monitoring at CCWEF: lark bunting (six individuals), golden eagle (two), McCown's longspur (two), ferruginous hawk, (one), and burrowing owl (one). As mentioned above, there is some uncertainty into the cause of death for some of the songbird species and the burrowing owl.

When CCWEF was in the planning stages, concerns were raised about the project proximity to raptor nests on the cliffs along the escarpment and in trees in project area. The concern was that turbines closer to the nests were more risky for those nesting birds; however, most raptor fatalities did not occur at turbines that were closer to nests. The golden eagle fatalities occurred 4.1 and 5.8 km (2.4 and 3.5 miles) from the nearest nests. Swainson's hawk fatalities occurred from 2.6 to 4.5 km (1.6 to 2.7 miles) from nests. The burrowing owl fatality was 1.8 km (1.1 miles) from the nearest burrow. The ferruginous hawk fatality was 0.85 km (0.53 mi) from the nearest nest. In all cases there were turbines closer to the nests that did not have raptor fatalities, indicating that turbine proximity to raptor nests may not be good index of risk to those raptors. For the whole CCWEF, 43 of the 274 turbines (15.7%) are rim-edge turbines (i.e., within 400 m of the rim edge). Five of the 15 raptor fatalities (33.3%) were found at rim-edge turbines

Bat Fatalities

The fatality estimate for bats during the two years of study (1.43 fatalities/MW/year) is well within rates reported for wind-energy facilities in the western US, and far below fatality rates reported from the eastern US (Johnson 2005, Arnett et al. 2008; Figure 13c). To date, the highest fatality estimates for bats have come from the eastern US, particularly the Appalachian region where estimates have ranged from 20.8 to 69.6 bats per turbine (Arnett et al. 2008). Regional data from the western states represent a range of survey effort and methodology. While these regional projects occur in six states (California, Oregon, Washington, Montana, Wyoming, Nebraska) and a Canadian province (Alberta), characteristics such as land cover are fairly similar including arid grassland, shrub-steppe, and dryland agriculture (mostly wheat or other small grain crops). Adjusted fatality estimates for 16 western projects range from 0.07 to 14.62 bat fatalities/MW/year (Erickson et al. 2000, 2003a, 2004, 2008b; Johnson et al. 2003b; Young et al. 2003, 2006, 2007; Kronner et al. 2005, 2008, URS et al. 2005; Brown and Hamilton 2006; Kerlinger 2006; Derby et al. 2007; NWC and WEST 2007; Baerwald 2008; TRC 2008), and bat fatalities at CCWEF appear to fall in the low end of this range.

Landscape and habitat context have both been proposed as hypotheses to explain bat fatalities at wind energy facilities. For example, in the eastern US, clearings cut into the forested ridges that some wind energy facilities are built on are thought to contribute to the relatively high numbers of bat fatalities at these sites, as clearings create potential foraging habitat, and ridges may serve as attractive linear features during foraging, commuting or migration (Kunz et al. 2007). None of those features are present at the CCWEF. However, the relatively large numbers of bat fatalities recently reported in northern Iowa (Jain 2005), Wisconsin (Gruver et al. 2009), and southwestern Alberta (Baerwald 2008) indicate that an open landscape is no guarantee of low bat mortality.

Species composition of fatalities at the CCWEF was similar to that at most other wind energy facilities, in that virtually all of identified bat fatalities were comprised of two migratory tree bats: the hoary bat and silver-haired bat. Based on the timing of fatalities for these two species, combined with the lack of forest cover that might provide habitat for resident bats, most were apparently fall migrants through the site, as is the case at virtually all other wind energy facilities in North America (Johnson 2005, Arnett et al. 2008). It seems unlikely that the CCWEF is located along a concentrated bat migration route, as there are no topographical features or large expanses of forested areas that would tend to concentrate migrating bats. This study was not designed to address that question, and obtaining information on migratory routes by bats (assuming they exist) has proven to be a very difficult hurdle to date (Arnett et al. 2008).

Pre-construction bat use surveys at the CCWEF consisted of both mist net and acoustic surveys (Good and Johnson 2007). The most common species detected during the mist netting surveys and the acoustic surveys was western small-footed myotis. However, no western small-footed myotis were observed as fatalities. The fringed myotis appears to be relatively uncommon in the project area, as it is throughout Colorado (Fitzgerald et al. 1994). Single individuals were captured during the study. Other species were detected during acoustic surveys, including the fringed myotis, silver-haired bat, little brown myotis, and hoary bat. Only silver-haired bat, little brown myotis, and hoary bat were found as fatalities.

Because migratory tree bats are primarily solitary tree dwellers that do not hibernate, it has not been possible to develop any suitable field methods to estimate their population sizes. As a result, impacts on these bat species caused by wind energy development cannot be put into perspective from a population impact standpoint. To help solve this problem, population genetic analyses of DNA sequence and microsatellite data are being conducted to provide effective population size estimates, to determine if populations are growing or declining, and to see if these populations comprise one large population or several discrete subpopulations that use spatially segregated migration routes (A.L. Russell, Assistant Professor, Grand Valley State University, Allendale, Michigan, pers. comm.). To date, initial analyses have been conducted only for eastern red bat using mitochondrial DNA. Based on these analyses, it appears that this species fits a model of a single, very large population with a history of strong population growth (Vonhof and Russell, in prep). The data do not suggest there are multiple populations separated by distinct migratory corridors. Although the point estimate for the eastern red bat population size in North America is 3.3 million, according to Dr. Russell (pers. comm.), the true population size is likely “millions to tens of millions” in size.

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Table 1. Bird fatalities found during walking and ATV searches within the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

Species	Scheduled Search Plot			All Fatalities	
	Walking	ATV	Incidental	Total	% Composition
horned lark	21	36	9	66	43.4
mourning dove	13	3	1	17	11.2
western meadowlark	8	3	0	11	7.2
lark bunting	4	2	0	6	3.9
unidentified bird	1	4	0	5	3.3
American kestrel	1	2	1	4	2.6
northern harrier	2	1	0	3	2.0
Swainson's hawk	1	3	0	4	2.6
mallard	1	1	0	2	1.3
McCown's longspur	2	0	0	2	1.3
rock wren	0	2	0	2	1.3
unidentified passerine	1	1	1	3	2.0
vesper sparrow	1	1	0	2	1.3
American coot	0	1	0	1	0.7
blue-winged teal	0	1	0	1	0.7
Brewer's blackbird	0	1	0	1	0.7
Brewer's sparrow	0	1	0	1	0.7
burrowing owl	1	0	0	1	0.7
chipping sparrow	1	0	0	1	0.7
Eurasian collared-dove	0	1	0	1	0.7
ferruginous hawk	0	1	0	1	0.7
golden eagle	1	0	1	2	1.3
grasshopper sparrow	0	1	1	2	1.3
Killdeer	0	1	0	1	0.7
lark sparrow	0	1	0	1	0.7
red-headed woodpecker	0	1	0	1	0.7
rock pigeon	0	1	0	1	0.7
ruddy duck	1	0	0	1	0.7
sharp-tailed grouse	1	0	0	1	0.7
small bird	1	0	0	1	0.7
sora	0	1	0	1	0.7
unidentified sparrow	1	0	0	1	0.7
yellow-headed blackbird	1	0	0	1	0.7
European starling	0	0	1	1	0.7
Lapland longspur	0	0	1	1	0.7
ring-necked pheasant	0	0	1	1	0.7
Total	64	71	17	152	100

Table 2a. Turbines searched during two years of fatality monitoring at Cedar Creek Wind-energy Facility, January 2008 – March 9, 2009.

Turbine	Habitat	Rim Edge	Search Type
A2	Grassland		Walking
A8	CRP		4-wheel
B12	Grassland		Walking
B15	CRP	Y	4-wheel
B17	Tilled agriculture	Y	Walking
B19	Grassland	Y	4-wheel
B2	CRP		Walking
B21	CRP	Y	Walking
B23	CRP	Y	4-wheel
B25	CRP	Y	Walking
B27	Grassland	Y	4-wheel
B7	Grassland		4-wheel
C10	Grassland	Y	Walking
C11	Grassland	Y	4-wheel
C12	Grassland	Y	Walking
C13	Tilled agriculture	Y	4-wheel
C16	Grassland	Y	Walking
C3	CRP		4-wheel
C7	Grassland	Y	4-wheel
D13	Tilled agriculture		Walking
D17	CRP		4-wheel
D2	Grassland		Walking
D20	Grassland	Y	Walking
D22	CRP	Y	4-wheel
D24	CRP	Y	Walking
D26	CRP	Y	4-wheel
D7	Grassland		4-wheel
E13	CRP		walking
E18	Grassland		4-wheel
E3	CRP		Walking
E8	CRP		4-wheel
F11	CRP	Y	Walking
F5	CRP		Walking
G1	Grassland		4-wheel
G11	Grassland		4-wheel
G16	CRP		Walking
G21	Grassland		4-wheel
G26	Grassland		Walking
G31	Tilled agriculture		4-wheel
G37	Grassland	Y	4-wheel
G5	Grassland		Walking

Table 2a. Turbines searched during two years of fatality monitoring at Cedar Creek Wind-energy Facility, January 2008 – March 9, 2009.

Turbine	Habitat	Rim Edge	Search Type
H1	Grassland		Walking
H11	Grassland		Walking
H16	Grassland		4-wheel
H21	Grassland		Walking
H26	Grassland		4-wheel
H31	Grassland		Walking
H37	Grassland		4-wheel
H42	Grassland		Walking
H46	Grassland		4-wheel
H52	Grassland		Walking
H57	Tilled agriculture		4-wheel
H6	CRP		4-wheel
H62	Grassland		Walking
J3	Grass/Yucca		4-wheel
J8	Grass/Yucca		Walking
K3	Grassland		4-wheel
K9	Grass/Yucca		Walking
L13	Grassland		4-wheel
L3	Grassland		4-wheel
L8	Tilled agriculture		Walking
M14	Grassland		Walking
M4	Grassland		Walking
M9	CRP		4-wheel
P11	Grassland	Y	Walking
P13	Grassland	Y	4-wheel
P15	Grassland	Y	Walking
P3	Grassland		4-wheel
P9	Grassland	Y	4-wheel

Table 2b. Turbines searched during two years of fatality monitoring at Cedar Creek Wind-energy Facility, March 10, 2009.

Turbine	Habitat	Rim Edge	Search Type
A6	Grassland		Walking
A8	CRP		Walking
B15	CRP	Y	4-wheel
B16	CRP	Y	Walking
B18	Grassland	Y	Walking
B23	CRP	Y	4-wheel
B25	CRP	Y	Walking
B26	CRP	Y	Walking
B27	Grassland	Y	4-wheel
C1	Grassland		Walking
C12	Grassland	Y	4-wheel
C13	Tilled agriculture	Y	4-wheel
C7	Grassland	Y	Walking
C8	Grassland	Y	4-wheel
D10	Grassland		Walking
D14	Tilled agriculture		4-wheel
D17	CRP		Walking
D19	CRP		4-wheel
D20	Grassland	Y	4-wheel
D21	Grassland	Y	Walking
D22	CRP	Y	Walking
D7	Grassland		4-wheel
D9	Grassland		Walking
E12	CRP		4-wheel
E2	CRP		Walking
E9	CRP		4-wheel
F6	CRP		4-wheel
G17	Grassland		Walking
G22	Grassland		Walking
G26	Grassland		Walking
G3	Grassland		4-wheel
G36	Grassland	Y	Walking
G37	Grassland	Y	Walking
G6	Grassland		4-wheel
G7	Grassland		4-wheel
G9	Grassland		4-wheel
H11	Grassland		4-wheel
H12	Grassland		Walking
H17	Grassland		Walking
H2	Grassland		Walking

Table 2b. Turbines searched during two years of fatality monitoring at Cedar Creek Wind-energy Facility, March 10, 2009.

Turbine	Habitat	Rim Edge	Search Type
H21	Grassland		4-wheel
H27	Grassland		4-wheel
H30	Grassland		Walking
H34	Grassland		Walking
H44	Grassland		Walking
H49	Grass/Yucca		4-wheel
H55	Grassland		Walking
H56	CRP		4-wheel
J4	Grass/Yucca		4-wheel
K1	Grassland		4-wheel
K2	Grassland		4-wheel
K4	Grassland		4-wheel
L10	Grassland		Walking
L11	Grassland		Walking
L13	Grassland		Walking
L3	Grassland		4-wheel
L6	Tilled agriculture		4-wheel
L8	Tilled agriculture		4-wheel
M3	Grassland		Walking
M7	Grassland		4-wheel
P10	Grassland	Y	Walking
P11	Grassland	Y	4-wheel
P13	Grassland	Y	4-wheel
P14	Grassland	Y	4-wheel
P15	Grassland	Y	Walking
P3	Grassland		Walking
P4	Grassland		Walking
P9	Grassland	Y	4-wheel
Met tower A9			Walking
Met tower H6			Walking

Table 3. Distribution of bat and bird fatalities among distances from turbines at Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

	% Bird Fatalities	% Bat Fatalities
Quadrant		
NE	25.0	20.7
NW	38.9	26.7
SW	18.1	17.3
SE	18.1	35.3
Distance to Turbine (m)		
0-20	19.3	37.5
20-40	14.0	38.9
40-60	15.3	16.7
60-80	13.3	5.6
80-100	14.0	1.4
100-120	12.0	0.0
>120	12.0	0.0

Table 4. Bat fatalities found during walking and ATV searches within the Cedar Creek Wind-Energy Facility 2009, January 3, 2008 – January 15, 2010.

Species	<u>Scheduled Search Plot</u>			<u>All Fatalities</u>	
	Walking	ATV	Incidental	Total	% Composition
hoary bat	12	28	4	44	61.1
silver-haired bat	7	15	0	22	30.6
little brown bat	0	2	0	2	2.8
big brown bat	0	1	1	2	2.8
unidentified bat	0	2	0	2	2.8
Total	19	48	5	72	100

Table 5. Results of searcher efficiency trials for large and small birds overall and by search type at the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

Overall								
	# Placed	# Available	# Found	% Found				
Bats	30	30	8	26.7				
Large Birds	231	228	175	76.8				
Small Birds	157	152	89	58.6				
Walking Searches					4-Wheel ATV Searches			
Bird Size	# Placed	# Available	# Found	% Found	# Placed	# Available	# Found	% Found
Bats	15	15	5	33.3	15	15	3	20.0
Large Birds	112	111	89	80.2	119	117	86	73.5
Small Birds	112	109	64	58.7	45	43	25	58.1
Rim-Edge Turbine					Non Rim-Edge Turbines			
Bird Size	# Placed	# Available	# Found	% Found	# Placed	# Available	# Found	% Found
Bats	5	5	2	40.0	25	25	6	24.0
Large Birds	95	95	78	82.1	136	133	97	72.9
Small Birds	60	58	38	65.5	97	94	51	54.3

Table 6a. Summary of bird and bat fatalities found during walking and ATV surveys at the Cedar Creek Wind-Energy Facility, January 3, 2008 – March 9, 2009.

Season	Dates	# of surveys	# of Turbines Searched	# Bird Species	# Bird Fatalities	# Bat Species	# Bat Fatalities
Winter	11/1 to 2/28	1143	72	2	15	1	1
Spring	3/1 to 5/15	826	71	11	24	2	2
Summer	5/16 to 9/15	1501	70	11	26	2	24
Fall	9/16 to 10/31	577	69	5	9	1	2
Overall		4047	74	20	74	2	29

Table 6b. Summary of bird and bat fatalities found during walking and ATV surveys at the Cedar Creek Wind-Energy Facility, March 10, 2009 – January 15, 2010.

Season	Dates	# of surveys	# of Turbines Searched*	# Bird Species	# Bird Fatalities	# Bat Species	# Bat Fatalities
Winter	11/1 to 2/28	724	70	5	12	0	0
Spring	3/1 to 5/15	732	70	9	16	1	4
Summer	5/16 to 9/15	1433	70	8	24	4	33
Fall	9/16 to 10/31	581	70	6	9	1	1
Overall		3470	70	18	61	4	38

* Includes two met towers

Table 6c. Summary of bird and bat fatalities found during walking and ATV surveys at the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

Season	Dates	# Bird Species	# Bird Fatalities	# Bat Species	# Bat Fatalities
Winter	11/1 to 2/28	6	27	1	1
Spring	3/1 to 5/15	15	40	2	6
Summer	5/16 to 9/15	14	50	4	57
Fall	9/16 to 10/31	9	18	2	3
Overall		30	135	4	67

Table 7a. Fatality estimates for birds: bootstrap point estimates (mean) standard errors (se) and lower (ll) and upper (ul) of 90% confidence intervals for bird fatality rate estimation for ATV and walking surveys at the Cedar Creek Wind-Energy Facility, January 3, 2008 – March 9, 2009.

Parameter	Walking Surveys				ATV Surveys			
	mean	se	90% C.I.		mean	se	90% C.I.	
			ll	ul			ll	Ul
Search Area Adjustment								
A (small)	1.00				1.00			
A (large)	1.00				1.00			
Observer Detection								
p (small)	0.59	0.05	0.52	0.67	0.59	0.05	0.52	0.67
p (large)	0.77	0.04	0.70	0.83	0.77	0.04	0.70	0.83
P (raptors)	0.77	0.04	0.69	0.83	0.77	0.04	0.69	0.83
Observed Fatality Rates (Fatalities/turbine/ study period)								
Small birds								
$\bar{f}_i$	0.78	0.16	0.54	1.05	0.92	0.15	0.69	1.19
Large birds								
$\bar{f}_i$	0.35	0.15	0.14	0.63	0.30	0.14	0.09	0.56
Raptors								
$\bar{f}_i$	0.05	0.04	0	0.12	0.14	0.07	0.03	0.25
Average Probability of Carcass Availability and Detected								
$\hat{p}_i$ (small)	0.31	0.03	0.26	0.37	0.67	0.04	0.61	0.73
$\hat{p}_i$ (large)	0.40	0.05	0.32	0.48	0.76	0.03	0.69	0.81
$\hat{p}_i$ (raptors)	0.40	0.05	0.32	0.48	0.76	0.04	0.69	0.81
Adjusted Fatality Estimates (Fatalities/turbine/ study period)								
m_i (all birds)	3.39	0.72	2.39	4.69	1.76	0.30	1.32	2.30
m_i (raptors)	0.13	0.10	0	0.30	0.18	0.09	0.04	0.33
Daily Fatality Rates (Fatalities/turbine/day)								
d_i (all birds)	0.008	0.002	0.006	0.011	0.004	0.001	0.003	0.005

Table 7b. Fatality estimates for birds: bootstrap point estimates (mean) standard errors (se) and lower (ll) and upper (ul) of 90% confidence intervals for bird fatality rate estimation for ATV and walking surveys at the Cedar Creek Wind-Energy Facility, March 10, 2009 – January 15, 2010.

Parameter	Walking Surveys				ATV Surveys			
	mean	se	90% C.I.		mean	se	90% C.I.	
			ll	ul			ll	Ul
Search Area Adjustment								
A (small)	1.00				1.00			
A (large)	1.00				1.00			
Observer Detection								
p (small)	0.59	0.05	0.52	0.67	0.59	0.05	0.52	0.67
p (large)	0.77	0.04	0.70	0.83	0.77	0.04	0.70	0.83
P (raptors)	0.77	0.04	0.70	0.83	0.77	0.04	0.70	0.83
Observed Fatality Rates (Fatalities/turbine/ study period)								
Small birds								
$\hat{f}_i$	0.44	0.10	0.28	0.61	0.74	0.21	0.43	1.12
Large birds								
$\hat{f}_i$	0.33	0.09	0.19	0.49	0.24	0.07	0.13	0.37
Raptors								
$\hat{f}_i$	0.11	0.05	0.03	0.20	0.06	0.04	0	0.13
Average Probability of Carcass Availability and Detected								
$\hat{p}_i$ (small)	0.35	0.04	0.29	0.41	0.69	0.04	0.63	0.74
$\hat{p}_i$ (large)	0.45	0.05	0.37	0.52	0.78	0.03	0.72	0.82
$\hat{p}_i$ (raptors)	0.45	0.05	0.37	0.52	0.78	0.03	0.72	0.82
Adjusted Fatality Estimates (Fatalities/turbine/ study period)								
m_i (all birds)	2.00	0.39	1.38	2.68	1.36	0.32	0.88	1.97
m_i (raptors)	0.25	0.12	0.07	0.46	0.08	0.05	0	0.17
Daily Fatality Rates (Fatalities/turbine/day)								
d_i (all birds)	0.006	0.001	0.004	0.009	0.004	0.001	0.003	0.006

Table 8. Overall bird and bat fatality estimates for Cedar Creek Wind-Energy Facility January 3, 2008 – January 15, 2010.

Fatalities/turbines/year	
All Birds	2.07
Raptors	0.16
Bats	1.61

Table 9a. Fatality estimates for bats: bootstrap point estimates (mean) standard errors (se) and lower (ll) and upper (ul) of 90% confidence intervals for 4-wheel ATV and walking surveys bat fatality rate estimation at the Cedar Creek Wind-Energy Facility, January 3, 2008 – March 9, 2009.

Parameter	Walking Surveys				ATV Surveys			
	mean	se	90% C.I.		mean	se	90% C.I.	
			ll	ul			ll	Ul
Search Area Adjustment								
A (bats)	1.00				1.00			
Observer Detection								
p (bats)	0.27	0.08	0.13	0.40	0.27	0.08	0.13	0.40
Observed Fatality Rates (Fatalities/turbine/ study period)								
Bats								
$\bar{c}_i$	0.30	0.08	0.19	0.43	0.49	0.10	0.32	0.67
Average Probability of Carcass Availability and Detected								
$\hat{\pi}_i$ (bats)	0.15	0.06	0.07	0.26	0.43	0.11	0.23	0.60
Adjusted Fatality Estimates (Fatalities/turbine/study period)								
All Bats								
m_i	2.00	1.35	0.93	4.62	1.13	0.53	0.64	2.22
Daily Fatality Rates (Fatalities/turbine/day)								
All Bats								
d_i	0.005	0.003	0.002	0.011	0.003	0.001	0.002	0.005

Table 9b. Fatality estimates for bats: bootstrap point estimates (mean) standard errors (se) and lower (ll) and upper (ul) of 90% confidence intervals for 4-wheel ATV and walking surveys bat fatality rate estimation at the Cedar Creek Wind-Energy Facility, March 10, 2009 – January 15, 2010.

Parameter	Walking Surveys				ATV Surveys			
	mean	se	90% C.I.		mean	se	90% C.I.	
			ll	ul			ll	Ul
Search Area Adjustment								
A (bats)	1.00				1.00			
Observer Detection								
p (bats)	0.27	0.08	0.13	0.40	0.27	0.08	0.13	0.40
Observed Fatality Rates (Fatalities/turbine/ study period)								
Bats								
$\bar{c}_i$	0.22	0.08	0.10	0.37	0.88	0.23	0.55	1.29
Average Probability of Carcass Availability and Detected								
$\hat{\pi}_i$ (bats)	0.17	0.07	0.08	0.29	0.45	0.11	0.25	0.62
Adjusted Fatality Estimates (Fatalities/turbine/ study period)								
All Bats								
m_i	1.29	0.91	0.52	3.25	1.94	0.91	1.09	3.70
Daily Fatality Rates (Fatalities/turbine/day)								
All Bats								
d_i	0.004	0.003	0.002	0.010	0.006	0.003	0.004	0.012

Table 10a. Total fatalities and adjusted fatality rates (number/turbine/study period) for fatalities found during scheduled searches at rim edge turbines (within 400 meters of the escarpment edge) and non-rim edge turbines (more than 400 meters from the escarpment edge) at the Cedar Creek Wind-Energy Facility, January 3, 2008 – March 9, 2009.

Adjusted Fatality Rates (number/turbine/study period)	Rim Edge	Non Rim Edge
All Birds		
Walking Surveys	4.39 (2.37 - 7.11)	2.95 (1.90 - 4.28)
ATV Surveys	2.98 (2.13 – 3.88)	1.07 (0.63 - 1.62)
Raptors		
Walking Surveys	0.20 (0 - 0.62)	0.09 (0 - 0.28)
ATV Surveys	0.30 (0.08 - 0.56)	0.11 (0 - 0.32)
Bats		
Walking Surveys	1.55 (0.50 - 3.82)	2.10 (0.86 – 5.58)
ATV Surveys	1.41 (0.79 - 2.48)	0.84 (0.37 - 1.82)

Table 10b. Adjusted fatality rates (number/turbine/study period) for fatalities found during scheduled searches at rim edge turbines (within 400 meters of the escarpment edge) and non-rim edge turbines (more than 400 meters from the escarpment edge) at the Cedar Creek Wind-Energy Facility, March 10, 2009 – January 15, 2010.

Adjusted Fatality Rates (number/turbine/study period)	Rim Edge	Non Rim Edge
All Birds		
Walking Surveys	1.24 (0.56 - 2.01)	2.45 (1.66 - 3.41)
ATV Surveys	1.82 (0.93 - 3.03)	1.15 (0.64 - 1.77)
Raptors		
Walking Surveys	0.19 (0 - 0.55)	0.28 (0.07 - 0.55)
ATV Surveys	0.11 (0 - 0.32)	0.06 (0 - 0.17)
Bats		
Walking Surveys	1.84 (0.59 - 4.30)	0.78 (0.15 - 2.22)
ATV Surveys	1.28 (0.65 - 2.30)	2.27 (1.09 - 4.77)

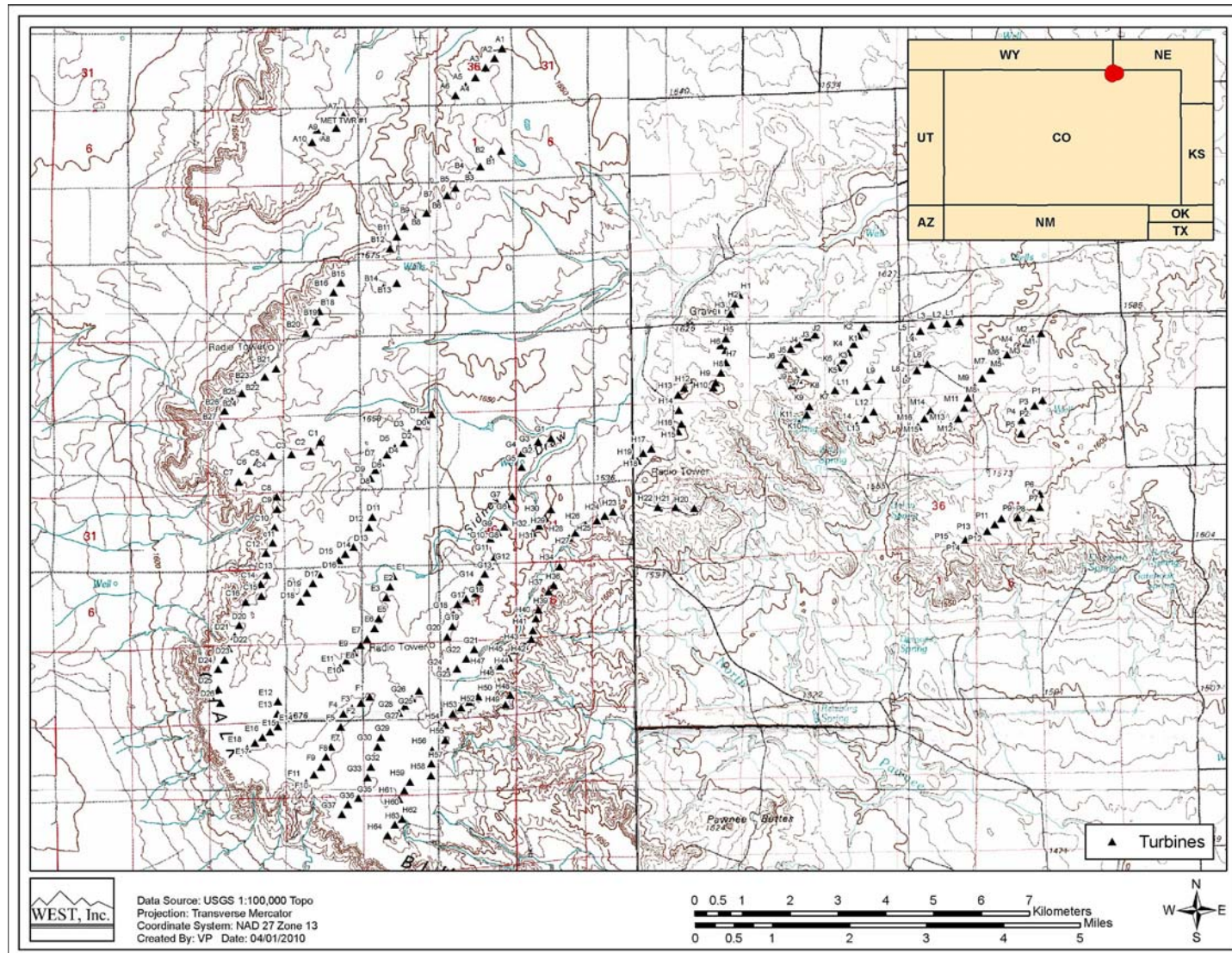


Figure 1. Location of the Cedar Creek Wind-Energy Facility.

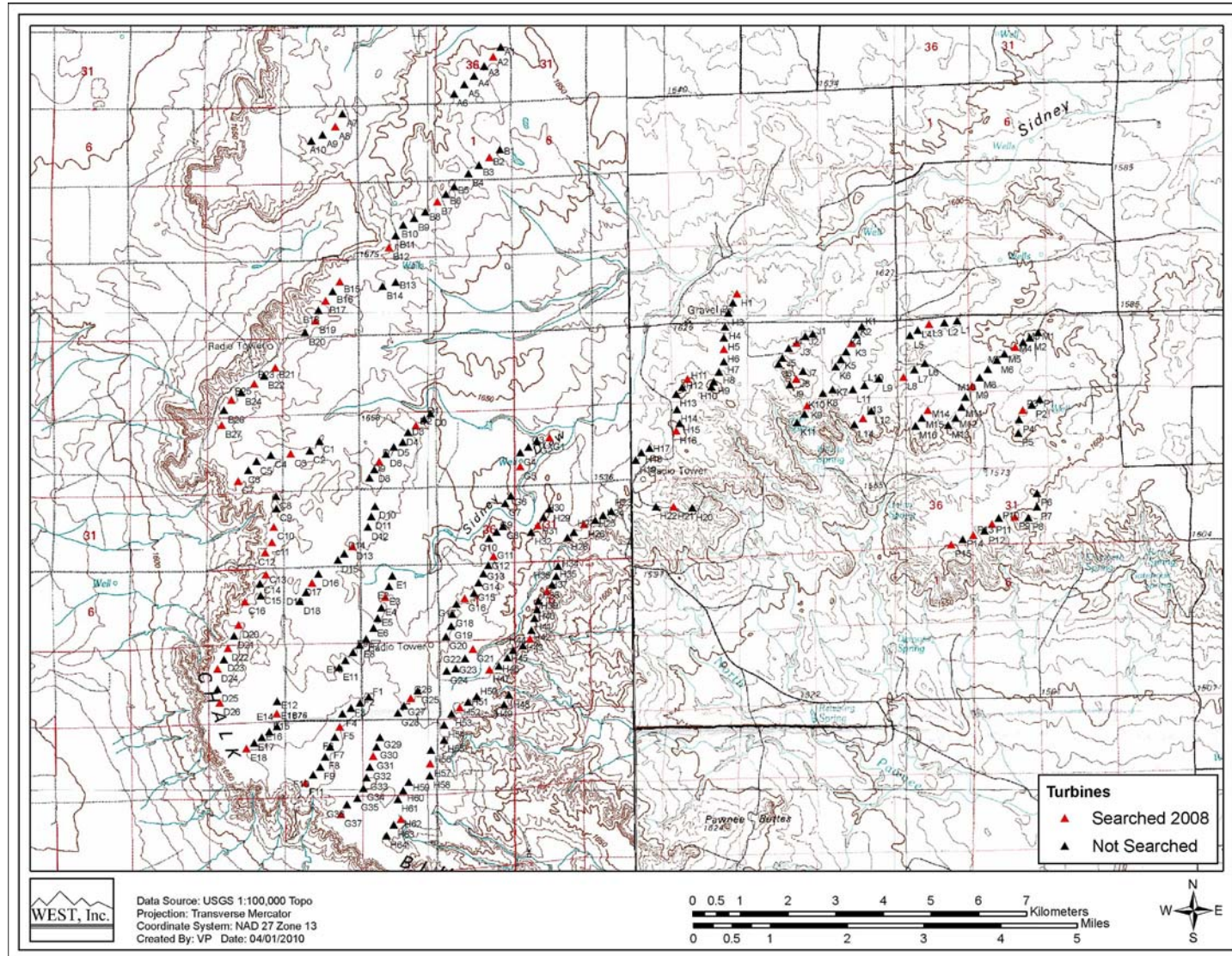
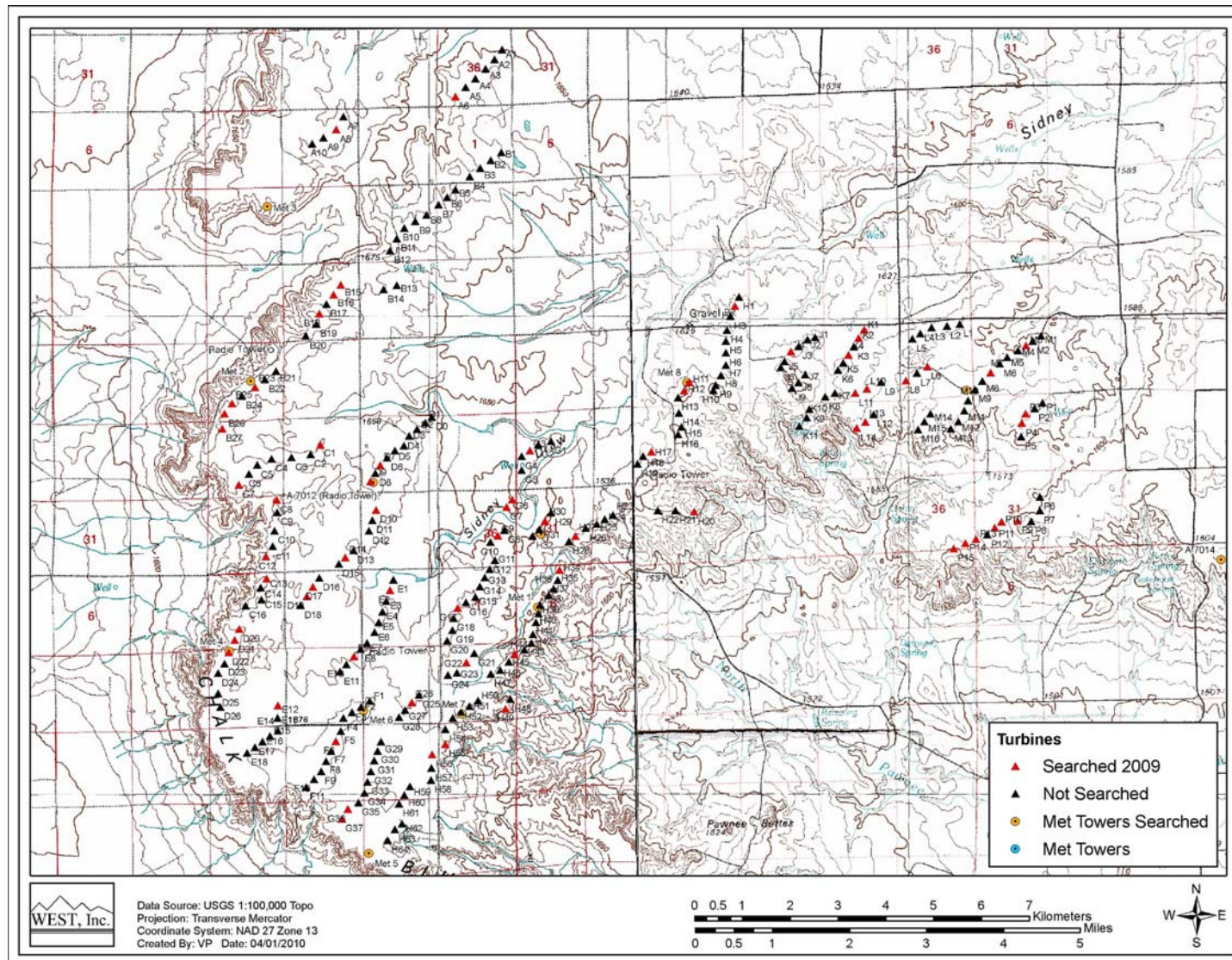


Figure 2a. Location of carcass search plots at the Cedar Creek Wind-Energy Facility from January 2, 2008 to March 9, 2009.



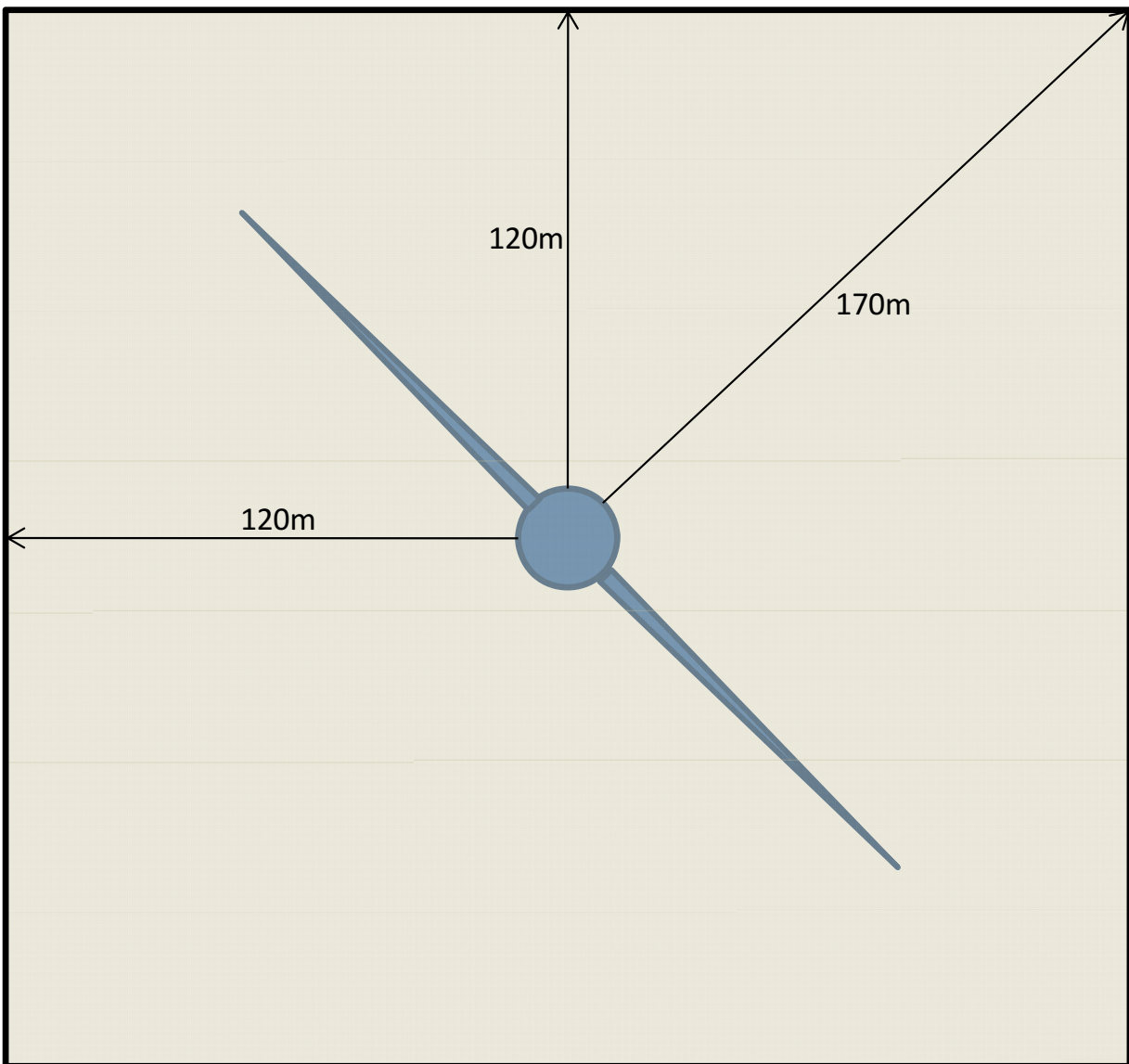


Figure 3. Illustration of search plots at the Cedar Creek Wind Energy Facility.

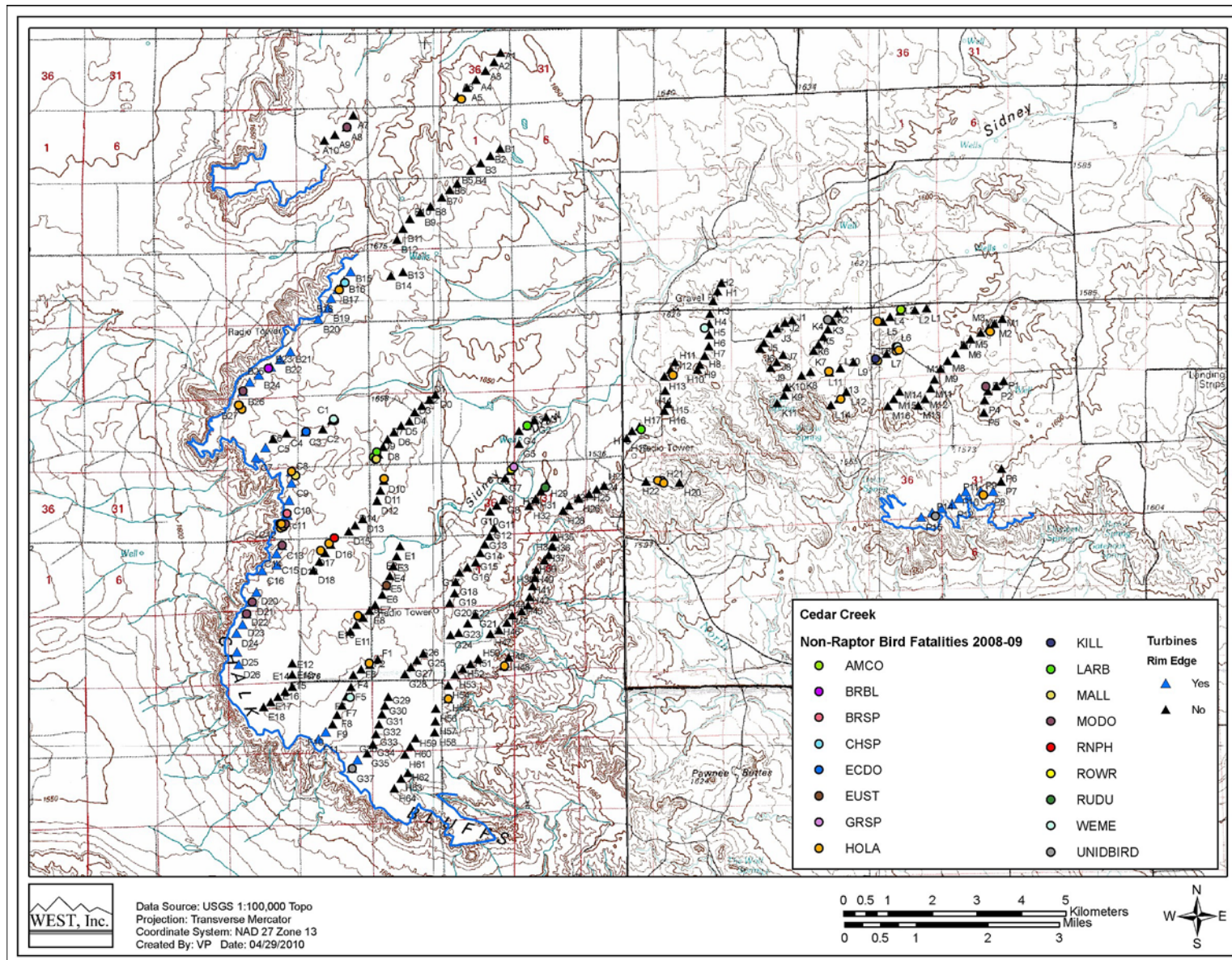


Figure 4a. Location of non-raptor bird fatalities found at the Cedar Creek Wind-Energy Facility.

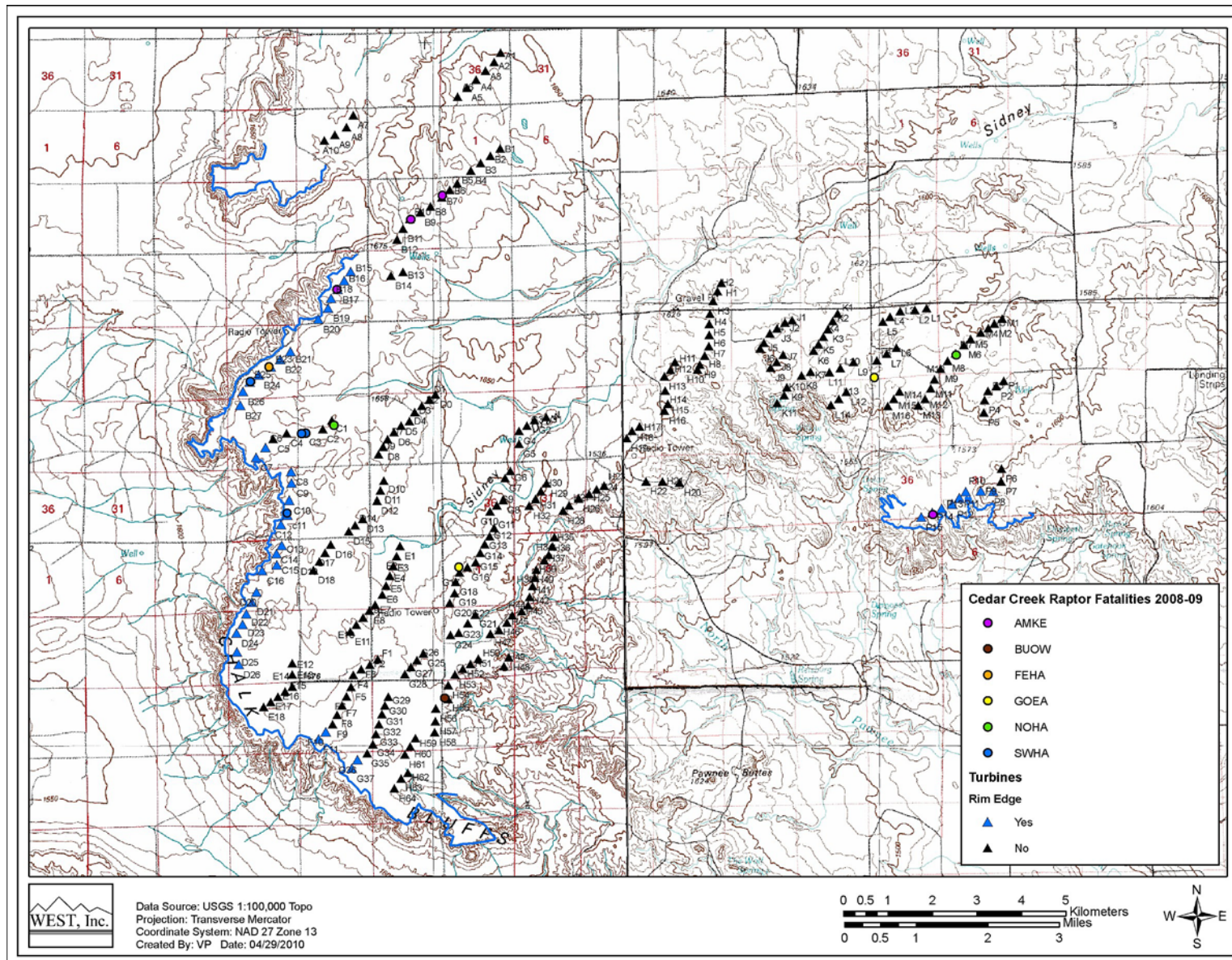


Figure 4b. Location of raptor fatalities found at the Cedar Creek Wind-Energy Facility.

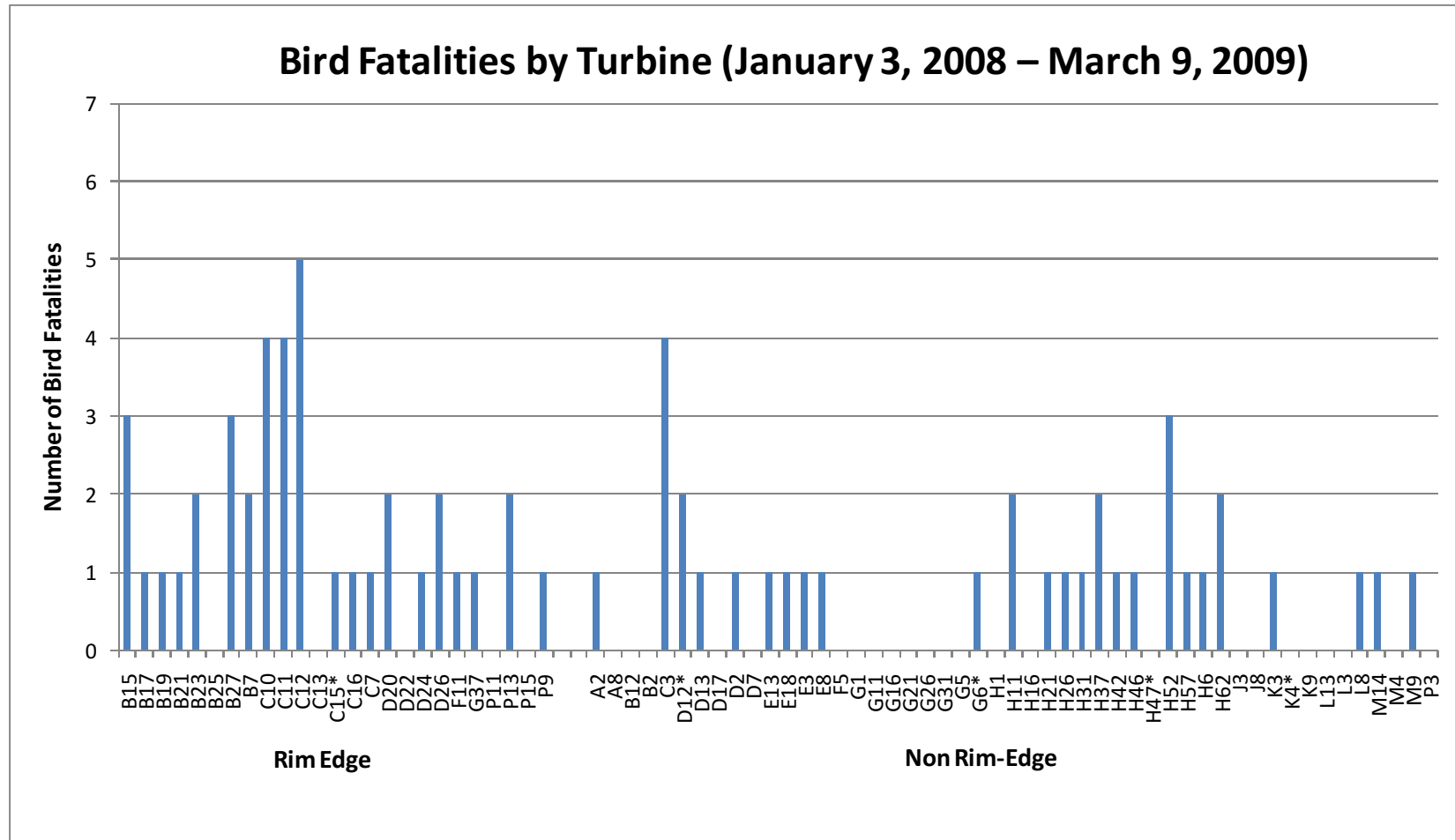


Figure 5a. Number of bird fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (January 3, 2008 – March 9, 2009). Turbines marked by an * were searched a few times at the beginning of the study, but were then replaced for the remainder of the year.

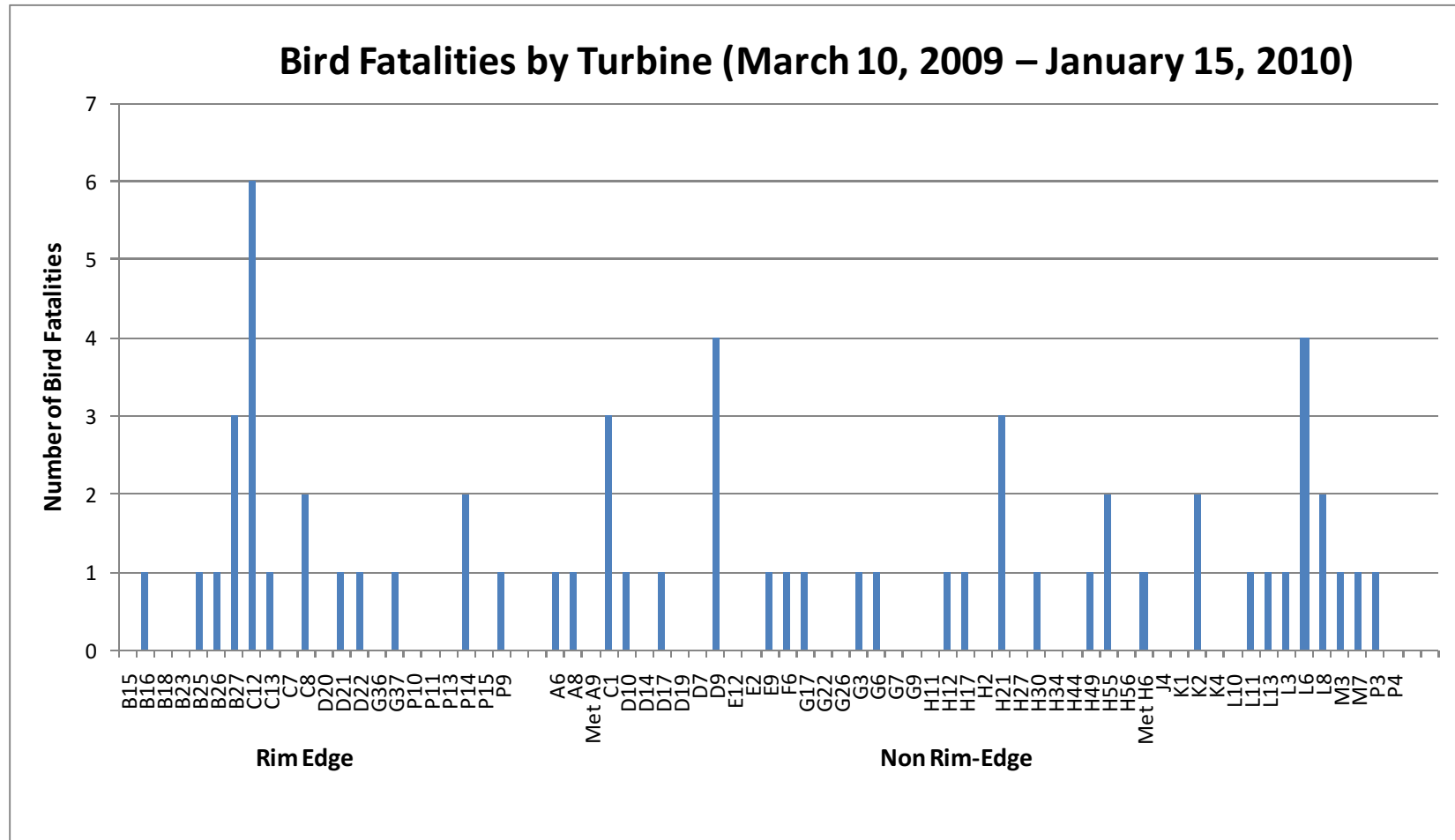


Figure 5b. Number of bird fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (March 10, 2009 – January 15, 2010).

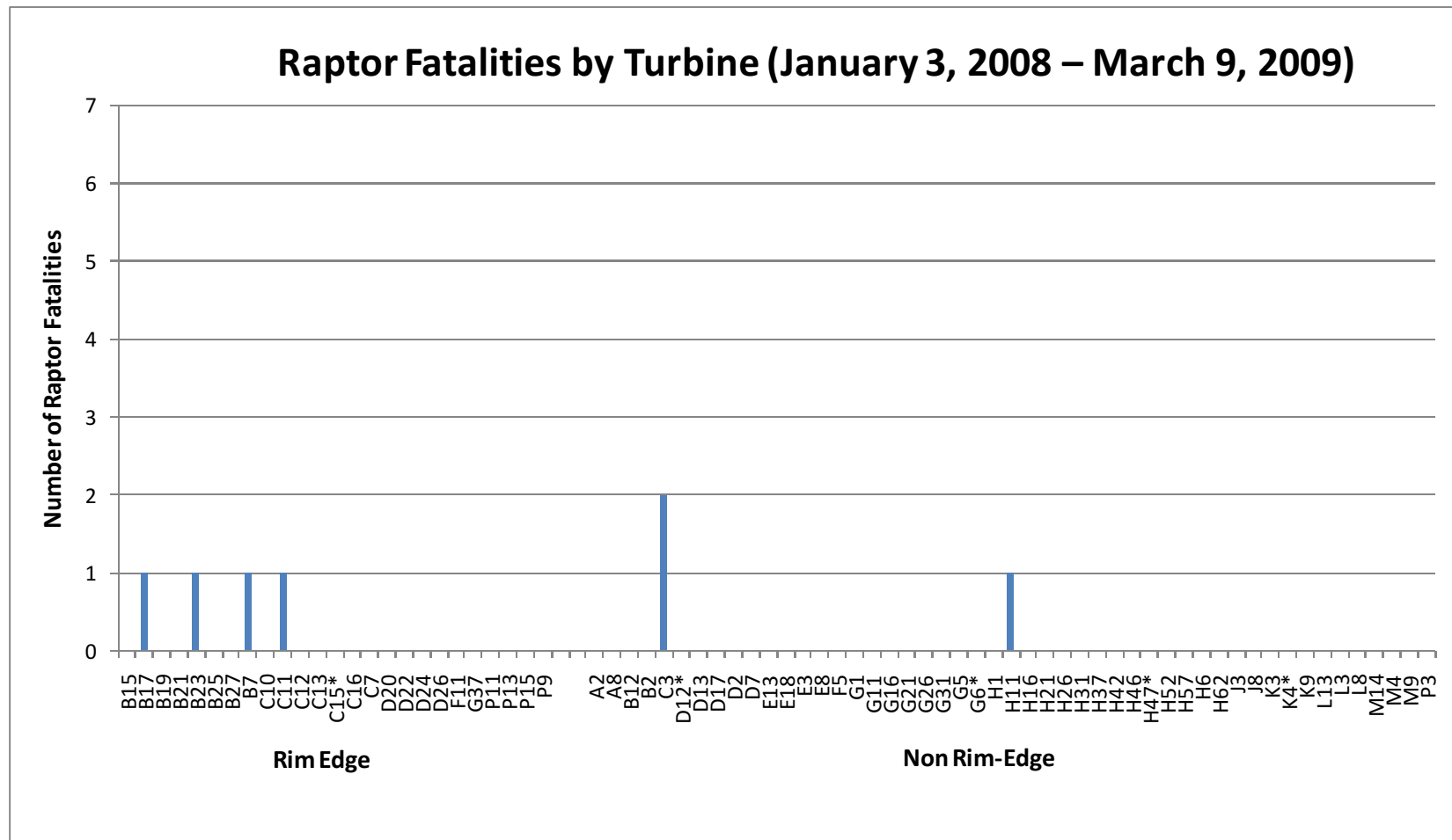


Figure 5c. Number of raptor fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (January 3, 2008 – March 9, 2009).

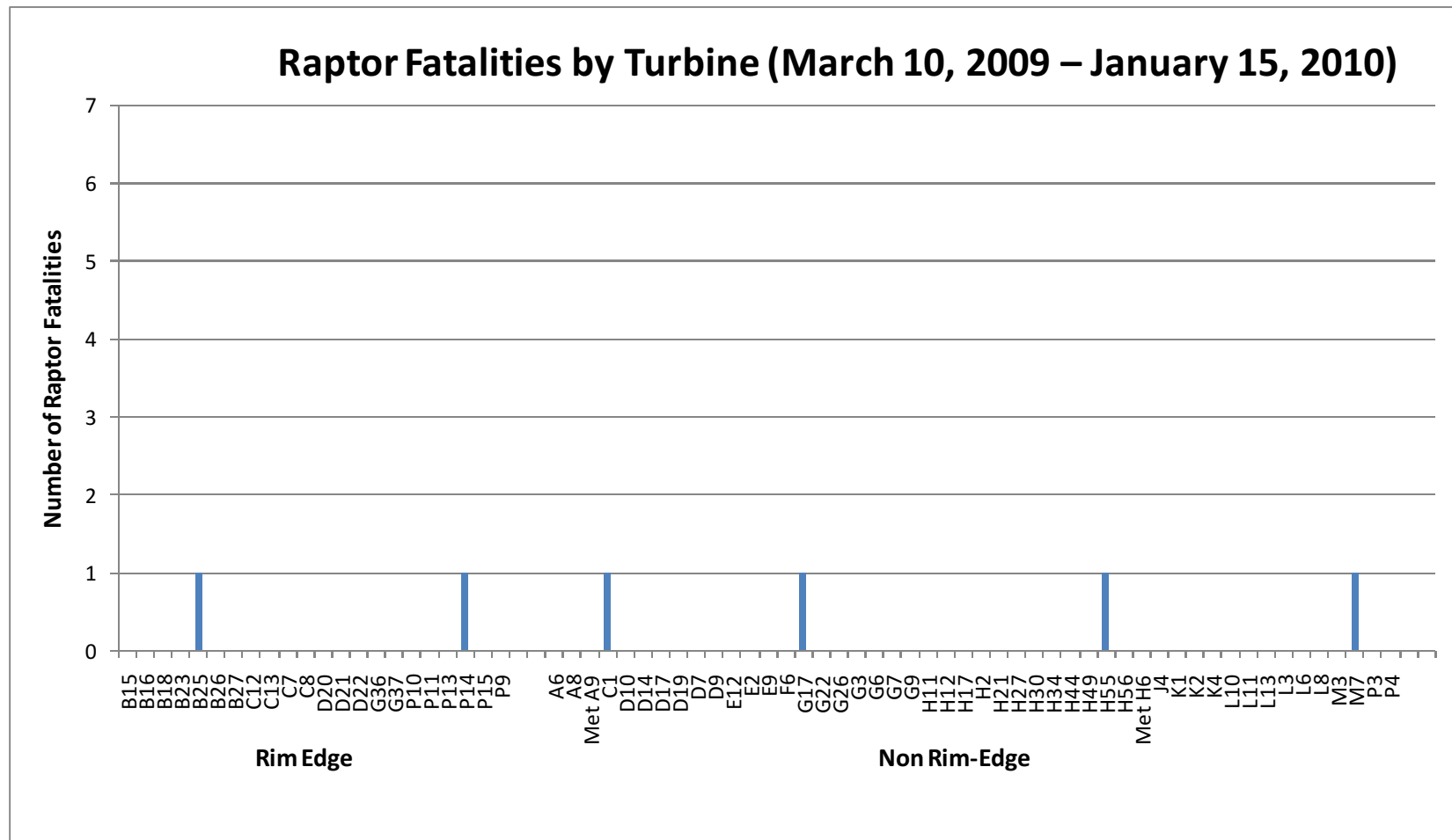


Figure 5d. Number of raptor fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (March 10, 2009 – January 15, 2010).

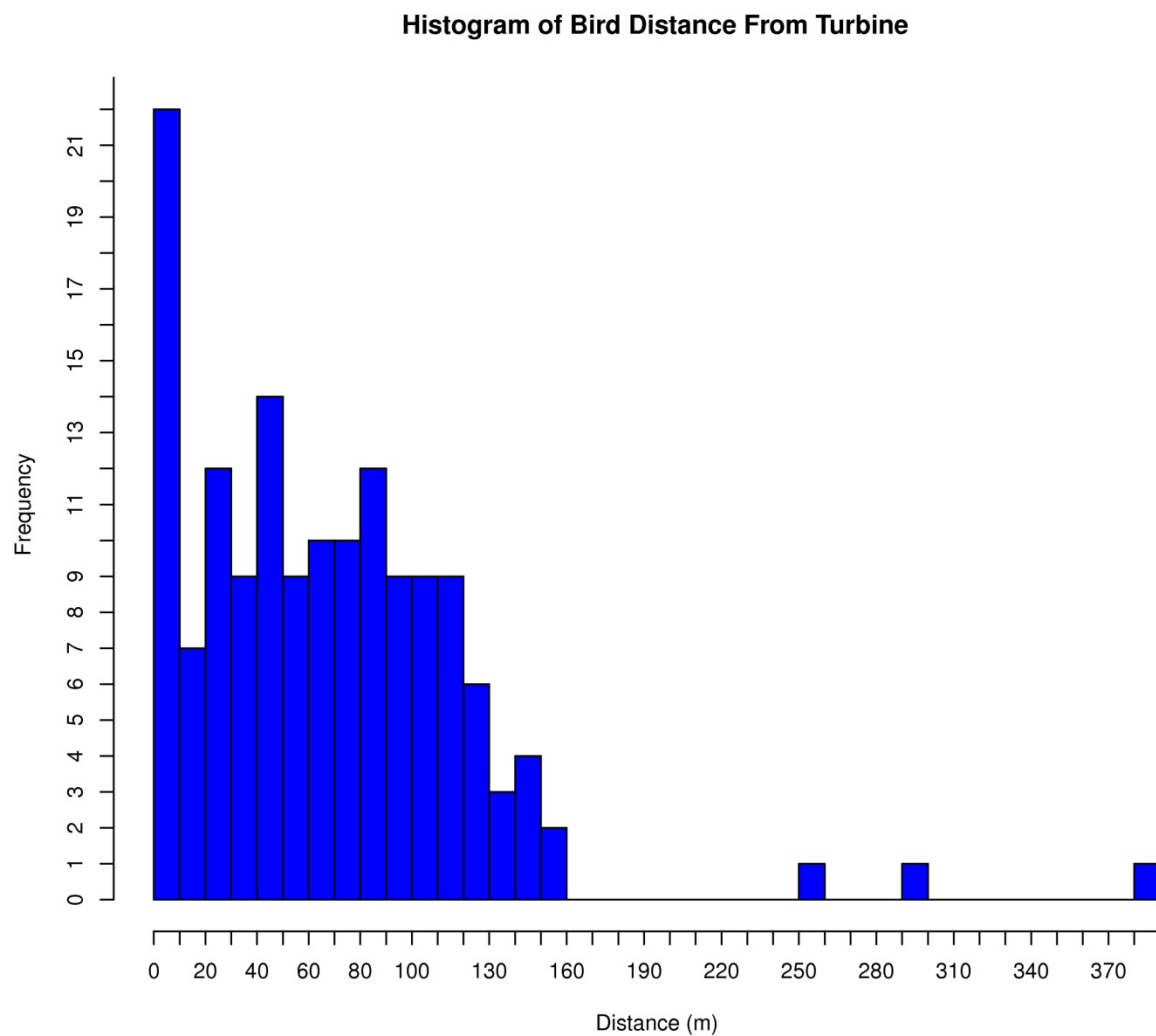


Figure 6a. Distance from turbine for bird fatalities at the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

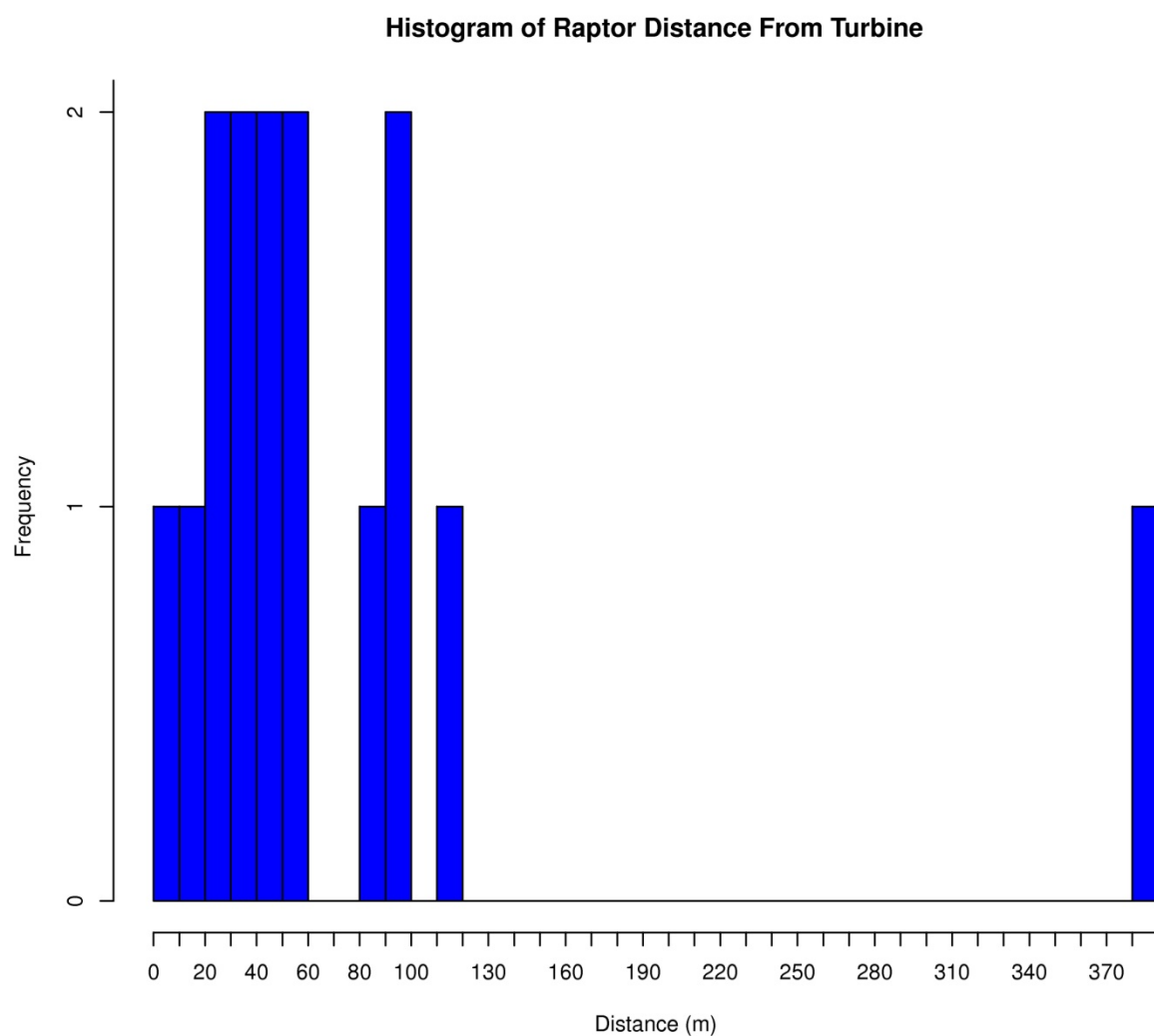


Figure 6b. Distance from turbine for raptor fatalities at the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

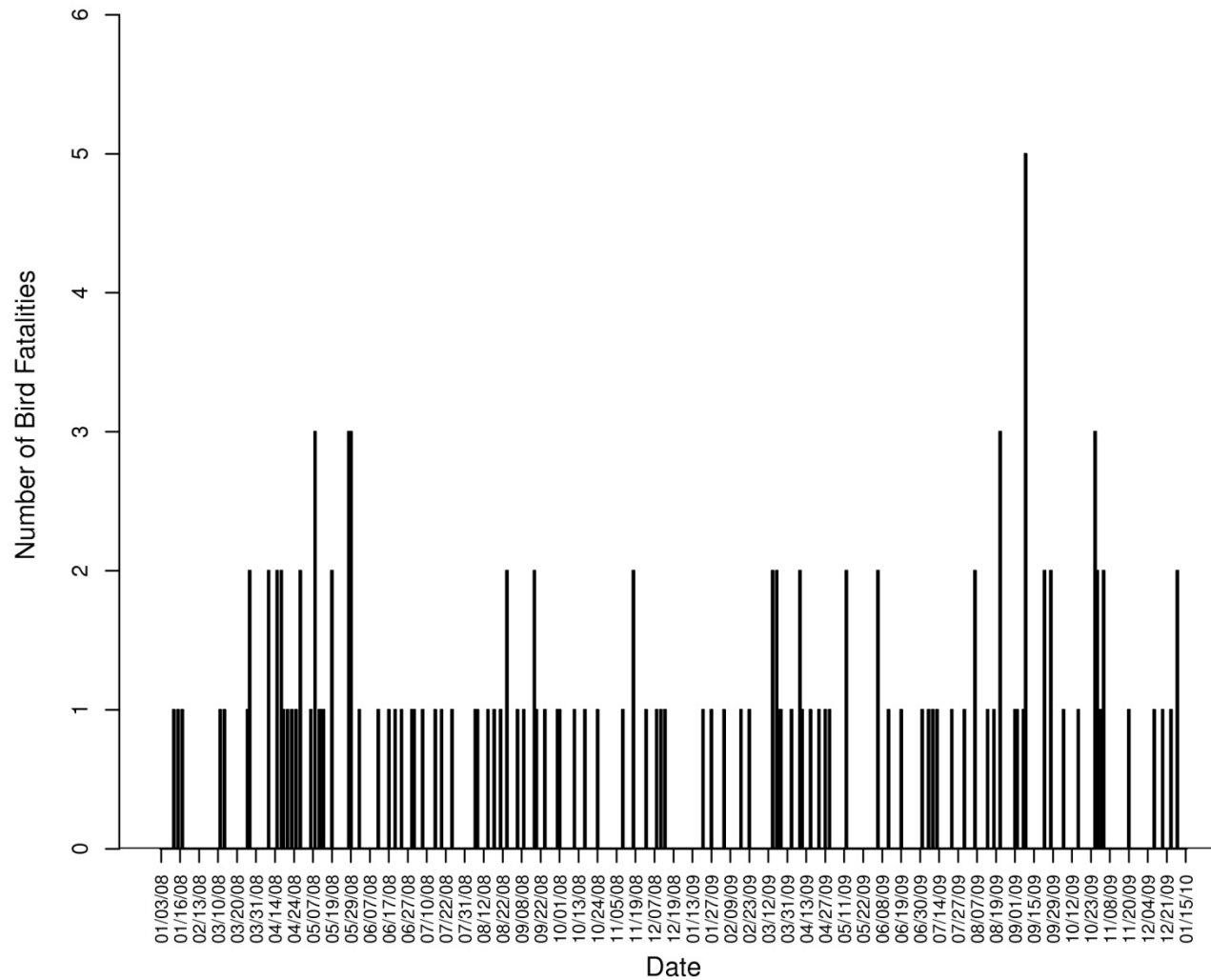


Figure 7. Timing of all bird mortality at the Cedar Creek Wind-Energy Facility.

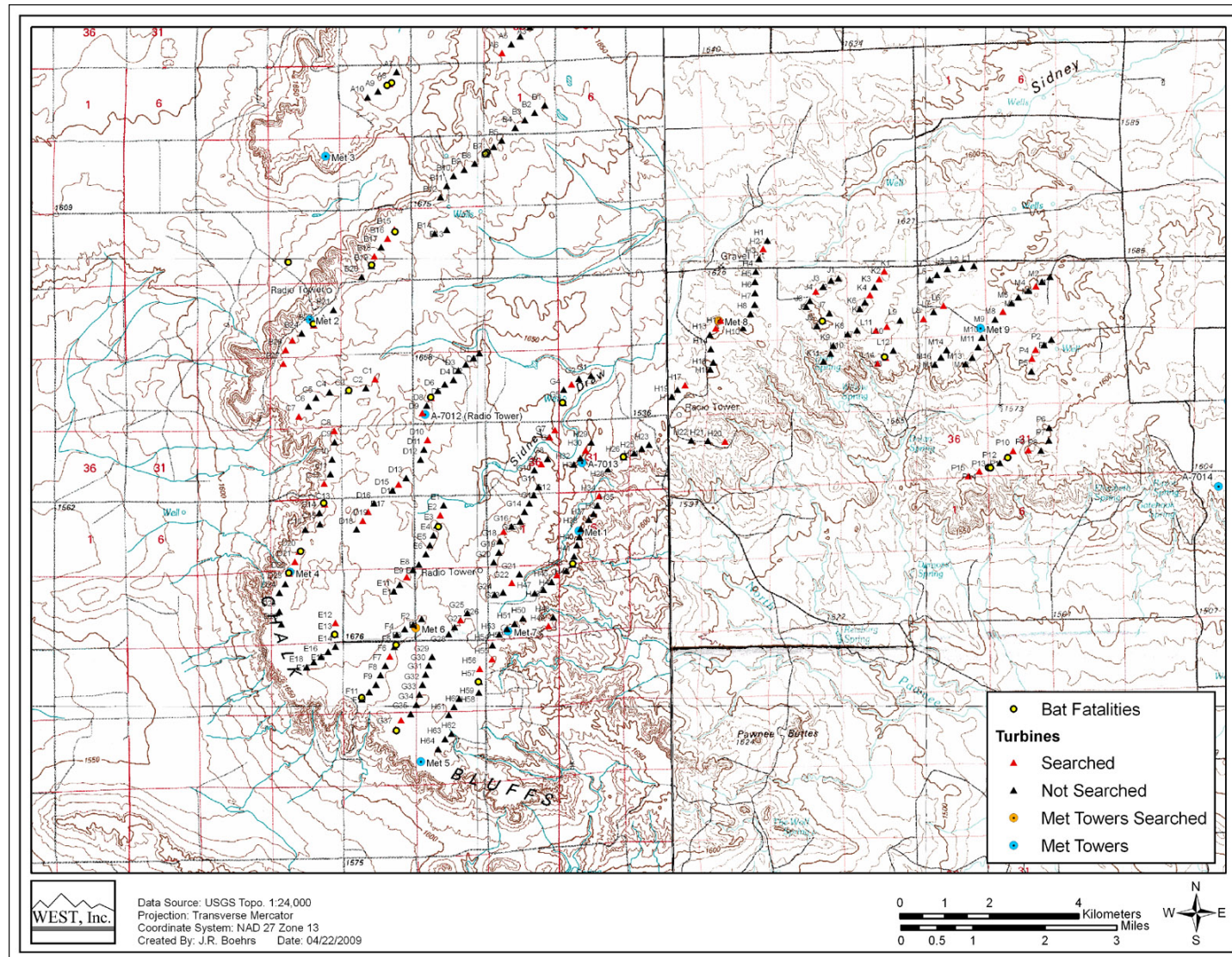


Figure 8. Location of bat fatalities found at the Cedar Creek Wind-Energy Facility.

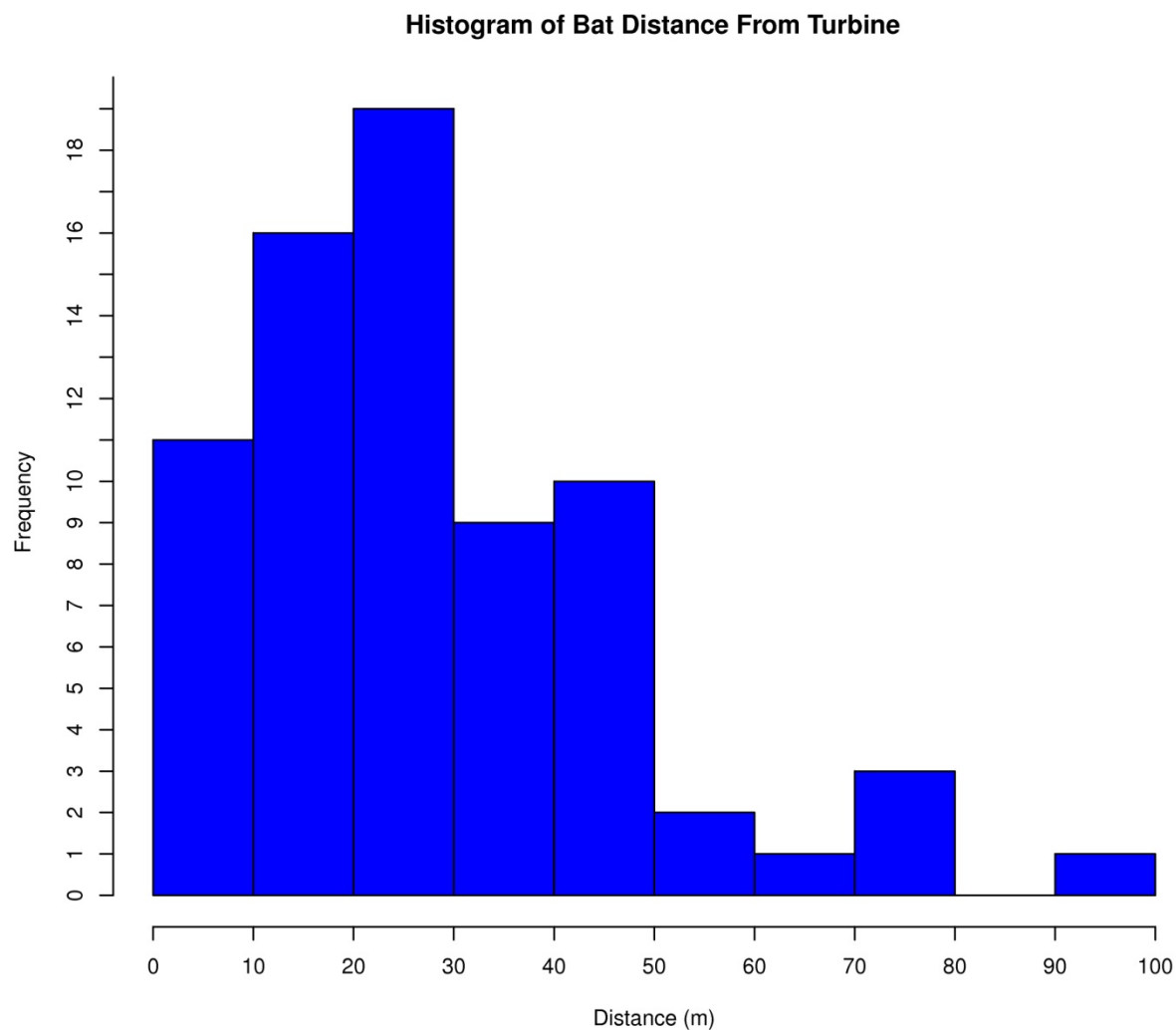


Figure 9. Distance from turbine for bat fatalities at the Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.

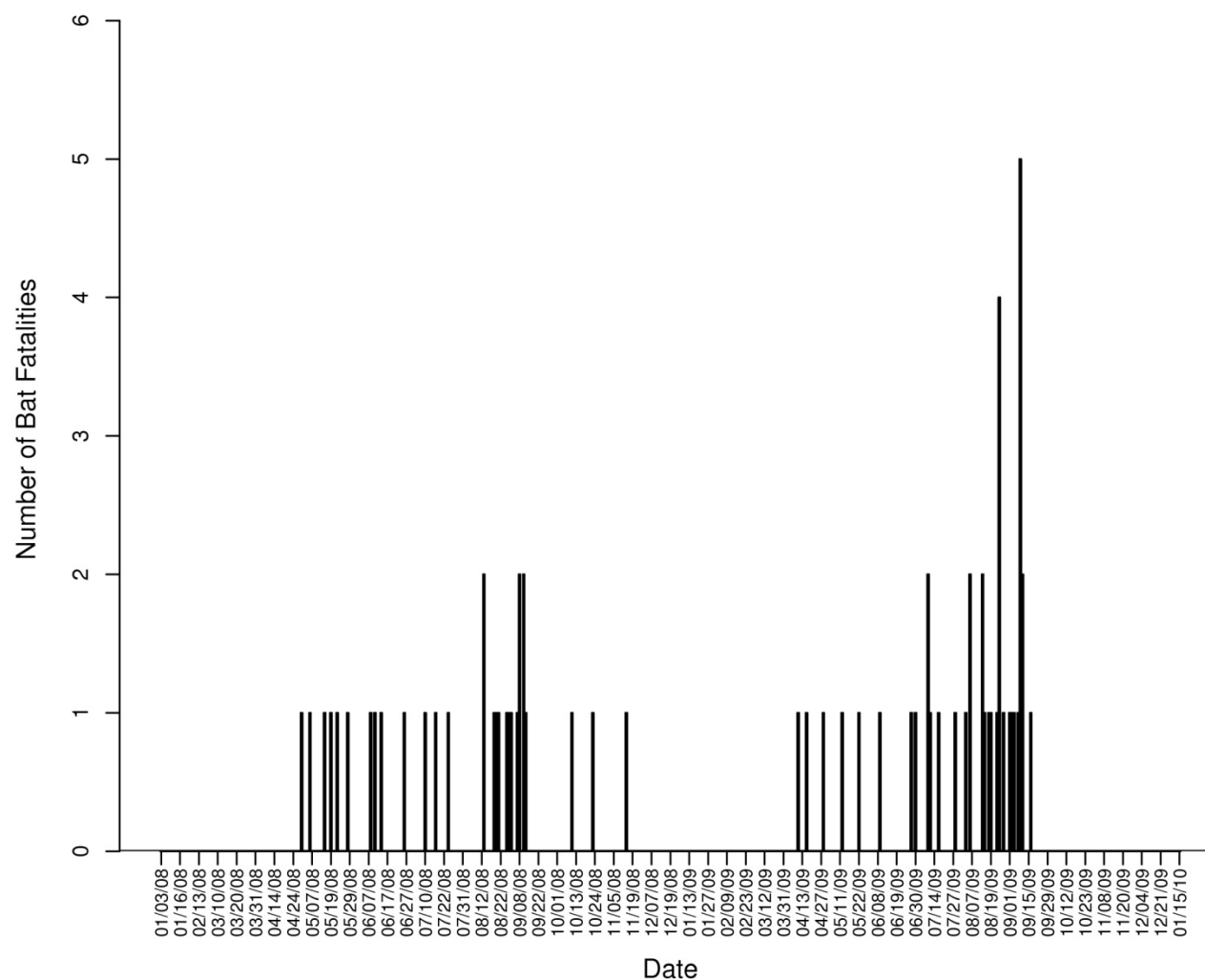


Figure 10. Timing of all bat mortality at the Cedar Creek Wind-Energy Facility.

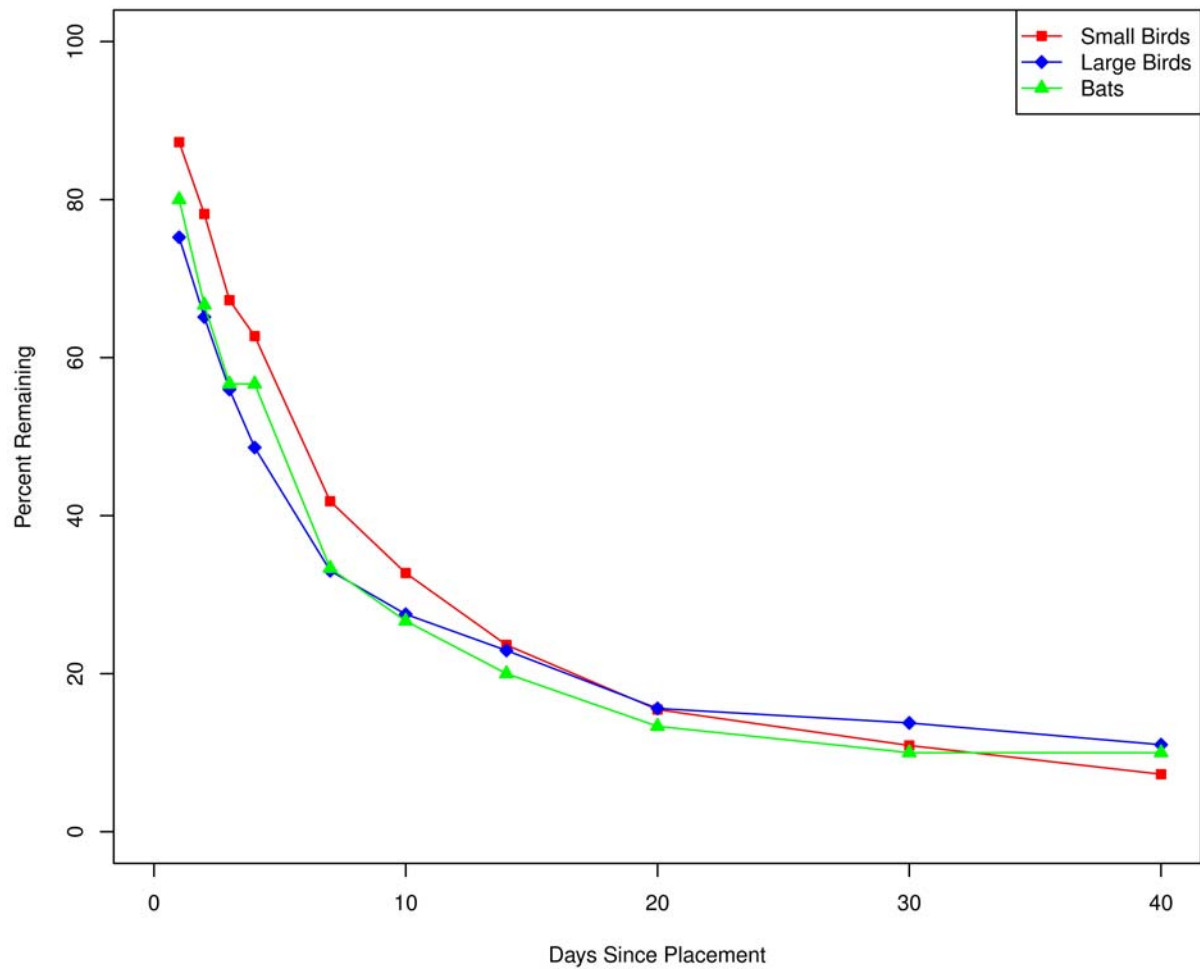


Figure 11. Removal rates for large birds and small birds (mallards, rock pigeons, Coturnix quail, unidentified quail, and unidentified sparrow) at Cedar Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010. For this project, the removal rates for small birds and bats were combined.

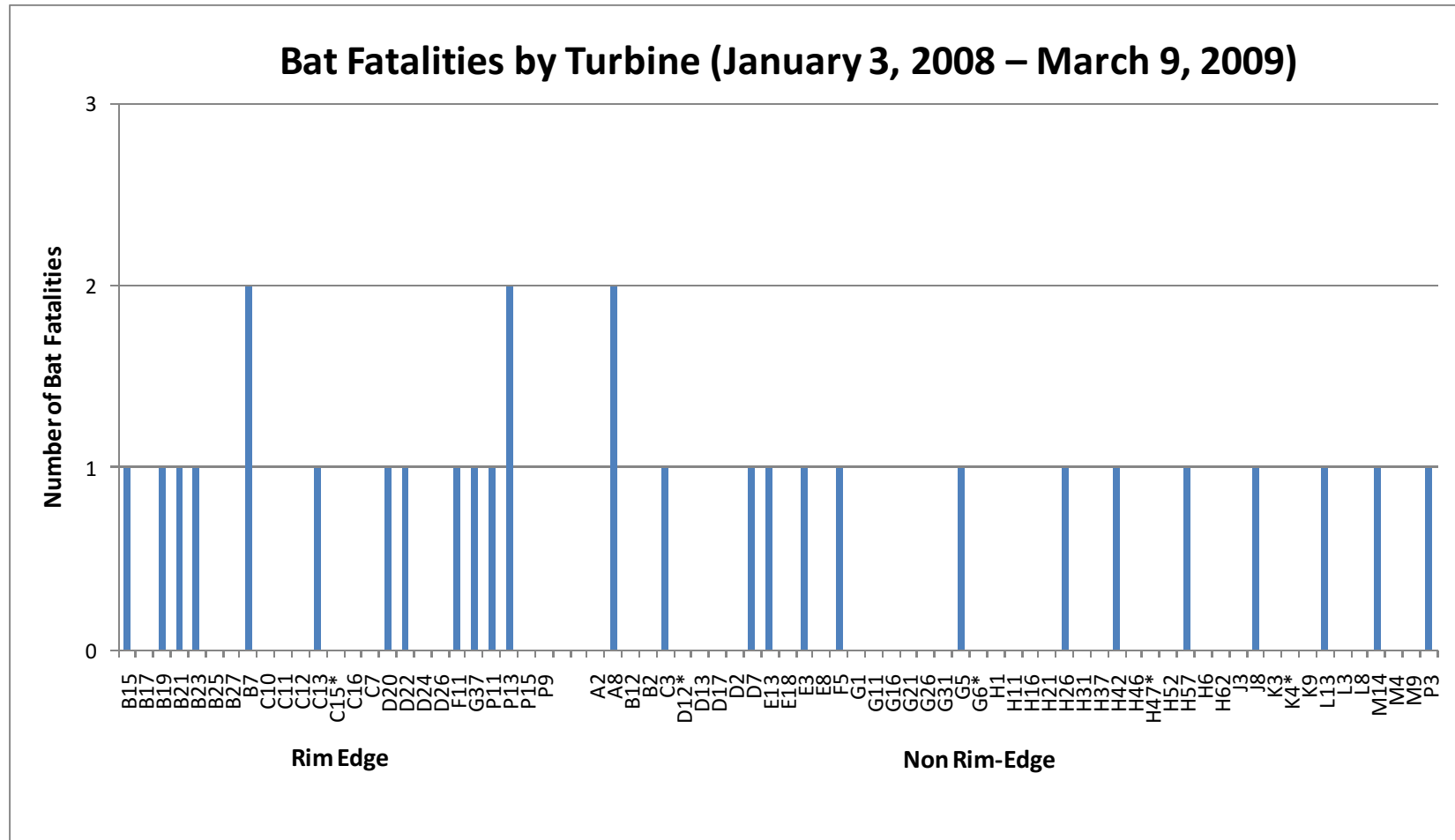


Figure 12a. Number of bat fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (January 3, 2008 – March 9, 2009). Turbines marked by an * were searched a few times at the beginning of the study, but were then replaced for the remainder of the year.

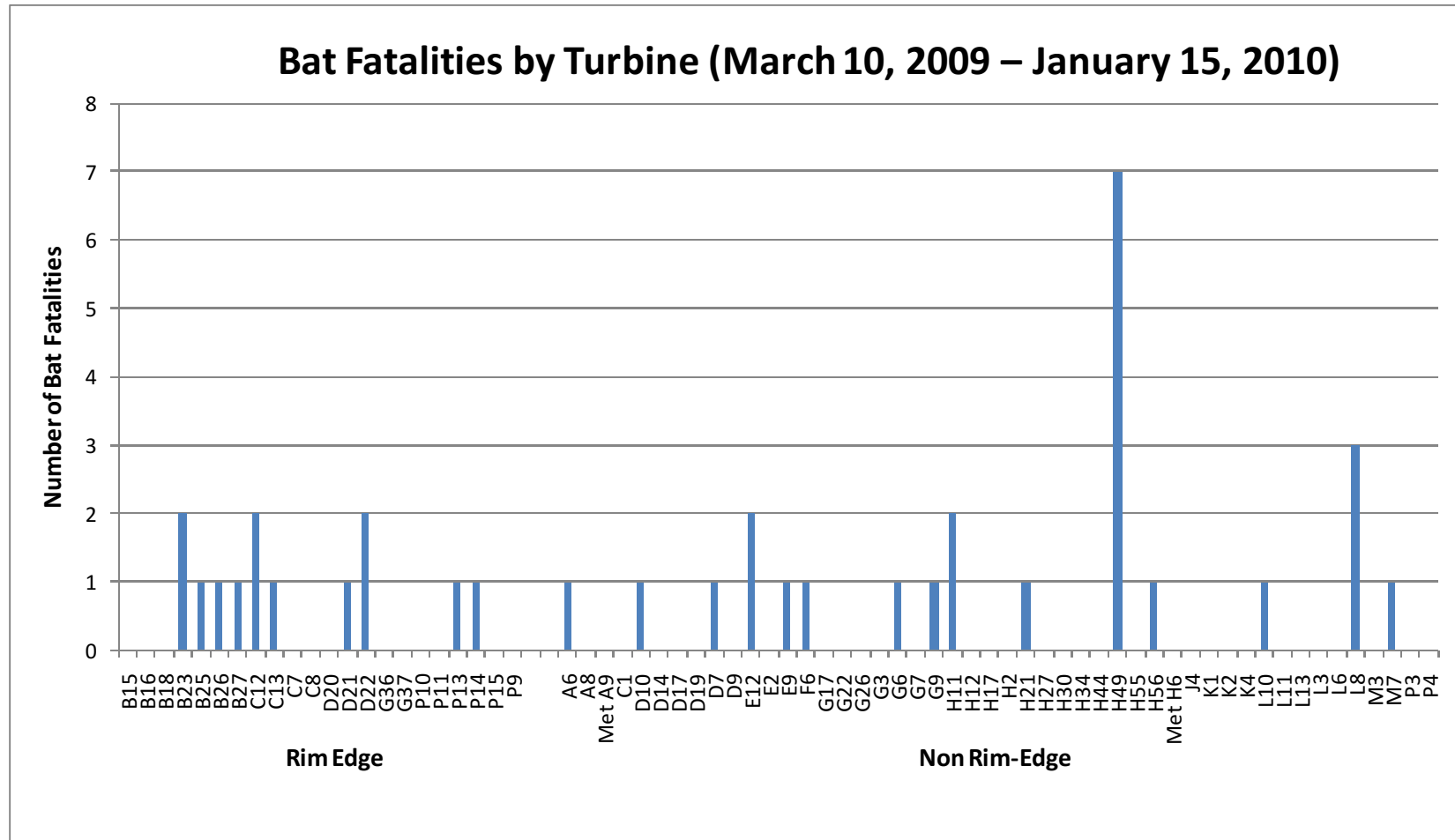


Figure 12b. Number of bat fatalities by rim-edge turbines, and non rim-edge turbines at the Cedar Creek Wind-Energy Facility; includes fatalities found during standardized carcass surveys only (March 10, 2009 – January 15, 2010).

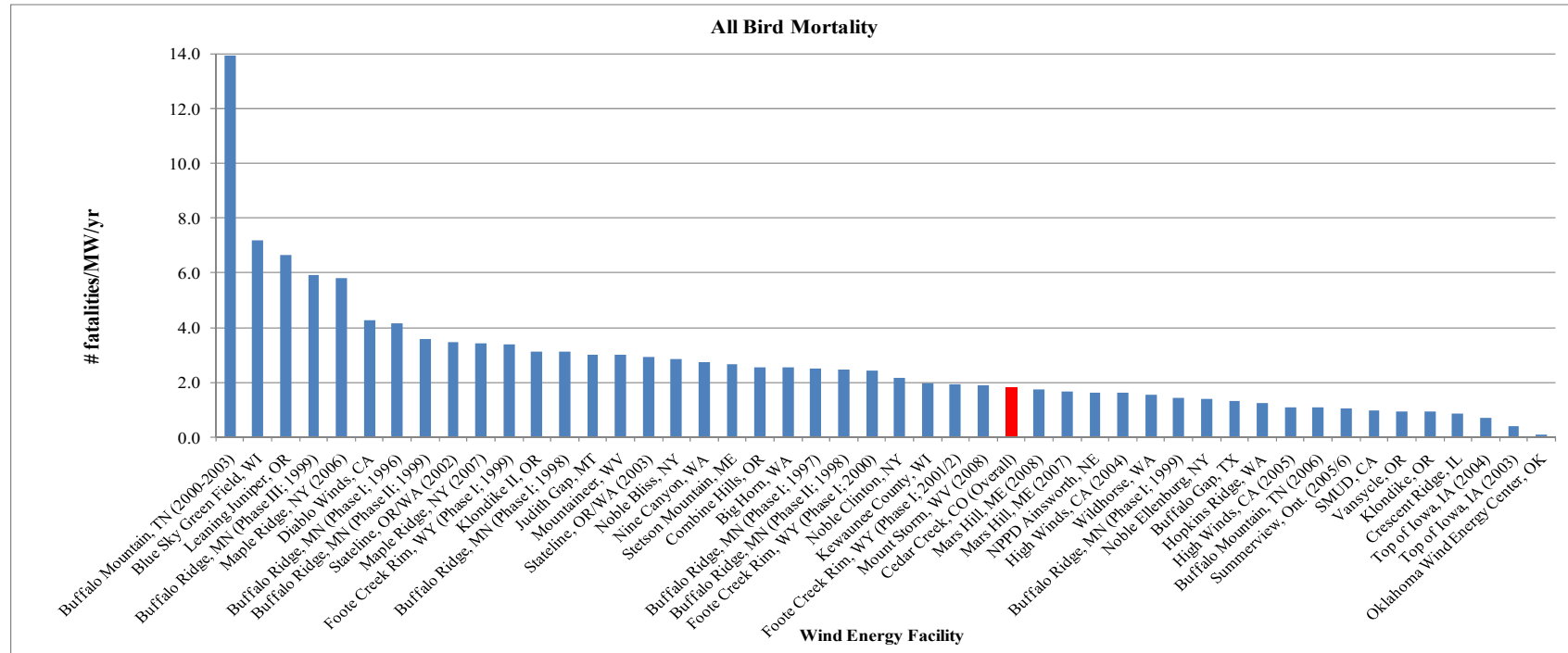


Figure 13a. Comparison of all bird mortality per nameplate MW per year at the Cedar Creek Wind Energy Facility compared to wind-energy facilities in North America with published fatality data.

Data from the following sources:

Cedar Creek, CO (overall)	This study				
Buffalo Mountain, TN (2000-2003)	Nicholson et al. 2005	Noble Bliss, NY	Jain et al. 2009c	Buffalo Ridge, MN (Phase I; 1999)	Johnson et al. 2000
Blue Sky Green Field, WI	Gruver et al. 2009	Nine Canyon, WA	Erickson et al. 2003b	Noble Ellenburg, NY	Jain et al. 2009a
Leaning Juniper, OR	Gritski et al. 2008	Combine Hills, OR	Young et al. 2006	Buffalo Gap, TX	Tierney 2007
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2000	Big Horn, WA	Kronner et al. 2008	Hopkins Ridge, WA	Young et al. 2007
Maple Ridge, NY (2006)	Jain et al. 2007	Buffalo Ridge, MN (Phase I; 1997)	Johnson et al. 2000	High Winds, CA (2005)	Kerlinger et al. 2006
Diablo Winds, CA	WEST 2008	Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Buffalo Mountain, TN (2006)	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	Johnson et al. 2000	Footee Creek Rim, WY (Phase I; 2000)	Young et al. 2003	Summerview, Alb. (2005/2006)	Brown and Hamilton 2006
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Noble Clinton, NY	Jain et al. 2009b	SMUD, CA	URS et al. 2005
Stateline, OR/WA (2002)	Erickson et al. 2004	Kewaunee County, WI	Howe et al. 2002	Vansycle, OR	Erickson et al. 2000
Maple Ridge, NY (2007)	Jain et al. 2008	Footee Creek Rim, WY (Phase I; 2001/2002)	Young et al. 2003	Klondike, OR	Johnson et al. 2003b
Footee Creek Rim, WY (Phase I; 1999)	Young et al. 2003	Mount Storm, WV (2008)	Young et al. 2009	Crescent Ridge, IL	Kerlinger et al. 2007
Klondike II, OR	NWC and WEST 2007	Mars Hill, ME (2008)	Stantec 2009	Top of Iowa, IA (2004)	Jain 2005
Buffalo Ridge, MN (Phase I; 1998)	Johnson et al. 2000	Mars Hill, ME (2007)	Stantec 2008	Top of Iowa, IA (2003)	Jain 2005
Judith Gap, MT	TRC 2008	NPPD Ainsworth, NE	Derby et al. 2007	Oklahoma Wind Energy Center, OK	Piorkowski 2006
Mountaineer, WV	Kerns and Kerlinger 2004	High Winds, CA (2004)	Kerlinger et al. 2006		
Stateline, OR/WA (2003)	Erickson et al. 2004	Wild Horse, WA	Erickson et al. 2008a		

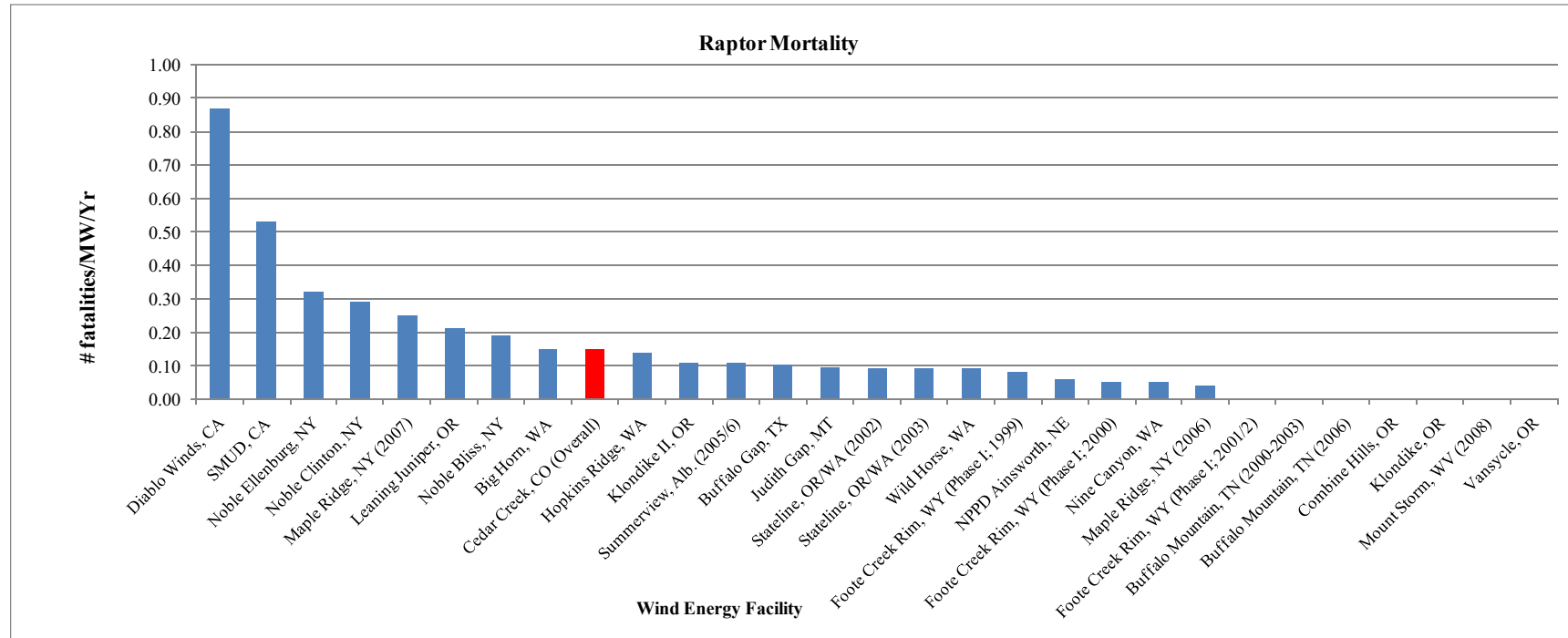


Figure 13b. Comparison of raptor mortality per nameplate MW per year at the Cedar Creek Wind Energy Facility compared to wind-energy facilities in North America with published fatality data.

Data from the following sources:

Cedar Creek, CO (overall)	This study				
Diablo Winds, CA	WEST 2008	Summerview, Alb. (2005/2006)	Brown and Hamilton 2006	Maple Ridge, NY (2006)	Jain et al. 2007
SMUD, CA	URS et al. 2005	Buffalo Gap, TX	Tierney 2007	Foot Creek Rim, WY (Phase I; 2000/2002)	Young et al. 2003
Noble Ellenburg, NY	Jain et al. 2009a	Judith Gap, MT	TRC 2008	Buffalo Mountain, TN (2000-2003)	Nicholson 2003, Nicholson et al. 2005
Noble Clinton, NY	Jain et al. 2009b	Stateline, OR/WA (2002)	Erickson et al. 2004	Buffalo Mountain, TN (2006)	Fiedler et al. 2007
Maple Ridge, NY (2007)	Jain et al. 2008	Stateline, OR/WA (2003)	Erickson et al. 2004	Combine Hills, OR	Young et al. 2006
Leaning Juniper, OR	Gritski et al. 2008	Wild Horse, WA	Erickson et al. 2008a	Klondike, OR	Johnson et al. 2003b
Noble Bliss, NY	Jain et al. 2009c	Foot Creek Rim, WY (Phase I; 1999)	Young et al. 2003	Mount Storm, WV (2008)	Young et al. 2009
Big Horn, WA	Kronner et al. 2008	NPPD Ainsworth, NE	Derby et al. 2007	Vansycle, OR	Erickson et al. 2000
Hopkins Ridge, WA	Young et al. 2007	Foot Creek Rim, WY (Phase I; 2000)	Young et al. 2003		
Klondike II, OR	NWC and WEST 2007	Nine Canyon, WA	Erickson et al. 2003b		

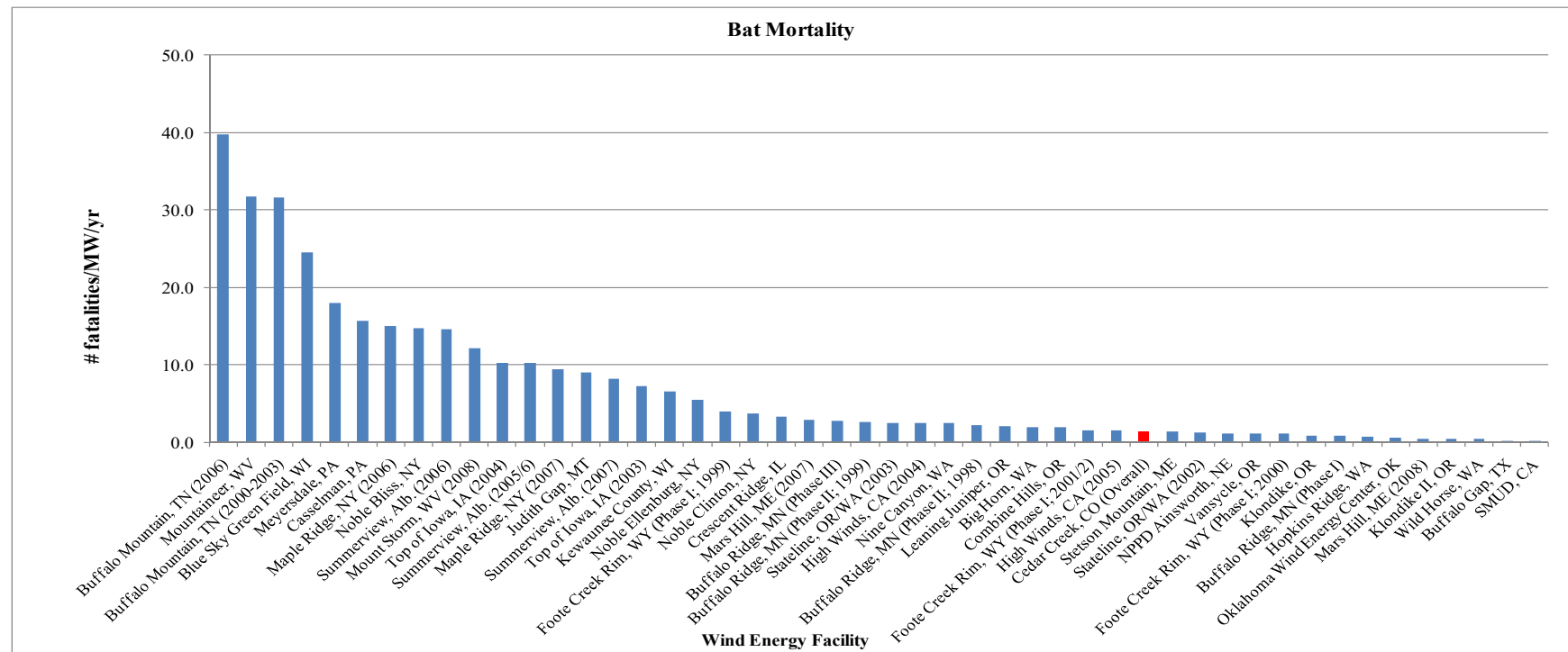


Figure 13c. Comparison of bat mortality per nameplate MW per year at the Cedar Creek Wind Energy Facility compared to wind-energy facilities in North America with published fatality data.

Data from the following sources:

Cedar Creek, CO (overall)	This study				
Buffalo Mountain, TN (2006)	Fiedler et al. 2007	Keweenaw County, WI	Howe et al. 2002	High Winds, CA (2005)	Kerlinger et al. 2006
Mountaineer, WV	Kerns and Kerlinger 2004	Noble Ellenburg, NY	Jain et al. 2009a	Stateline, OR/WA (2002)	Erickson et al. 2004
Buffalo Mountain, TN (2000-2003)	Nicholson et al. 2005	Foot Creek Rim, WY (Phase I; 1999)	Young et al. 2003	NPPD Ainsworth, NE	Derby et al. 2007
Blue Sky Green Field, WI	Gruver et al. 2009	Noble Clinton, NY	Jain et al. 2009b	Vansycle, OR	Erickson et al. 2000
Meyersdale, PA	Arnett et al. 2005	Crescent Ridge, IL	Kerlinger et al. 2007	Foot Creek Rim, WY (Phase I; 2000)	Young et al. 2003
Casselman, PA	Arnett et al. 2009	Mars Hill, ME (2007)	Stantec 2008	Klondike, OR	Johnson et al. 2003b
Maple Ridge, NY (2006)	Jain et al. 2007	Buffalo Ridge, MN (Phase III)	Johnson et al. 2000	Buffalo Ridge, MN (Phase I)	Johnson et al. 2000
Noble Bliss, NY	Jain et al. 2009c	Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Hopkins Ridge, WA	Young et al. 2007
Summerview, Alb. (2006)	Baerwald 2008	Stateline, OR/WA (2003)	Erickson et al. 2004	Oklahoma Wind Energy Center, OK	Piorkowski 2006
Mount Storm, WV (2008)	Young et al. 2009	High Winds, CA (2004)	Kerlinger et al. 2006	Mars Hill, ME (2008)	Stantec 2009
Top of Iowa, IA (2004)	Jain 2005	Nine Canyon, WA	Erickson et al. 2003b	Klondike II, OR	NWC and WEST 2007
Summerview, Alb. (2005/2006)	Brown and Hamilton 2006	Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Wild Horse, WA	Erickson et al. 2008a
Maple Ridge, NY (2007)	Jain et al. 2008	Leaning Juniper, OR	Gritski et al. 2008	Buffalo Gap, TX	Tierney 2007
Judith Gap, MT	TRC 2008	Big Horn, WA	Kronner et al. 2008	SMUD, CA	URS et al. 2005
Summerview, Alb. (2007)	Baerwald 2008	Combine Hills, OR	Young et al. 2006		
Top of Iowa, IA (2003)	Jain 2005	Foot Creek Rim, WY (Phase I; 2001/02)	Young et al. 2003		

**APPENDIX A – Avian and Bat Casualties Found During Fatality Monitoring at the Cedar
Creek Wind-Energy Facility, January 3, 2008 – January 15, 2010.**

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
042709-AMCO-L3-1	4/27/2009	American coot	L3	FALSE	4-Wheel	complete
AMKE063008-01	6/30/2008	American kestrel	B7	TRUE	4-Wheel	intact
AMKE070108-01	7/1/2008	American kestrel	B10			intact
AMKE100108-01	10/1/2008	American kestrel	B17	TRUE	Walking	feather spot
110209-AMKE-P14-1	11/2/2009	American kestrel	P14	TRUE	4-Wheel	complete
BBBA071008-02	7/10/2008	big brown bat	P8			intact
052209-BBBA-P14-1	5/22/2009	big brown bat	P14	TRUE	4-Wheel	complete
102709-HOLA-B27-1	10/27/2009	blue-winged teal	B27	TRUE	4-Wheel	feather spot
BRBL070808-01	7/8/2008	Brewer's blackbird	B23	TRUE	4-Wheel	intact
BRSP082608-02	8/26/2008	Brewer's sparrow	C11	TRUE	4-Wheel	intact
090209-BUOW-H55-1	9/2/2009	burrowing owl	H55	FALSE	Walking	feather spot
042209-CHSP-B16-1	4/22/2009	chipping sparrow	B16	TRUE	Walking	complete
ECDO062008-01	6/20/2008	Eurasian collared-dove	C3	FALSE	4-Wheel	intact
EUST090208-01	9/2/2008	European starling	E5			intact
FEHA042108	4/21/2008	ferruginous hawk	B23	TRUE	4-Wheel	dismembered
040209-GOEA-G17-1	4/2/2009	golden eagle	G17	FALSE	Walking	partial
071009-GOEA-L8-2	7/10/2009	golden eagle				complete
GRSP060308-01	6/3/2008	grasshopper sparrow				intact
051209-GRSP-H21-3	5/12/2009	grasshopper sparrow	H21	FALSE	4-Wheel	complete
HOBAA050608-01	5/6/2008	hoary bat	D22	TRUE	4-Wheel	intact
HOBAA060808-01	6/8/2008	hoary bat	G37	TRUE	4-Wheel	intact
HOBAA061008-01	6/10/2008	hoary bat	A8	FALSE	4-Wheel	intact
HOBAA061308-01	6/13/2008	hoary bat	F5	FALSE	Walking	intact
HOBAA072408-01	7/24/2008	hoary bat	E13	FALSE	Walking	intact
HOBAA081308-02	8/13/2008	hoary bat	K2			intact
HOBAA081908-01	8/19/2008	hoary bat	D7	FALSE	4-Wheel	intact
HOBAA082008-01	8/20/2008	hoary bat	H26	FALSE	4-Wheel	intact
HOBAA082108-02	8/21/2008	hoary bat	C13	TRUE	4-Wheel	intact
HOBAA082608-03	8/26/2008	hoary bat	P2			intact
HOBAA082808-01	8/28/2008	hoary bat	P11	TRUE	Walking	intact

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
HOBAA090108-01	9/1/2008	hoary bat	L13	FALSE	4-Wheel	intact
HOBAA090408-01	9/4/2008	hoary bat	C3	FALSE	4-Wheel	intact
HOBAA090808-01	9/8/2008	hoary bat	G5	FALSE	Walking	intact
HOBAA090908-02	9/9/2008	hoary bat	P 6 & P1			intact
HOBAA091008-01	9/10/2008	hoary bat	H42	FALSE	Walking	intact
HOBAA111308-01	11/13/2008	hoary bat	E3	FALSE	Walking	scavenged
060909-HOBA-E12-1	6/9/2009	hoary bat	E12	FALSE	4-Wheel	scavenged
062809-HOBA-B26-1	6/28/2009	hoary bat	B23	TRUE	4-Wheel	complete
063009-HOBA-D7-1	6/30/2009	hoary bat	D7	FALSE	4-Wheel	scavenged
070909-HOBA-H56-2	7/9/2009	hoary bat	H56	FALSE	4-Wheel	complete
071609-HOBA-D22-1	7/16/2009	hoary bat	D22	TRUE	Walking	complete
072809-HOBA-D10-1	7/28/2009	hoary bat	D10	FALSE	Walking	complete
080409-HOBA-D26-1	8/4/2009	hoary bat	D26			complete
080609-HOBA-G9-2	8/6/2009	hoary bat	G9	FALSE	4-Wheel	complete
080609-HOBA-G6-3	8/6/2009	hoary bat	G6	FALSE	4-Wheel	complete
081309-HOBA-F6-2	8/13/2009	hoary bat	F6	FALSE	4-Wheel	complete
081409-HOBA-L8-1	8/14/2009	hoary bat	L8	FALSE	4-Wheel	complete
081809-HOBA-H11-1	8/18/2009	hoary bat	H11	FALSE	4-Wheel	complete
081909-HOBA-B23-1	8/19/2009	hoary bat	B23	TRUE	4-Wheel	scavenged
082409-HOBA-B26-1	8/24/2009	hoary bat	B26	TRUE	Walking	complete
082509-HOBA-C12-1	8/25/2009	hoary bat	C12	TRUE	4-Wheel	complete
082509-HOBA-H49-1	8/25/2009	hoary bat	H49	FALSE	4-Wheel	scavenged
082509-HOBA-H49-2	8/25/2009	hoary bat	H49	FALSE	4-Wheel	scavenged
082509-HOBA-H49-3	8/25/2009	hoary bat	H49	FALSE	4-Wheel	complete
082709-HOBA-H49-1	8/27/2009	hoary bat	H49	FALSE	4-Wheel	complete
090109-HOBA-H49-1	9/1/2009	hoary bat	H49	FALSE	4-Wheel	complete
090809-HOBA-B25-1	9/8/2009	hoary bat	B25	TRUE	Walking	complete
090909-HOBA-D22-1	9/9/2009	hoary bat	D22	TRUE	Walking	complete
090909-HOBA-D21-1	9/9/2009	hoary bat	D21	TRUE	Walking	complete
090909-HOBA-L8-1	9/9/2009	hoary bat	L8	FALSE	4-Wheel	complete

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
090909-HOBA-L8-2	9/9/2009	hoary bat	L8	FALSE	4-Wheel	complete
091009-HOBA-E12-1	9/10/2009	hoary bat	E12	FALSE	4-Wheel	complete
091609-HOBA-E9-1	9/16/2009	hoary bat	E9	FALSE	4-Wheel	complete
HOLA011108-01	1/11/2008	horned lark	E18	FALSE	4-Wheel	feather spot
HOLA011708-01	1/17/2008	horned lark	D24	TRUE	Walking	feather spot
HOLA031108-01	3/11/2008	horned lark	H6	FALSE	4-Wheel	feather spot
HOLA031308-02	3/13/2008	horned lark				other
HOLA031308-01	3/13/2008	horned lark	H11	FALSE	Walking	feather spot
HOLA032708-02	3/27/2008	horned lark	H62	FALSE	Walking	injured
HOLA041508-01	4/15/2008	horned lark	A2	FALSE	4-Wheel	intact
HOLA041708-01	4/17/2008	horned lark	B21	TRUE	Walking	feather spot
HOLA041708	4/17/2008	horned lark	G37	TRUE	4-Wheel	intact
HOLA041708	4/17/2008	horned lark				intact
HOLA041808	4/18/2008	horned lark	K3	FALSE	4-Wheel	intact
HOLA042308	4/23/2008	horned lark				intact
HOLA042308-01	4/23/2008	horned lark	M9	FALSE	4-Wheel	intact
HOLA050608-02	5/6/2008	horned lark	H37	FALSE	4-Wheel	intact
HOLA051408-01	5/14/2008	horned lark	C10	TRUE	Walking	feather spot
HOLA051908-01	5/19/2008	horned lark	B7	TRUE	4-Wheel	dismembered
HOLA051908	5/19/2008	horned lark	C7	TRUE	4-Wheel	dismembered
HOLA052808-04	5/28/2008	horned lark	D22	TRUE	4-Wheel	intact
HOLA060208-01	6/2/2008	horned lark	H62	FALSE	Walking	feather spot
HOLA061708-01	6/17/2008	horned lark	B15	TRUE	4-Wheel	dismembered
HOLA062408-01	6/24/2008	horned lark	D2	FALSE	Walking	intact
HOLA062808-01	6/28/2008	horned lark	H25			intact
HOLA062908-01	6/29/2008	horned lark	P9	TRUE	4-Wheel	intact
HOLA071808-01	7/18/2008	horned lark	C3	FALSE	4-Wheel	intact
HOLA091708-02	9/17/2008	horned lark	C12	TRUE	Walking	injured
HOLA093008-01	9/30/2008	horned lark	C11	TRUE	4-Wheel	feather spot
HOLA101608-01	10/16/2008	horned lark	H57	FALSE	4-Wheel	intact

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
HOLA102408-01	10/24/2008	horned lark	C10	TRUE	Walking	feather spot
HOLA111808-01	11/18/2008	horned lark	H52	FALSE	Walking	intact
HOLA112608-01	11/26/2008	horned lark	M14	FALSE	Walking	intact
HOLA120808-01	12/8/2008	horned lark	D13	FALSE	Walking	feather spot
HOLA121008-01	12/10/2008	horned lark	H46	FALSE	4-Wheel	intact
HOLA121208-01	12/12/2008	horned lark	H52	FALSE	Walking	intact
HOLA012209-01	1/22/2009	horned lark				feather spot
HOLA012709-01	1/27/2009	horned lark	E8	FALSE	4-Wheel	intact
HOLA020409-01	2/4/2009	horned lark	P13	TRUE	4-Wheel	intact
HOLA021209-01	2/12/2009	horned lark	H40			dismembered
HOLA022309-01	2/23/2009	horned lark	B27	TRUE	4-Wheel	intact
031609-HOLA-C12-1	3/16/2009	horned lark	C12	TRUE	4-Wheel	complete
031609-HOLA-F2-3	3/16/2009	horned lark	F2			feather spot
031609-HOLA-C12-2	3/16/2009	horned lark	H49	FALSE	4-Wheel	complete
031809-HOLA-L13-1	3/18/2009	horned lark	L13	FALSE	Walking	complete
031809-HOLA-L11-2	3/18/2009	horned lark	L11	FALSE	Walking	complete
031909-HOLA-L8-1	3/19/2009	horned lark	L8	FALSE	4-Wheel	complete
040809-HOLA-P9-1	4/8/2009	horned lark	P9	TRUE	4-Wheel	complete
040909-HOLA-D10-1	4/9/2009	horned lark	D10	FALSE	Walking	complete
041509-HOLA-H12-2	4/15/2009	horned lark	H12	FALSE	Walking	complete
052109-HOLA-D16-1	5/21/2009	horned lark	D16			complete
060409-HOLA-B15-2	6/4/2009	horned lark	B17			complete
061109-HOLA-C1-1	6/11/2009	horned lark	C1	FALSE	Walking	complete
061909-HOLA-C12-1	6/19/2009	horned lark	C12	TRUE	4-Wheel	complete
070709-HOLA-H21-1	7/7/2009	horned lark	H21	FALSE	4-Wheel	complete
081309-HOLA-H21-3	8/13/2009	horned lark	H21	FALSE	4-Wheel	complete
082109-HOLA-L6-1	8/21/2009	horned lark	L6	FALSE	4-Wheel	complete
082109-HOLA-D17-1	8/21/2009	horned lark	D17	FALSE	Walking	complete
092809-HOLA-E9-1	9/28/2009	horned lark	E9	FALSE	4-Wheel	feather spot
092809-HOLA-M3-1	9/28/2009	horned lark	M3	FALSE	Walking	partial

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
102709-HOLA-B27-2	10/27/2009	horned lark	B27	TRUE	4-Wheel	feather spot
102709-HOLA-B27-3	10/27/2009	horned lark	B27	TRUE	4-Wheel	complete
110509-HOLA-A6-1	11/5/2009	horned lark	A6	FALSE	Walking	complete
110509-HOLA-L6-1	11/5/2009	horned lark	L6	FALSE	4-Wheel	complete
122209-HOLA-C12-1	12/12/2009	horned lark	C12	TRUE	4-Wheel	complete
121709-HOLA-K2-1	12/17/2009	horned lark	K2	FALSE	4-Wheel	complete
122909-HOLA-C8-1	12/29/2009	horned lark	C8	TRUE	4-Wheel	complete
010510-HOLA-C12-01	1/5/2010	horned lark	C12	TRUE	4-Wheel	feather spot
010510-HOLA-C12-02	1/5/2010	horned lark	C12	TRUE	4-Wheel	complete
090909-KILL-L8-3	9/9/2009	killdeer	L8	FALSE	4-Wheel	feather spot
LALO031008-01	3/10/2008	Lapland longspur	D25			intact
LARB052808-01	5/28/2008	lark bunting	C10	TRUE	Walking	feather spot
LARB081408-01	8/14/2008	lark bunting	B19	TRUE	4-Wheel	intact
081809-LARB-G3-1	8/18/2009	lark bunting	G3	FALSE	4-Wheel	complete
090109-LARB-H17-1	9/1/2009	lark bunting	H17	FALSE	Walking	feather spot
090909-LARB-D9-2	9/9/2009	lark bunting	D9	FALSE	Walking	feather spot
090909-LARB-D9-3	9/9/2009	lark bunting	D9	FALSE	Walking	feather spot
LASP04080801	4/8/2008	lark sparrow	B27	TRUE	4-Wheel	intact
071009-LBBA-H11-1	7/10/2009	little brown bat	H11	FALSE	4-Wheel	complete
081309-LBBA-C13-1	8/13/2009	little brown bat	C13	TRUE	4-Wheel	complete
100609-MALL-D9-1	10/6/2009	mallard	D9	FALSE	Walking	feather spot
110309-MALL-C8-1	11/3/2009	mallard	C8	TRUE	4-Wheel	feather spot
MCLO032708-01	3/27/2008	McCown's longspur	H31	FALSE	Walking	scavenged
MCLO041508-02	4/15/2008	McCown's longspur	E3	FALSE	Walking	feather spot
MODO050808-01	5/8/2008	mourning dove	D20	TRUE	Walking	feather spot
MODO052908-01	5/29/2008	mourning dove	B26			scavenged
MODO061108-01	6/11/2008	mourning dove	C16	TRUE	Walking	dismembered
MODO072508-01	7/25/2008	mourning dove	C12	TRUE	Walking	feather spot
MODO080708-01	8/7/2008	mourning dove	C12	TRUE	Walking	feather spot
MODO081808-01	8/18/2008	mourning dove	L8	FALSE	Walking	feather spot

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
MODO082108-01	8/21/2008	mourning dove	E13	FALSE	Walking	feather spot
MODO090308-01	9/3/2008	mourning dove	B15	TRUE	4-Wheel	feather spot
MODO091708-01	9/17/2008	mourning dove	C10	TRUE	Walking	feather spot
042909-MODO-P3-1	4/29/2009	mourning dove	P3	FALSE	Walking	partial
060409-MODO-B26-2	6/4/2009	mourning dove	B26	TRUE	Walking	complete
070109-MODO-A8-1	7/1/2009	mourning dove	A8	FALSE	Walking	complete
070909-MODO-C13-1	7/9/2009	mourning dove	C13	TRUE	4-Wheel	complete
073009-MODO-C12-1	7/30/2009	mourning dove	C12	TRUE	4-Wheel	feather spot
082109-MODO-D21-1	8/21/2009	mourning dove	D21	TRUE	Walking	complete
090909-MODO-D9-1	9/9/2009	mourning dove	D9	FALSE	Walking	feather spot
092209-MODO-D22-1	9/22/2009	mourning dove	D22	TRUE	Walking	complete
NOHA042508-01	4/25/2008	northern harrier	H11	FALSE	Walking	other
040809-NOHA-C1-1	4/8/2009	northern harrier	C1	FALSE	Walking	partial
110209-NOHA-M7-1	11/2/2009	northern harrier	M7	FALSE	4-Wheel	scavenged
RHWO052808-02	5/28/2008	red-headed woodpecker	B15	TRUE	4-Wheel	intact
110409-RNPH-D19-1	11/4/2009	ring-necked pheasant				feather spot
ROPI040808-01	4/8/2008	rock pigeon	B27	TRUE	4-Wheel	dismembered
ROWR04290801	4/29/2008	rock wren	H37	FALSE	4-Wheel	intact
051209-ROWR-G6-2	5/12/2009	rock wren	G6	FALSE	4-Wheel	complete
101509-RUDU-H30-1	10/15/2009	ruddy duck	H30	FALSE	Walking	partial
STGR032608-01	3/26/2008	sharp-tailed grouse	C12	TRUE	Walking	feather spot
SHBA04300801	4/30/2008	silver-haired bat	P3	FALSE	4-Wheel	intact
SHBA051608-01	5/16/2008	silver-haired bat	F11	TRUE	Walking	intact
SHBA051908-01	5/19/2008	silver-haired bat	B7	TRUE	4-Wheel	intact
SHBA052308-01	5/23/2008	silver-haired bat	P13	TRUE	4-Wheel	scavenged
SHBA062608-01	6/26/2008	silver-haired bat	D20	TRUE	Walking	intact
SHBA071008-01	7/10/2008	silver-haired bat	P13	TRUE	4-Wheel	intact
SHBA081308-01	8/13/2008	silver-haired bat	M14	FALSE	Walking	intact
SHBA082708-01	8/27/2008	silver-haired bat	B15	TRUE	4-Wheel	intact
SHBA090808-02	9/8/2008	silver-haired bat	H57	FALSE	4-Wheel	intact

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
SHBA091008-02	9/10/2008	silver-haired bat	J8	FALSE	Walking	intact
SHBA091108-01	9/11/2008	silver-haired bat	B23	TRUE	4-Wheel	intact
SHBA100908-01	10/9/2008	silver-haired bat	A8	FALSE	4-Wheel	scavenged
SHBA102308-01	10/23/2008	silver-haired bat	B21	TRUE	Walking	dismembered
040909-SHBA-C12-2	4/9/2009	silver-haired bat	C12	TRUE	4-Wheel	complete
041509-SHBA-M7-1	4/15/2009	silver-haired bat	M7	FALSE	4-Wheel	complete
042809-SHBA-L10-1	4/28/2009	silver-haired bat	L10	FALSE	Walking	complete
051209-SHBA-H49-1	5/12/2009	silver-haired bat	H49	FALSE	4-Wheel	complete
070909-SHBA-H21-3	7/9/2009	silver-haired bat	H21	FALSE	4-Wheel	complete
090209-SHBA-P13-1	9/2/2009	silver-haired bat	P13	TRUE	4-Wheel	complete
090309-SHBA-H49-1	9/3/2009	silver-haired bat	H49	FALSE	4-Wheel	complete
090909-SHBA-A6-1	9/9/2009	silver-haired bat	A6	FALSE	Walking	complete
091009-SHBA-B27-1	9/10/2009	silver-haired bat	B27	TRUE	4-Wheel	complete
SMBI042908-02	4/29/2008	small bird	D12	FALSE	Walking	feather spot
SORA100908-02	10/9/2008	sora	D26	TRUE	4-Wheel	intact
SWHA050808-03	5/8/2008	Swainson's hawk	C3	FALSE	4-Wheel	intact
SWHA080608-01	8/6/2008	Swainson's hawk	C3	FALSE	4-Wheel	intact
SWHA082608-01	8/26/2008	Swainson's hawk	C11	TRUE	4-Wheel	intact
072209-SWHA-B25-1	7/22/2009	Swainson's hawk	B25	TRUE	Walking	complete
UNBA052808-03	5/28/2008	unidentified bat	B7	TRUE	4-Wheel	scavenged
UNBA071608-01	7/16/2008	unidentified bat	B19	TRUE	4-Wheel	intact
UNBU012009-01	1/20/2009	unidentified bird	H26	FALSE	4-Wheel	feather spot
UNID021609-01	2/16/2009	unidentified bird	D26	TRUE	4-Wheel	dismembered
071309-UNID-G37-1	7/13/2009	unidentified bird	G37	TRUE	Walking	
110409-UNID-K2-1	11/4/2009	unidentified bird	K2	FALSE	4-Wheel	feather spot
112009-UNID-P14-1	11/20/2009	unidentified bird	P14	TRUE	4-Wheel	feather spot
UNPA011508-01	1/15/2008	unidentified passerine	C11	TRUE	4-Wheel	feather spot
UNPA052908-02	5/29/2008	unidentified passerine	B26			intact
UNPA052908-03	5/29/2008	unidentified passerine	D20	TRUE	Walking	dismembered
UNSP051508-01	5/15/2008	unidentified sparrow	C15	TRUE	Walking	feather spot

**APPENDIX A – Avian and bat casualties found during fatality monitoring at the Cedar Creek Wind-Energy Facility,
January 3, 2008 – January 15, 2010.**

Sample ID	Date	Taxa ID	Turbine	Rim Edge	Search Type	Condition
VESP091808-01	9/18/2008	vesper sparrow	F11	TRUE	Walking	injured
VESP092408-01	9/24/2008	vesper sparrow	P13	TRUE	4-Wheel	intact
WEME050808-02	5/8/2008	western meadowlark	G6	FALSE	Walking	feather spot
WEME051308-01	5/13/2008	western meadowlark	D12	FALSE	Walking	feather spot
WEME071508-01	7/15/2008	western meadowlark	H42	FALSE	Walking	feather spot
WEME111008-01	11/10/2008	western meadowlark	C12	TRUE	Walking	intact
WEME111808-02	11/18/2008	western meadowlark	H52	FALSE	Walking	feather spot
032009-WEME-H6-1	3/20/2009	western meadowlark	H6	FALSE	Walking	complete
080609-WEME-F6-1	8/6/2009	western meadowlark	F6	FALSE	4-Wheel	complete
080609-HOLA-H55-4	8/6/2009	western meadowlark	H55	FALSE	Walking	complete
090809-WEME-C1-1	9/8/2009	western meadowlark	C1	FALSE	Walking	feather spot
090909-WEME-L6-1	9/9/2009	western meadowlark	L6	FALSE	4-Wheel	feather spot
092209-WEME-L6-1	9/22/2009	western meadowlark	L6	FALSE	4-Wheel	feather spot
YHBL090908-01	9/9/2008	yellow-headed blackbird	H21	FALSE	Walking	intact



**ATTORNEY CLIENT WORK PRODUCT
CONFIDENTIAL BUSINESS INFORMATION**

DATE: 5 December 2013

TO: James Lynch, K&L Gates

FROM: Victoria Poulton, WEST, Inc.

RE: Results from clearing search at Cedar Creek, November-December 2013

At the request of K&L Gates, Western EcoSystems Technology, Inc. (WEST) conducted one clearing search round of all 274 wind turbines at the Cedar Creek Wind Project (CCWP) in Weld County, Colorado. The purpose of the clearing search was to check all turbines at the CCWP for fatalities, with a focus on golden eagles and other large-bodied raptors.

Searches were conducted from a four-wheel drive all-terrain vehicle (ATV) or from a truck and on foot. Searchers spent 5-10 minutes at each turbine, driving around the turbine pad area, and driving or walking another loop around the turbine approximately 30-50 meters out from the turbine base. Binoculars were used to scan the ground around the turbine for fatalities.

Searches were conducted by a team of two field biologists. The field biologists received CCWP site safety training and search protocol training prior to conducting searches. Field biologists had completed ATV operations training, and used personal protective gear including safety-toed boots, protective clothing suitable for the weather, gloves, and ATV helmet or hard hat with safety glasses as appropriate.

Searches were conducted on November 25-26 and December 2-3, 2013 (Table 1). All turbines were visited. Due to a storm in the area prior to searches, snow was present at most turbines that covered some to much of the searched area with 1-2 inches of snow. Landcover/vegetation at turbines included grassland, cultivated land, grassland with shrubs, and likely Conservation Reserve Program (CRP) lands that were unfenced and had ungrazed and uncut grass (see Table 1).

Only one bird fatality was found during the clearing search. The fatality was in an advanced state of decay – mostly bones and feathers – and was likely a red-tailed hawk. The red-tailed hawk fatality was found at turbine G2 on 2 December 2013. The fatality was located about 20 meters southwest of the turbine base, and was left in place. The datasheet and some photos are appended to this memo. No other bird or bat fatalities were detected during the clearing search.



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
A1	12/2/2013	SAQ	0	CRP land, Low vegetation
A2	12/2/2013	SAQ	0	CRP land, Low vegetation
A3	12/2/2013	SAQ	0	CRP land, Low vegetation
A4	12/2/2013	SAQ	0	CRP land, Low vegetation
A5	12/2/2013	SAQ	0	Higher grass making spotting difficult
A6	12/2/2013	SAQ	0	Higher grass making spotting difficult
A7	12/2/2013	SAQ	0	Higher grass making spotting difficult
A8	12/2/2013	SAQ	0	Higher grass making spotting difficult
A9	12/2/2013	SAQ	0	Open pad- low grass
A10	12/2/2013	SAQ	0	Shrubland and some higher grass- Shortgrass species
B1	12/3/2013	OZ	0	GRASS
B2	12/3/2013	OZ	0	GRASS
B3	12/3/2013	OZ	0	GRASS
B4	12/3/2013	OZ	0	GRASS
B5	12/3/2013	OZ	0	GRASS
B6	12/3/2013	OZ	0	GRASS
B7	12/3/2013	OZ	0	GRASS
B8	12/3/2013	OZ	0	GRASS
B9	12/3/2013	OZ	0	GRASS
B10	12/3/2013	OZ	0	GRASS
B11	12/3/2013	OZ	0	GRASS
B12	12/3/2013	OZ	0	GRASS
B13	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B14	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B15	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B16	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B17	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B18	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B19	11/26/2013	SAQ	0	CRP land, very high grass making spotting difficult. Drove 2 circles around the turbine on pad and out roughly 40 meters.
B20	11/26/2013	SAQ	0	On hill overlooking valley to the south. Low vegetation
B21	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
B22	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
B23	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
B24	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
B25	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
B26	11/26/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
B27	11/26/2013	SAQ	0	Low vegetation, cattle present
C1	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C2	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C3	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C4	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C5	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C6	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C7	11/26/2013	SAQ	0	Low vegetation. Some drifting snow made viewing difficult, but good visibility overall.
C8	11/25/2013	VP	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
C9	11/25/2013	VP	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
C10	11/26/2013	SAQ	0	Low vegetation but a lot of snow
C11	11/25/2013	VP	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
C12	11/25/2013	VP	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
C13	11/26/2013	SAQ	0	Grassland
C14	11/26/2013	SAQ	0	Grassland
C15	11/26/2013	SAQ	0	Grassland
C16	11/26/2013	SAQ	0	Grassland
D0	11/25/2013	SAQ	0	Low vegetation, cultivated
D1	11/25/2013	SAQ	0	Low vegetation, cultivated
D2	11/25/2013	SAQ	0	Low vegetation, cultivated
D3	11/25/2013	SAQ	0	Low vegetation, cultivated
D4	11/25/2013	SAQ	0	Low vegetation, cultivated
D5	11/25/2013	SAQ	0	Low vegetation, cultivated
D6	11/25/2013	SAQ	0	Low vegetation, cultivated
D7	11/25/2013	SAQ	0	Low vegetation, cultivated
D8	11/25/2013	SAQ	0	Low vegetation, cultivated



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
D9	11/25/2013	SAQ	0	Low vegetation, cultivated
D10	11/25/2013	SAQ	0	grassland
D11	11/25/2013	SAQ	0	grassland
D12	11/25/2013	SAQ	0	grassland
D13	11/25/2013	SAQ	0	cultivated
D14	11/25/2013	SAQ	0	cultivated
D15	11/25/2013	SAQ	0	cultivated
D16	11/25/2013	SAQ	0	cultivated
D17	11/25/2013	SAQ	0	CRP?
D18	11/25/2013	SAQ	0	CRP?
D19	11/25/2013	SAQ	0	cultivated
D20	11/26/2013	SAQ	0	
D21	11/26/2013	SAQ	0	cattle on site
D22	11/26/2013	SAQ	0	Low vegetation. Cultivated
D23	11/26/2013	SAQ	0	Low vegetation. Cultivated
D24	11/26/2013	SAQ	0	Low vegetation. Cultivated
D25	11/26/2013	SAQ	0	Low vegetation. Cultivated
D26	11/26/2013	SAQ	0	Low vegetation. Cultivated
E1	11/25/2013	OZ	0	CRP
E2	11/25/2013	OZ	0	CRP
E3	11/25/2013	OZ	0	CRP
E4	11/25/2013	OZ	0	CRP
E5	11/25/2013	OZ	0	CRP
E6	11/25/2013	OZ	0	CRP
E7	11/25/2013	OZ	0	CRP
E8	11/25/2013	OZ	0	CRP
E9	11/25/2013	OZ	0	CRP
E10	11/25/2013	OZ	0	CRP
E11	11/25/2013	OZ	0	CRP
E12	11/25/2013	OZ	0	GRASS
E13	11/25/2013	OZ	0	GRASS
E14	11/25/2013	OZ	0	GRASS
E15	11/25/2013	OZ	0	GRASS
E16	11/25/2013	OZ	0	GRASS
E17	11/25/2013	OZ	0	GRASS
E18	11/25/2013	OZ	0	GRASS
F1	12/2/2013	OZ	0	GRASS



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
F2	12/2/2013	OZ	0	GRASS
F3	12/2/2013	OZ	0	GRASS
F4	12/2/2013	OZ	0	GRASS
F5	12/2/2013	OZ	0	GRASS
F6	12/2/2013	OZ	0	GRASS
F7	12/2/2013	OZ	0	GRASS
F8	12/2/2013	OZ	0	GRASS
F9	12/2/2013	OZ	0	GRASS
F10	12/3/2013	OZ	0	GRASS
F11	12/2/2013	OZ	0	GRASS
G1	12/2/2013	SAQ	0	Low grasses
G2	12/2/2013	SAQ	Yes	Low grass surrounding pad. Decomposed Raptor likely a Red Tailed Hawk at coordinates 13T0582199, 4527507
G3	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G4	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G5	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G6	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G7	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G8	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G9	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G10	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G11	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G12	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G13	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G14	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G15	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G16	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G17	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G18	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G19	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
G20	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G21	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G22	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G23	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G24	12/2/2013	SAQ	0	Low grass- circled pad and searched grass immediately around pad and 30-40 meters out- likely CRP land grazed
G25	11/25/2013	VP	0	grassland; snow some of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
G26	11/25/2013	VP	0	grassland; snow some of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
G27	11/25/2013	VP	0	ungrazed grassland; drove truck around pad and walked meandering loop around turbine
G28	11/25/2013	VP	0	ungrazed grassland; drove truck around pad and walked meandering loop around turbine
G29	12/3/2013	SAQ	0	Cultivated- recently seeded
G30	12/3/2013	SAQ	0	Cultivated- recently seeded
G31	12/3/2013	SAQ	0	Cultivated- recently seeded
G32	12/3/2013	SAQ	0	Shrubland- High Grass
G33	12/3/2013	SAQ	0	Shrubland- High Grass
G34	12/3/2013	SAQ	0	Shrubland- High Grass
G35	12/3/2013	SAQ	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
G36	12/3/2013	SAQ	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
G37	12/3/2013	SAQ	0	grassland; snow much of area; drove truck around pad and searched a circle on foot about 30-40 m out from turbine
H1	12/3/2013	OZ	0	GRASS
H2	12/3/2013	OZ	0	GRASS
H3	12/3/2013	OZ	0	GRASS
H4	12/3/2013	OZ	0	GRASS
H5	12/3/2013	OZ	0	GRASS
H6	12/3/2013	OZ	0	GRASS
H7	12/3/2013	OZ	0	GRASS
H8	12/3/2013	OZ	0	GRASS
H9	12/3/2013	OZ	0	GRASS
H10	12/3/2013	OZ	0	GRASS
H11	12/3/2013	OZ	0	GRASS
H12	12/3/2013	OZ	0	GRASS
H13	12/3/2013	OZ	0	GRASS



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
H14	12/3/2013	OZ	0	GRASS
H15	12/3/2013	OZ	0	GRASS
H16	12/3/2013	OZ	0	GRASS
H17	12/3/2013	OZ	0	GRASS
H18	12/3/2013	OZ	0	GRASS
H19	12/3/2013	OZ	0	GRASS
H20	12/3/2013	OZ	0	GRASS
H21	12/3/2013	OZ	0	GRASS
H22	12/3/2013	OZ	0	GRASS
H23	12/3/2013	OZ	0	GRASS
H24	12/3/2013	OZ	0	GRASS
H25	12/3/2013	OZ	0	GRASS
H26	12/3/2013	OZ	0	GRASS
H27	12/3/2013	OZ	0	GRASS
H28	12/3/2013	OZ	0	GRASS
H29	12/3/2013	OZ	0	GRASS
H30	12/3/2013	OZ	0	GRASS
H31	12/3/2013	OZ	0	GRASS
H32	12/3/2013	OZ	0	GRASS
H34	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H35	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H36	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H37	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H38	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H39	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H40	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H41	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H42	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H43	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H44	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H45	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H46	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H47	12/2/2013	SAQ	0	CRP-low grass, circled pad and turbine about 30-40 meters out
H48	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H49	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H50	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
H51	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H52	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H53	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H54	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H55	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H56	12/3/2013	SAQ	0	Shrubland- high grass, drove truck
H57	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H58	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H59	12/3/2013	SAQ	0	CRP- low grass- drove around pad in truck and walked around turbine 30-40 meters
H60	12/3/2013	SAQ	0	Cultivated- recently seeded
H61	12/3/2013	SAQ	0	Cultivated- recently seeded
H62	12/3/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
H63	12/3/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
H64	12/3/2013	SAQ	0	CRP- High grass. Difficult to see in grass. Drove 2 circles around turbines near pad and about 40 meters out.
J1	12/3/2013	OZ	0	GRASS
J2	12/3/2013	OZ	0	GRASS
J3	12/3/2013	OZ	0	GRASS
J4	12/3/2013	OZ	0	GRASS
J5	12/3/2013	OZ	0	GRASS
J6	12/3/2013	OZ	0	GRASS
J7	12/3/2013	OZ	0	GRASS
J8	12/3/2013	OZ	0	GRASS
J9	12/3/2013	OZ	0	GRASS
K1	12/2/2013	OZ	0	GRASS
K2	12/2/2013	OZ	0	GRASS
K3	12/2/2013	OZ	0	GRASS
K4	12/2/2013	OZ	0	GRASS
K5	12/2/2013	OZ	0	GRASS
K6	12/2/2013	OZ	0	GRASS
K7	12/2/2013	OZ	0	GRASS
K8	12/2/2013	OZ	0	GRASS
K9	12/3/2013	OZ	0	GRASS



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
K10	12/3/2013	OZ	0	GRASS
K11	12/3/2013	OZ	0	GRASS
L1	12/2/2013	OZ	0	GRASS
L2	12/2/2013	OZ	0	GRASS
L3	12/2/2013	OZ	0	GRASS
L4	12/2/2013	OZ	0	GRASS
L5	12/2/2013	OZ	0	GRASS
L6	12/2/2013	OZ	0	GRASS
L7	12/2/2013	OZ	0	GRASS
L8	12/2/2013	OZ	0	GRASS
L9	12/2/2013	OZ	0	GRASS
L10	12/2/2013	OZ	0	GRASS
L11	12/2/2013	OZ	0	GRASS
L12	12/2/2013	OZ	0	GRASS
L13	12/2/2013	OZ	0	GRASS
L14	12/2/2013	OZ	0	GRASS
M1	12/2/2013	OZ	0	GRASS
M2	12/2/2013	OZ	0	GRASS
M3	12/2/2013	OZ	0	GRASS
M4	12/2/2013	OZ	0	GRASS
M5	12/2/2013	OZ	0	GRASS
M6	12/2/2013	OZ	0	GRASS
M7	12/2/2013	OZ	0	GRASS
M8	12/2/2013	OZ	0	GRASS
M9	12/2/2013	OZ	0	GRASS
M10	12/2/2013	OZ	0	GRASS
M11	12/2/2013	OZ	0	GRASS
M12	12/2/2013	OZ	0	GRASS
M13	12/2/2013	OZ	0	GRASS
M14	12/2/2013	OZ	0	GRASS
M15	12/2/2013	OZ	0	GRASS
M16	12/2/2013	OZ	0	GRASS
P1	12/2/2013	OZ	0	GRASS
P2	12/2/2013	OZ	0	GRASS
P3	12/2/2013	OZ	0	GRASS
P4	12/2/2013	OZ	0	GRASS
P5	12/2/2013	OZ	0	GRASS



Table 1. Clearing search information for all turbines at Cedar Creek Wind Project, November 25 – December 3, 2013.

Turbine	Date Searched	Observer Initials	Fatalities Found	Notes
P6	12/2/2013	OZ	0	GRASS
P7	12/2/2013	OZ	0	GRASS
P8	12/2/2013	OZ	0	GRASS
P9	12/2/2013	OZ	0	GRASS
P10	12/2/2013	OZ	0	GRASS
P11	12/2/2013	OZ	0	GRASS
P12	12/2/2013	OZ	0	GRASS
P13	12/2/2013	OZ	0	GRASS
P14	12/2/2013	OZ	0	GRASS
P15	12/2/2013	OZ	0	GRASS



NATURAL RESOURCES ♦ SCIENTIFIC SOLUTIONS



Photo 1. Red-tailed hawk fatality at turbine G2, 2 December 2013.



NATURAL RESOURCES ♦ SCIENTIFIC SOLUTIONS



Photo 2. Red-tailed hawk fatality at turbine G2, 2 December 2013, showing turbine location for perspective.



Photo 3. Red-tailed hawk fatality at turbine G2, 2 December 2013, close up.

**Six Months Post-Construction Monitoring
Cedar Creek Wind Project
Weld County, Colorado**

**Final Report
April – September 2014**

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February 5, 2015



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INTRODUCTION

In April, 2014, West Inc. conducted six months of monitoring at the Cedar Creek Wind Project (CCWP) in Weld County, Colorado (Figure 1). Post-construction monitoring at the CCWP was conducted between April and September 2014.

The CCWP includes 279 wind turbines for a total capacity of 300 megawatts (MW). Associated infrastructure includes access roads, underground electric collection systems, a substation, an operations and maintenance building (O&M building), and meteorological (met) towers. Land use/vegetation communities are dominated by grassland with some cultivated agriculture, mostly winter wheat (*Triticum aestivum*). The focus of this monitoring study was on golden eagles (*Aquila chrysaetos*). Two years of monitoring for all bird and bat species was previously conducted during 2008-2010.

The primary purpose of the monitoring study was to determine if eagle fatalities occurred at CCWP. A secondary purpose was to roughly quantify bird fatality rates for the study period and determine if fatality rates were high, similar, or low compared to results from the 2008-2010 study. This study was designed with a focus on golden eagles, following the US Fish and Wildlife Service (USFWS) Wind Energy Guidelines (WEG; USFWS 2012).

The methods for the study were broken into four primary components: 1) standardized carcass surveys of selected turbines; 2) searcher efficiency trials to estimate the percentage of carcasses found by searchers; 3) carcass removal trials to estimate the length of time that a carcass remains in the field for possible detection (based on data from 2008-2010); and 4) adjusted fatality estimates for birds and bats calculated using the results from searcher efficiency trials and carcass removal trials to estimate the total number of bird and bat fatalities within the project area. This report focuses on results from the first component.

STUDY AREA

The CCWP is located in Weld County, in northeastern Colorado, approximately eight miles (12 kilometers [km]) east of the town of Grover (Figure 1). Land cover in the area is mostly short-grass prairie, with some parcels of cultivated agriculture (mostly winter wheat) and hayed lands or Conservation Reserve Program (CRP) lands that were tilled in the past but have been re-seeded with grass species. Land ownership is a mixture of state- and privately-owned land and is relatively undeveloped, with the exception of a few rural homes, missile sites, a few existing radio towers, and local utility lines. The dominant land uses for the area are cattle grazing, wheat production, and wind power development.

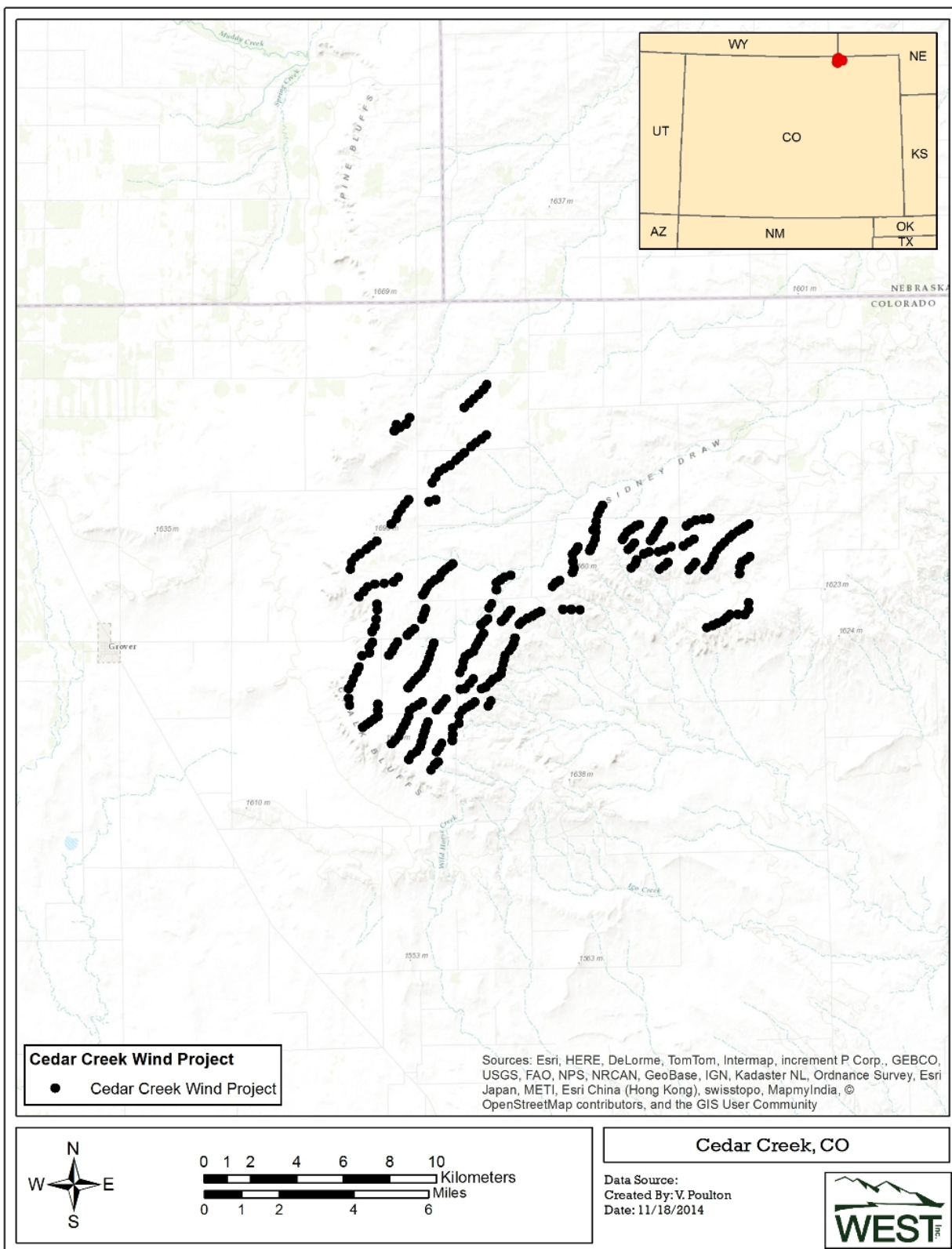


Figure 1. Location of the Cedar Creek Wind Project.

The CCWP is located on a broad plateau. Topography on the top of the plateau where many of the turbines are located is flat to rolling, while the edges of the plateau are relatively steep and defined, especially along the western and southwestern edges of the project area. The western and southwestern edges of the plateau contain some chalk bluffs and scattered limber pine (*Pinus flexilis*) and juniper (*Juniperus scopulorum*) woodlands.

METHODS

Avian and Bat Carcass Surveys

The primary objective of the monitoring study was to determine if eagle fatalities occurred at CCWP. Fatalities of small birds, large birds, raptors other than eagles, and bats were also recorded during surveys. Monitoring began on April 6, 2014, and continued through September 23, 2014.

Fatalities were found under three different circumstances at the CCWP: 1) during the standardized carcass searches for the study; 2) while observers were on site, but not conducting a standardized search (classified as an incidental find); and 3) by facility personnel or others on site for other purposes (incidental find). Carcasses found by study personnel regardless of timing (i.e., during a standardized survey or not) were recorded following the methods described below. All carcasses found within a search plot, even if outside of the standard survey period, were included in the dataset under the broad assumption that these carcasses would have been found during standardized surveys. All bird and bat carcasses found within search plots were recorded and assumed to be turbine-related for the purposes of this study, unless visible injuries indicated another potential cause of death.

Field Methods

Standardized carcass surveys were conducted once per month from April through September 2014. Square plots were established around 82 turbines (Figure 2), which represented 30% of all turbines at the CCWP, following the WEG (USFWS 2012). A higher sampling rate was used for turbines along the escarpment edge (approximately 50% of searched turbines), similar to what was during the initial post-construction study during 2008-2010. To select turbine plots for searching, turbines classified as near the escarpment (within 400 m [1,312 ft]) or away from the escarpment (more than 400 m [1,312 ft]), and random selections of 41 turbines were made within each group. Some search plots were dropped and others re-selected based on search conditions in the field.

Search plots were 240 x 240-m (787 x 787-ft) squares, centered on the turbine. Plots were oriented so that the maximum distance searched (the corners of the square) coincided with the direction of the prevailing winds, if possible given crop plantings, topography, and other considerations. Plots were searched from a 4-wheel-drive all-terrain vehicle (ATV) or utility vehicle (UTV). Searchers drove slowly along transects spaced 30 m (98 ft) apart within each plot, scanning the ground on either side of each transect for carcasses or other evidence of fatalities (bones, feathers). Though the study is focused on eagles, all carcasses detected were recorded.

For all carcasses found, data recorded included species, sex and age when possible, date and time collected, Global Positioning System (GPS) location, condition (intact, scavenged, feather spot), and any comments that indicated possible cause of death. All carcasses were photographed as found and plotted on a map of the search area. Carcasses were left in the field and marked with flagging or spray paint.

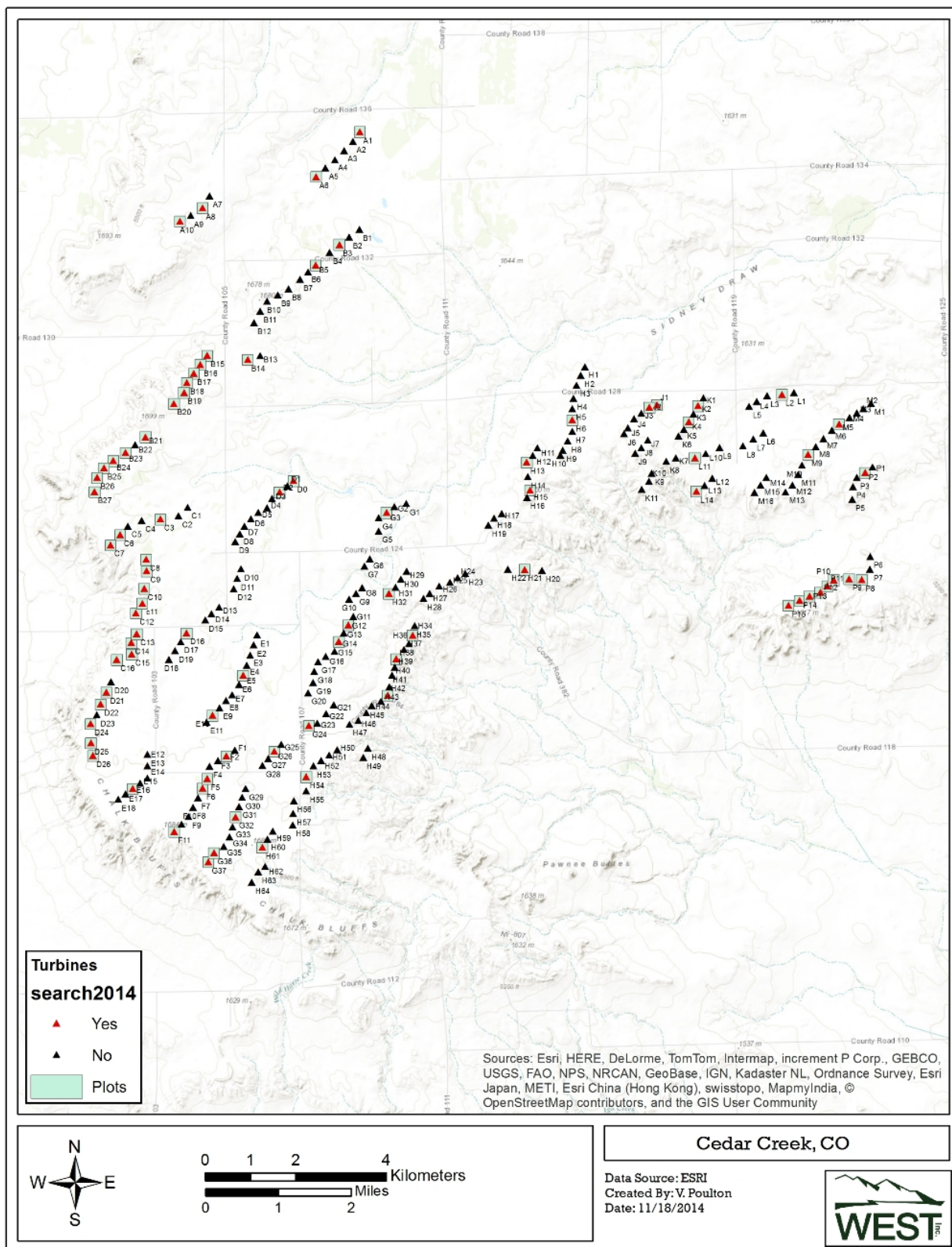


Figure 2. Location of search plots at the Cedar Creek Wind Project during 2014.

Carcasses found outside the formal search area by search technicians were treated following the above protocol as closely as possible. Carcasses observed in non-search areas (e.g., near a turbine not included in the search area) were coded as incidental discoveries and documented in a similar fashion as those found during standard searches. Carcasses found by maintenance personnel and others not conducting the formal searches were similarly documented and included in the overall dataset. Carcasses found within search areas but outside of the standard search period (e.g., when arriving at the plot) were included in the dataset under the assumption they would have been found during the standardized search.

Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the percentage of available carcasses found by searchers. Searcher efficiency trials were conducted in the same areas as carcass surveys and searcher efficiency rates were estimated by carcass size and season. Estimates of searcher efficiency were used to adjust the total number of carcasses found for those missed by searchers, correcting for detection bias.

Searcher efficiency trials were conducted four times throughout the study period. Personnel conducting carcass surveys did not know when searcher efficiency trials were being conducted or the location of the trial carcasses. A total of 61 carcasses (31 large birds and 30 small birds) were placed on four dates. Carcasses used for searcher efficiency trials were non-native/non-protected or commercially available species - ring-necked pheasant (*Phasianus colchicus*) and Eurasian collared-dove (*Streptopelia decaocto*) were used for large birds; European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and Japanese quail (*Coturnix japonica*) were used as small birds. Searcher efficiency was not calculated for bats.

All searcher efficiency trial carcasses were placed at random locations within the search area prior to that day's scheduled carcass survey. Carcasses were placed in a variety of postures to simulate a range of conditions. For example, birds were: 1) placed in an exposed posture (tossed randomly to one side); 2) partially hidden; or 3) mostly hidden to simulate a crippled bird (e.g., placed beneath vegetation). Each trial carcass was discreetly marked so that it could be identified as a study carcass after it was found.

The number and location of the searcher efficiency carcasses found during the carcass survey 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.

Carcass Removal Trials

The objective of carcass removal trials was to estimate the length of time fatalities remain in the search area. Estimates of carcass removal are intended to adjust carcass counts for removal bias. Carcass removal includes removal by scavengers or removal by other means (e.g., being plowed into a field, grass/brush mowing). Carcass removal values from the previous study at the CCWP (from March – November 2009 only) were used for this study, thereby reducing the number of carcasses placed under turbines that may attract golden eagles for scavenging.

RESULTS

Avian and Bat Carcass Surveys

Eighty-two wind turbines, representing approximately 30% of all turbines within the CCWP, were searched over the course of the six-month search period, for a total of 495 turbine searches. Five birds and two bats were found during standardized carcass surveys or incidentally (Table 1). No eagle carcasses were detected. Overall fatality rates for birds and bats were not calculated due to low sample sizes and low visibility conditions (discussed below).

Bird Carcasses

During the study, five birds representing four identifiable species were found during scheduled searches (Table 1, Figure 3). The birds found included mourning dove (*Zenaida macroura*), savannah sparrow (*Passerculus sandwichensis*), an unidentifiable passerine, Swainson's hawk (*Buteo swainsoni*), and red-tailed hawk (*B. jamaicensis*; Table 1).

Each bird was found at a different turbine, and four of the five birds were found at rim-edge turbines on the western side of the project (Figure 3). Four of the five birds were found within 40 m (131 ft) of the turbines, while the fifth was between 100 and 110 m (328 and 361 ft) from the turbine. Four birds were found during searches in August and September, and one was found in April (Table 1).

Table 1. All birds and bats detected at the Cedar Creek Wind Project from April 9 – September 23, 2014.

Unique ID	Common Name	Scientific Name	Type	Turbine	Date	Scheduled Search/ Incidental
BIRDS						
042114-MODO-B27-1	mourning dove	<i>Zenaida macroura</i>	Large bird	B27	4/21/2014	Scheduled
080114-SAVS-F6-1	Savannah sparrow	<i>Passercula sandwichensis</i>	Small Bird	F6	8/1/2014	Scheduled
081814-RTHA-C6-1	red-tailed hawk	<i>Buteo jamaicensis</i>	Large Bird	C6	8/18/2014	Incidental – on plot
091514-SWHA-C10-1	Swainson's hawk	<i>Buteo swainsoni</i>	Large Bird	C10	9/16/2014	Scheduled
091614-UNPA-C16-1	unidentified passerine		Large bird	C16	9/15/2014	Scheduled
BATS						
081814-HOBA-H64-1	hoary bat	<i>Lasiurus cinereus</i>	Bat	H64	8/18/2014	Incidental
082114-HOBA-H21-1	hoary bat	<i>Lasiurus cinereus</i>	Bat	H21	8/21/2014	Scheduled

*Fatalities found incidentally on turbine search plots were included in analyses.

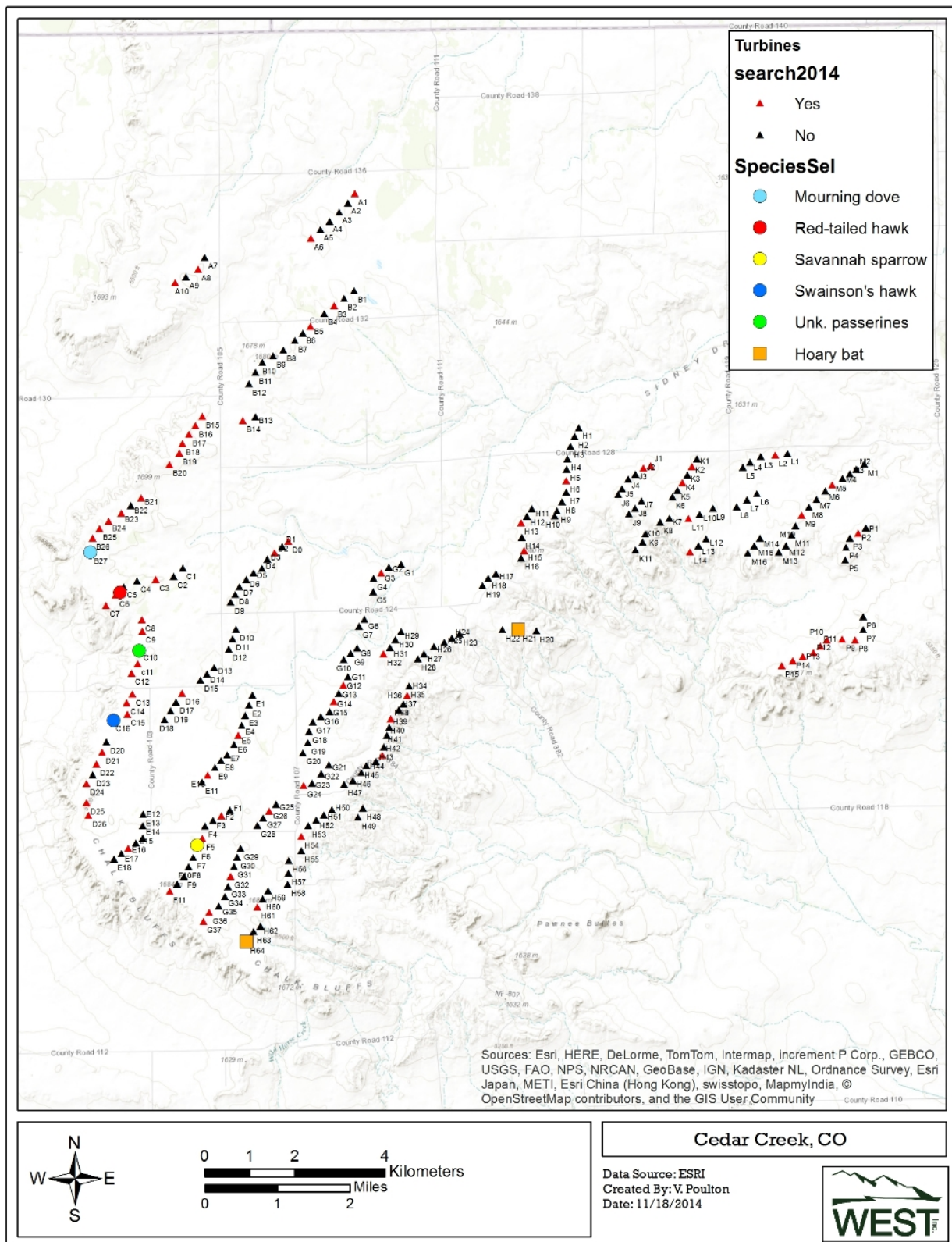


Figure 3. Location of all fatalities found at the Cedar Creek Wind Project, April – September 2014.

Bat Carcasses

One bat was found during scheduled turbine searches, and one was recorded incidentally after being found by site personnel at a non-searched turbine. Both bats were hoary bats (*Lasiurus cinereus*; Table 1). Both bats were found on the H-string of turbines; however, since that string includes many turbines, they were not close to each other geographically. The bats were found within a few days of each other, on August 18 and 21, 2014 (Table 1). Both bats were within five m (16 ft) of a turbine.

Searcher Efficiency Trials

Although not used for further analysis (see discussion below), for searcher efficiency trials, 57 bird carcasses were placed throughout the project area on four different dates. The overall searcher efficiency rate for small birds was 20.7%, and for large birds it was 55.6%. These results were not analyzed further in this report.

Carcass Removal Trials

Data from 99 individual carcass removal trials (39 large birds, 40 small birds, and 20 bats) conducted at the CCWP from March through November 2009 were used for this study. Average removal time for small birds was 4.97 days, for large birds it was 4.25 days, and for bats it was 13.3 days. These results were not analyzed further in this report.

DISCUSSION

No golden eagles were found at the CCWP during monitoring from April through September, 2014. Several other bird species and bats were found during searches, but low visibility conditions coupled with a small number of fatalities found, made it inappropriate to calculate overall fatality estimates for the study period.

Visibility conditions were affected by high precipitation rates in the region during late spring and summer of 2014 that caused unusual vegetation growth. Where blue grama (*Bouteloua gracilis*) and buffalo grass (*B. dactyloides*) usually dominate grasslands in the project area for a grass height of about four to six inches (10 to 15 cm), western wheatgrass (*Pascopyrum smithii*), reaching heights over two ft (0.6 m), was more prevalent during summer of 2014. The tall grass likely made it more difficult to detect fatalities on the ground, and measured searcher efficiency rates were lower than rates measured during the 2008-2010 surveys. Another factor affecting visibility conditions was use of the UTV for searches. We used an ATV for the first round of searches, but site rules changed during the spring and the more enclosed UTVs were required after April. Cedar Creek operations staff provided two different UTV vehicles for use during fatality searches – a Razor with a semi-enclosed cab was used from May – July, and a Ranger with an entirely closed cab was used for most searches during August and September. The Ranger was used because Cedar Creek staff had need of the Razor.

Due to relatively large size of eagles (golden eagles are approximately three times the size of female ring-necked pheasants) and their dark coloration that contrasts well with ground cover

such as grass and wheat, the likelihood is high that any eagle carcasses that were present would have been found by observers. Prior to this study, golden eagle carcasses have been found at the CCWP between April and July, which was covered by the 2014 study period.

CONCLUSION

This study was designed to detect any golden eagle carcasses during the study period. No eagles were detected. While some factors contributed to lower visibility conditions during this study, methods likely were sufficient to detect eagle carcasses due to their large size and coloration that contrasts with ground cover at CCWP.

**2008 Plains Sharp-Tailed Grouse
(*Tympanuchus phasianellus jamesii*)
Lek and Raptor Nest Surveys
Cedar Creek Wind-Energy Facility
Weld County, Colorado**

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EXECUTIVE SUMMARY

During the fall of 2007, Cedar Creek Wind Energy completed construction of a 300-megawatt wind-energy facility in Weld County, Colorado, just east of the town of Grover (Figure 1). The facility included the construction of 221 1-megawatt Mitsubishi turbines, 53 1.5-megawatt General Electric turbines, and associated infrastructure.

To better understand the potential impacts of the proposed wind-energy facility on grouse and nesting raptors, and to compare results to surveys conducted in 2006 and 2007, Cedar Creek Wind Energy contracted with Western EcoSystems Technology, Inc. to conduct surveys for sharp-tailed grouse leks and raptor nests during the spring of 2008.

Surveys at the Cedar Creek Wind-Energy Facility were conducted during the spring of 2008, and involved stopping and listening and looking for grouse leks at regular intervals at approximately 2,250-foot (686-meter) intervals. The survey routes for grouse leks were identical to those performed in 2007, and were primarily located along existing turbine access roads. Existing lek locations were also visited two to four times to count the number of birds attending lek sites.

The results of lek monitoring at the Cedar Creek Wind-Energy Facility indicate that sharp-tailed grouse may not attend leks located near wind turbines the year following construction. Five of the seven leks that were active in 2007 were inactive in 2008, and no new leks were identified. The five leks that became inactive in 2008 ranged from 355 to 2,722 meters (1,165 to 8,930 feet) from turbine locations. Two of the leks that became inactive were located within 800 meters (2,625 feet) of turbine locations (355 and 662 meters [1,165 and 2,041 feet]) and the closest active lek was 1,400 meters (4,593 feet) from a turbine. While the results of 2008 monitoring of lek sites at the Cedar Creek Wind-Energy Facility may indicate some avoidance of turbine locations, other factors may also influence use by sharp-tailed grouse. Surveys were primarily conducted along existing turbine locations, and previously documented lek locations were revisited during 2008. Sharp-tailed grouse may also move lek locations between years, regardless of the presence of turbines. While five of the seven active leks were inactive in 2008, new leks could have been established away from survey routes and might not have been detected during our surveys. The extent and condition of Conservation Reserve Program fields was also not monitored in 2008, and may have influenced use by sharp-tailed grouse. Broader survey efforts, data from nearby populations, and information regarding habitat quality would help to discern the effects of wind turbines, habitat, and other factors on sharp-tailed grouse use of the Cedar Creek Wind-Energy Facility.

Surveys for raptor nests were conducted within a half-mile (0.80 km) of turbines prior to construction in 2006, and the year following construction in 2008. The number of active raptor nests found during the year following construction (32) was comparable to the number of active nests found prior to construction (35), despite reduced access during the 2008 surveys. Surveys were focused within a half-mile of turbine locations, and based on the first year of monitoring, raptor nesting activity did not decrease the year following construction.

About 46% of the nests surveyed in June 2008 had young present or adults defending nests. Some of the birds observed during the surveys appeared close to fledging from nests, and it is possible

that some birds on other nests had already fledged prior to some surveys at nests in late June. Surveys in 2006 did not include follow-up surveys to nests in June, and thus it is unclear if the nest success rate observed in 2008 is typical for the Cedar Creek Wind-Energy Facility.

Many factors may cause raptors to abandon nests, including predation, weather, disturbance, variations in prey bases, or turbine fatalities, and the monitoring conducted in 2008 was not designed to discern the influence of these factors on nest productivity. A total of four raptor fatalities were recorded at the Cedar Creek Wind-Energy Facility between April and June of 2008, and other fatalities likely occurred during this period outside of plots searched. It could not be determined if the fatalities were birds that nested near Cedar Creek, or were non-breeding individuals or floaters (non-breeding adult birds which are non-territorial).

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INTRODUCTION

During the fall of 2007, Cedar Creek Wind Energy (CCWE) completed construction of a 300-megawatt (MW) wind-energy facility in Weld County, Colorado, just east of the town of Grover (Figure 1). The facility, known as Cedar Creek Wind Project (Cedar Creek), included the construction of 221 1-MW Mitsubishi turbines, 53 1.5-MW General Electric turbines, and associated infrastructure.

CCWE and the Colorado Division of Wildlife (CDOW) conducted a number of meetings and discussions concerning wildlife issues in early 2006. During those meetings, the CDOW brought up various concerns with the proposed facility, including the plains sharp-tailed grouse (*Tympanuchus phasianellus jamesii*) and nesting raptors. Surveys for sharp-tailed grouse leks were conducted at Cedar Creek during 2006 and 2007, prior to and during construction (Good et al. 2006, Good and Poulton 2007), and surveys for nesting raptors were conducted prior to construction in 2006 (Good et al. 2006).

To better understand the potential impacts of Cedar Creek on grouse, CCWE contracted with Western EcoSystems Technology, Inc. (WEST) to continue surveys for sharp-tailed grouse leks and raptor nests during the spring of 2008. The following report describes the results of the 2008 surveys and compares the results to previous surveys in the study area.

STUDY AREA

Cedar Creek is located within a mosaic of native short-grass prairie, active agriculture, and areas that were formerly tilled but have been re-seeded with grass species (Figure 1). The area is relatively undeveloped, with the exception of a few rural homes and missile sites. The dominant land uses for the area are cattle grazing, wheat (*Triticum* spp.) production, and wind-energy development. Cedar Creek contains a few existing radio towers and local power and telephone lines.

Cedar Creek is located on a broad plateau, and topography on the top of the plateau, where many of the turbines are located, is flat to rolling. The edges of the plateau are relatively steep and defined, especially in the western and southwestern edges of the study area. These western and southwestern edges of the plateau contain some chalk bluffs and scattered limber pine (*Pinus flexilis*) and juniper (*Juniperus scopulorum*) woodlands.

Cedar Creek has a relatively dry climate, with an average rainfall of 12.9 inches (32.8 centimeters [cm]) per year. The area experiences warm summers and cold winters, with an average annual maximum temperature of 63.2° F (17.3° C) and an average minimum of 33.3° F (0.7° C). Elevation ranges from 5,400 to 5,600 feet (ft; 1,646 to 1,707 meters [m]) above sea level. Cedar Creek is located on a mixture of privately owned and State of Colorado land.

METHODS

Sharp-Tailed Grouse Lek Surveys

Sharp-tailed grouse lek surveys started April 2 and ended May 8, 2008 (Table 2). Surveys were conducted from 30 minutes (min) before sunrise to one or two hours after sunrise, which is the period when birds should be most active on the leks. To the greatest extent possible, surveys were conducted only on clear mornings with calm winds. However, considering that this is the location of wind-energy facility selected for the presence of sustained winds, this was not always possible.

Survey routes were located along turbine strings, and were identical to routes surveyed in 2007. Surveys were conducted along the actual turbine strings, as well as some of the old string locations that were surveyed in 2006 (Figure 1). For each survey route, observers determined the presence of active lek sites by listening at approximately 2,250-ft (686-m) intervals (every third or fourth turbine site along the route) and recording compass bearings from the stop point towards all audible leks. If birds were heard during their display (booming) during the surveys, observers found the locations of displaying birds and visually confirmed the presence of leks. In order to compensate for potential “quiet” periods and the influences of time-of-day upon booming, routes were surveyed in two directions: starting at one end of a turbine string one survey and at the opposite end on the next survey. This process was repeated twice for a total of four surveys per turbine string. This procedure entailed beginning at turbine “A”, listening for booming for three min, and proceeding along the selected route to turbine “D”, while stopping for three min at each 2,250-ft interval until the end of the route. Observers referred to current sunrise/sunset tables to establish start times.

In addition to surveys for leks along established routes, we visited lek locations previously reported by the CDOW to determine lek status and to obtain counts of birds. Leks were visited between two and four times between April 1 and May 8, 2008. These leks were also visited from 30 min prior to sunrise to one or two hours after sunrise.

Raptor Nest Surveys

Methods used to survey for raptor nests in 2008 were consistent with methods used in 2006. Ground-based surveys for raptor nests were conducted from April 2 to June 27, 2008, within a half-mile (0.80 kilometers [km]) of turbine locations and project infrastructure. Initial surveys were conducted between April 2 and May 7 to determine nest occupancy, and a second series of surveys were conducted from June 3 to June 27 to determine if late nesting species, such as Swainson’s hawk (*Buteo swainsoni*), occupied nests that were inactive during the initial surveys. A subset of nests identified during the initial surveys was also re-visited during the second surveys in order to determine if the nests were successful.

As suggested by the CDOW, two methods were used to survey for raptor nests. On the top of the plateau, the majority of suitable raptor nesting habitat is composed of isolated stands of planted trees or lone cottonwoods (*Populus* spp.). These areas are highly visible and were surveyed by searching trees for nest structures from the ground with binoculars or spotting scopes, and determining if any nests observed were occupied by raptors or corvids. The potential exists for some species, such as ferruginous hawk (*Buteo regalis*) and burrowing owl (*Athene cunicularia*),

to nest on the ground in Cedar Creek. These possible nest locations were noted during other surveys in the study area, including grouse lek surveys and fatality surveys.

Cliffs located along the western and southern edges of Cedar Creek provide potential nesting habitat for prairie falcons (*Falco mexicanus*), and other species such as ferruginous hawks and golden eagles (*Aquila chrysaetos*). Observers walked along the base and top of the cliffs and searched for raptor nests. In addition to walking surveys, a protocol was developed by the CDOW to survey cliff habitats, and was utilized along the western edge of Cedar Creek where cliffs were present. Observers continuously observed a section of cliff for raptor nesting activity for up to four hours to confirm a stretch of cliff did not contain an active prairie falcon eyrie. Other species nest locations were also noted during the surveys. All surveys were conducted near dawn or dusk.

Approximately 18 miles (29 km) of escarpment are present along the western and southern edges of Cedar Creek. Prior to field surveys, a total of 20 observation points spaced at approximately 1-mile (1.6-km) intervals were established along the base of the escarpment. Survey points were also established systematically with a random start by placing observation points 400 m (0.25 mile) from the rim edge at 1-mile intervals along the rim. Observation points were adjusted up to 400 m in the field in order to maximize the length of cliff face surveyed and suitable nesting habitat for prairie falcons was not evenly distributed along the escarpment. A total of fifteen of the 20 observation points were surveyed (Table 1 and Figure 3). Five observation points were not surveyed due to either a lack of suitable nesting habitat, lack of access to private land, or the presence of confirmed active prairie falcon eyries found during walking surveys of the rim edge (see below for details on methods). In the field, observation points were located far enough away from cliff faces in order to maximize viewing areas (with the general rule of thumb that if the entire cliff face is within the view of a spotting scope on low power, then the point is too far away), and close enough that observers were able to hear normal vocalizations of nesting raptors or young anywhere on the surveyed cliff face. The observation points maximized optimal viewing conditions by moving the points in the field to provide a line of sight that was as perpendicular to as much cliff as possible. All observers were experienced in identifying and ageing raptors and experienced in conducting nest searches. All observations were conducted with optics of good quality, including 8-10X binoculars and a spotting scope with zoom capability (minimum range 20-45X). The location of each observation point was documented with a global positioning system (GPS) unit.

Cliffs along the rim edge vary greatly in angle and size. In order to compensate for some areas along the cliffs that were not viewable from observation points, the entire length of cliffs were also be surveyed by walking along the rim top and at the base of cliffs and searching for active prairie falcon eyries, raptor nest structures, or signs of raptor occupancy, such as whitewash.

Several items were recorded for each nest site, including species occupying the nest site, nest status (adult incubating, young present, adults present, unknown, or inactive), the number of young present, nest condition (poor, fair, good), nest location (GPS coordinates or mapped location), and nest substrate (tree, cliff, power line, etc). We assigned nests as active if an adult was incubating on the nest, chicks were observed, or in cases where adults were circling the nest and exhibiting defensive behavior (in cases where incubation or chicks were not detected). All other nests were deemed inactive. Species were only associated with inactive nests in cases where: 1) birds were

observed exhibiting nesting behavior early in the season; or 2) the size and nest structure were obviously associated with a species; or 3) historical data from the CDOW, or survey data from 2006, indicated a nest was previously occupied by a certain species.

RESULTS

Sharp-Tailed Grouse Lek Surveys

No new leks were observed in 2008. Existing lek sites were visited from two to four times between April 1 and May 8, 2008 (Table 1). The number of active lek sites recorded during surveys declined from 12 leks in 2006, seven leks in 2007, to two leks in 2008 (Table 2). The distance of recorded lek sites to turbines ranged from 170 to 5,180 m (558 ft to 3.2 miles; Table 3).

Raptor Nest Surveys

Access to portions of the survey area was reduced in 2008 due to private landowner concerns. Despite the reduced access, the total number of nests and number of active nests found within a half-mile of proposed turbine locations was similar between 2006 and 2008 (Tables 4 and 5). An additional 13 nests were documented in 2008 outside of the formal search area approximately one to three miles (1.6 to 4.8 km) from turbine locations. The additional 13 nests included one active burrowing owl nest, one active red-tailed hawk nest (*Buteo jamaicensis*), and 11 inactive nests. Nest locations are not provided within this report in order to protect sensitive raptor nest locations.

For the 2008 raptor nest surveys, follow-up visits were made to 28 active nests to gain a better understanding of nest productivity. A total of 13 of the 28 nests checked had young present or had adults present and defending during the month of June, while no young or adults were observed at the remaining 15 nests (Table 6).

DISCUSSION

Sharp-Tailed Grouse

The sharp-tailed grouse present at Cedar Creek are part of widely distributed population that extends from Wyoming in to Colorado. While sharp-tailed grouse are considered an endangered species by the state of Colorado, populations are apparently more robust in Wyoming and Nebraska, where relatively liberal hunting seasons are present. The plains sharp-tailed grouse is listed under the Colorado Endangered Species Act as an endangered species. Many state agencies and the US Fish and Wildlife Service (USFWS) have expressed concern over the potential impacts of wind-energy development on prairie grouse species, including the sharp-tailed grouse. However, few researchers have examined sharp-tailed grouse response to wind-energy development. Based on the locations of leks and general observations in 2006 and 2007, sharp-tailed grouse appear to be closely tied to Conservation Reserve Program (CRP) habitats in Cedar Creek. Observed use of habitats at Cedar Creek was similar to sharp-tailed grouse use just over the border of Colorado in Laramie County, Wyoming. Wachob (1997) found that sharp-tailed grouse were closely tied to CRP habitats for nesting, brood rearing, and lek habitats.

The results of lek monitoring at Cedar Creek indicate that sharp-tailed grouse may not attend leks located near wind turbines the year following construction. Five of the seven leks that were active in 2007 were inactive in 2008. The five leks that became inactive in 2008 ranged from 355 to 2,722 m (1,165 to 8,930 ft) from turbine locations. Two of the leks that became inactive were located within 800 m (2,625 ft) of turbine locations (355 and 662 m [1,165 and 2,041 feet]), and the closest active lek was located was 1,400 m (4,593 ft) from a turbine.

We are aware of only two publicly-available studies that examined response of prairie grouse species to wind-energy development. The Nebraska Game and Parks Commission (NGPC) monitored both greater prairie-chicken (*Typanuchus cupido*) and sharp-tailed grouse leks following construction of the 36-turbine Ainsworth wind-energy facility in Brown County, Nebraska (NGPC 2009). Surveys for leks were conducted for four years post-construction (2006-2009) within a 1- to 2-mile (1.6- to 3.2-km) radius of the facility, an area that covered approximately 25 square miles (mi²; 65 km²). The number of leks of both species combined in the study area was 13, 12, nine and 12 leks in the first four years post-construction, respectively. The number of greater prairie-chickens counted on leks increased from 70 to 95 birds during the 4-year period, whereas the number of sharp-tailed grouse decreased from 66 to 56 birds. No pre-construction data were available on prairie grouse leks near the site. However, densities of lekking grouse on the study area at the Ainsworth facility were within the range of expected grouse densities in similar habitats in Brown County and the adjacent Rock County (NGPC 2009). The leks at the Ainsworth facility ranged from approximately 0.68 to 2.66 km (0.42 to 1.65 miles) from the nearest turbine, with an average distance of 1.42 km (0.88 miles).

At a three-turbine wind energy facility in Minnesota, researchers documented six active greater prairie-chicken leks within two miles of the turbines, with the nearest lek located within one km (0.6 miles) of the nearest turbine (USFWS 2004). During subsequent research at this facility based on 40 nest locations, it was found that nesting hens were not avoiding turbines. Based on extensive research of the greater prairie-chicken population in the vicinity of this wind-energy facility from 1997 to 2009, it was concluded that the distribution and location of leks, and especially nests, was determined by the presence of adequate habitat in the form of residual grass cover, not the presence of vertical structures such as trees, woodlots, power lines, and wind turbines (Toepfer and Vodehnal 2009).

Another grouse with a lek mating system, the black grouse (*Lyrurus tetrix*), was found to be negatively affected by wind-energy development in Austria (Zeiler and Grünsachner-Berger 2009). The number of displaying males in the development area increased from 23 to 41 birds during the 3-year period immediately prior to construction, but the number declined to nine males four years after construction. In addition to the decline in displaying males, the remaining birds shifted their distribution away from the turbines. One lek located within 200 m (656 ft) of the nearest turbine declined from 12 birds one year prior to construction to no birds four years after construction.

While the results of 2008 monitoring of lek sites at Cedar Creek may indicate some avoidance of turbine locations, other factors may also influence use by sharp-tailed grouse. Surveys were primarily conducted along existing turbine locations, and previously documented lek locations were revisited during 2008. Sharp-tailed grouse may move lek locations between years, regardless

of the presence of turbines (Connelly et al. 1998). While five of the seven active leks were inactive in 2008, new sharp-tailed grouse leks could have been established away from survey routes and might not have been detected during our surveys. Also, CRP fields were not monitored in 2008, and the extent and condition of the CRP field may have influenced use by sharp-tailed grouse. Broader survey efforts, data collected from nearby populations, and information regarding habitat quality would help to discern the effects of wind turbines, habitat, and other factors on sharp-tailed grouse use of Cedar Creek.

Raptor Nests

The number of active nests found during the year following construction was comparable to the number of active nests found prior to construction, despite reduced access during the 2008 surveys. Surveys were focused within a half-mile of turbine locations, and based on the first year of monitoring, raptor nesting activity did not decrease the year following construction.

About 46% percent of the nests surveyed in June 2008 had young present or adults defending nests. Some of the birds observed during the surveys appeared close to fledging from nests, and it is possible that some birds on other nests had already fledged prior to some nests surveys in late June. Surveys in 2006 did not include follow-up surveys in June, so it is unclear if the nest success rate is typical for Cedar Creek.

Many factors may cause raptors to abandon nests, including predation, weather, disturbance, variations in prey bases, or turbine fatalities, and the monitoring conducted in 2008 was not designed to discern the influence of these factors on nest productivity. A total of four raptor fatalities were recorded at Cedar Creek between April and June of 2008, and other fatalities likely occurred during this period, but outside of plots searched (Erickson et al. 2010). It could not be determined if the fatalities were birds that nested near Cedar Creek, or were non-breeding individuals or floaters (non-breeding adult birds which are non-territorial).

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Table 1. Lek count results at the Cedar Creek during the spring of 2008.

Lek ID	Count 1	Date of Count 1	Count 2	Date of Count 2	Count 3	Date of Count3	Count 4	Date of Count 4
1	0	4/1/2008	0	4/29/2008	N/A	N/A	N/A	N/A
2	0	4/1/2008	0	4/20/2008	0	4/29/2008	N/A	N/A
3	0	4/29/2008	0	5/5/2008	0	5/8/2008	N/A	N/A
5	0	4/7/2008	0	5/8/2008	N/A	N/A	N/A	N/A
6	0	4/1/2008	0	4/29/2008	0	5/5/2008	N/A	N/A
7 or 9	7	4/1/2008	5	4/29/2008	0	5/5/2008	N/A	N/A
8	0	4/1/2008	0	4/29/2008	0	5/5/2008	N/A	N/A
10	0	4/23/2008	0	4/29/2008	0	5/5/2008	0	5/8/2008
11	0	4/23/2008	0	4/29/2008	0	5/5/2008	0	5/8/2008
12	0	4/23/2008	0	4/29/2008	0	5/5/2008	5	5/8/2008
13	0	4/29/2008	0	5/5/2008	0	5/8/2008	N/A	N/A
14	0	4/29/2008	0	5/5/2008	0	5/8/2008	N/A	N/A

N/A = Not applicable, no surveys were performed

Table 2. Lek survey results at the Cedar Creek from 2006, 2007, and 2008.

Lek ID	Active in 2006?	Max Number Observed	Active in 2007?	Max Number Observed	Active in 2008?	Max Number Observed
1	Yes	6	Yes	3	No	0
2 ¹	Yes	9	Yes	8	No	0
3	Yes	9	Yes	Active, but no count	No	0
5 ¹	Yes ³	? - CDOW Data	No	0	No	0
6	Yes ³	? - CDOW Data	Not Surveyed	Not Surveyed	No	0
7 or 9 ²	Yes ³	? - CDOW Data	Yes	7 or 14	Yes	7
8	Yes ³	? - CDOW Data	Not Surveyed	Not Surveyed	No	0
10	Yes ³	? - CDOW Data	Yes	2	No	0
11	Yes ³	? - CDOW Data	Yes	2	No	0
12	Yes ³	? - CDOW Data	Yes	2	Yes	5
13	Yes ³	? - CDOW Data	Not Surveyed	Not Surveyed	No	0
14	Yes ³	? - CDOW Data	Not Surveyed	Not Surveyed	No	0

¹ Lek Number 5 was reported by the CDOW. However, the position accuracy of the location could not be verified.

Based on the proximity to Lek 2, we assume that leks 2 and 5 were the same lek location.

² Lek locations reported by the CDOW. Due to proximity of two leks, we could not distinguish between the two.

³ Active lek locations were reported to WEST by the CDOW in 2007. However, count data were not provided.

Table 3. Approximate distances of lek locations to nearest turbine during 2008 surveys at the Cedar Creek.

Lek	Turbine	Distance (m)
STGR1	B9	355.48
STGR2	E9	662.24
STGR3	A10	1,012.02
STGR5	E8	170.62
STGR6	B20	790.68
STGR7	D0	1,422.06
STGR8	B14	803.33
STGR9	B13	1,507.81
STGR10	G1	844.99
STGR11	G1	1,377.47
STGR12	G1	2,722.60
STGR13	A1	2,168.33
STGR14	A1	5,180.90

Table 4. Raptor nests recorded within an approximate quarter-mile of turbine locations during 2006 surveys at the Cedar Creek .

Species			
Observed in 2006	Active	Inactive	Total
burrowing owl	1	0	1
ferruginous hawk	7	4	11
great-horned owl	1	0	1
golden eagle	2	1	3
American kestrel	1	0	1
prairie falcon	10	0	10
red-tailed hawk	5	0	5
Swainson's hawk	8	0	8
unknown	0	34	34
Total	35	39	74

Table 5. Raptor nests recorded within an approximate half-mile of turbine locations during 2008 surveys at Cedar Creek

Species Observed in 2008	Active	Gone	Inactive	Not Checked	Not Found	Total
burrowing owl	2	0	0	0	0	2
ferruginous hawk	6	0	6	1	0	13
great-horned owl	1	0	0	0	0	1
golden eagle	2	0	2	0	0	4
American kestrel	1	0	0	0	1	2
prairie falcon	8	0	1	2	0	11
red-tailed hawk	6	0	0	1	0	7
Swainson's hawk	6	1	1	1	0	9
unknown		3	33	3	0	39
Grand Total	32	4	43	8	1	88

Table 6. Results of productivity surveys during June 2008 surveys at 28 raptor nests at Cedar Creek.

Observation Number	2008 Species	Date of Productivity Check	Number of Young Present	Productivity Check Notes
65n	burrowing owl	6/18/2008	unknown	1 adult seen
88n	ferruginous hawk	6/9/2008	2	Active
20n	ferruginous hawk	6/10/2008	0	No birds observed
32n	ferruginous hawk	6/10/2008	0	No birds observed
87n	ferruginous hawk	6/17/2008	3	Nest active and in good condition with 3 chicks close to fledging
77n	ferruginous hawk	6/18/2008	0	Nest in good condition, no birds seen
48n	ferruginous hawk	6/20/2008	2	Nest active and in good condition, 2 juveniles seen
51n	ferruginous hawk	6/20/2008	0	No birds observed
81n	ferruginous hawk	6/17/2008, 6/27/2008	0,0	Nest active on 6/17/08; nest fallen out of tree on 6/27/2008
60n	great-horned owl	6/21/2008	0	No birds observed
J12	golden eagle	6/3/2008	1	One young observed
69n	American kestrel	6/21/2008	Unknown	Nest could not be found, no birds seen
28n	prairie falcon	6/9/2008	0	No birds observed
41n	prairie falcon	6/9/2008	At least 1	Active
17n	prairie falcon	6/10/2008	0	No birds observed
30n	prairie falcon	6/10/2008	0	No birds observed
89n	prairie falcon	6/10/2008	U	Active
14n	prairie falcon	6/20/2008	2	Nest active and in good condition, 2 juveniles seen
49n	prairie falcon	6/20/2008	3	Nest active and in good condition, 3 juveniles seen
39n	red-tailed hawk	6/3/2008	0	No birds observed
2n	red-tailed hawk	6/9/2008	0	No birds observed
45n	red-tailed hawk	6/9/2008	unknown	Adults defended vigorously, did not obtain good view of nest
4n	red-tailed hawk	6/9/2008	at least 1	Active
80n	red-tailed hawk	6/17/2008	0	Nest inactive, but in good condition, no birds seen
50n	red-tailed hawk	6/20/2008	2	Nest active and in good condition, 2 juveniles seen
75n	Swainson's hawk	6/17/2008	unknown	Nest active and in good condition, 2 adults in the area

Table 6. Results of productivity surveys during June 2008 surveys at 28 raptor nests at Cedar Creek.

Observation Number	2008 Species	Date of Productivity Check	Number of Young Present	Productivity Check Notes
85n	Swainson's hawk	6/17/2008	0	Nest inactive and in fair condition, no birds seen
76n	Swainson's hawk	6/19/2008	0	Nest inactive and in fair condition, no birds seen

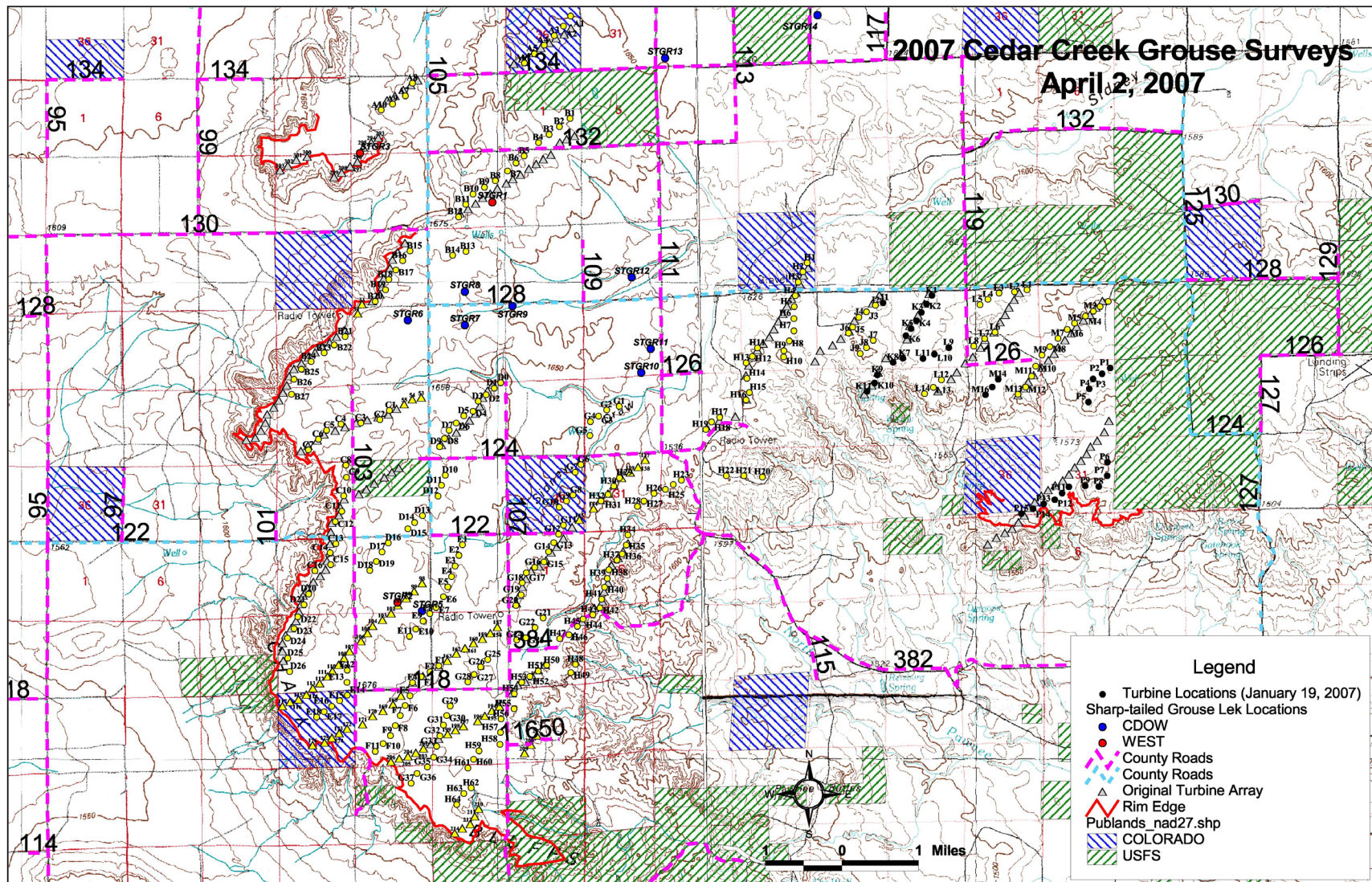


Figure 1. 2007 and 2008 survey routes for sharp-tailed grouse leks at the Cedar Creek Wind-Energy Facility. Survey routes are highlighted in yellow.