APPENDIX E

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Avian Baseline Studies for the Chokecherry-Sierra Madre Wind Resource Area Carbon County, Wyoming

Final Report
June 26, 2008 – June 16, 2009

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EXECUTIVE SUMMARY

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming, capable of producing 2,000 megawatts of energy with 1,000 wind turbines. To assist with preparing an Environmental Impact Statement for the proposed facility, AECOM contracted Western Ecosystems Technology, Inc. to conduct surveys and monitor wildlife resources in the Chokecherry-Sierra Madre Wind Resource Area to estimate the impacts of project construction and operations on wildlife. The following document contains results for fixed-point bird use surveys and incidental wildlife observations.

The principal objectives of the study were to (1) provide site specific bird use data that would be useful in evaluating potential impacts from the proposed wind-energy facility; (2) provide information that could be used in project planning and design of the facility to minimize impacts to birds; and (3) recommend further studies or potential mitigation measures, if warranted.

The proposed wind-energy facility is composed primarily (77%) of scrub-scrub habitat dominated by big sagebrush. The remaining areas are covered by grassland (19.3%), evergreen forest (1.4%) deciduous forest (0.7%), and emergent wetlands (0.6%), with smaller patches of open water, developed space, barren habitat, mixed forest, woody wetlands, and pastures.

The study used fixed-point bird use surveys to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors. Fixed-point surveys were conducted from June 26, 2008 through June 16, 2009 at nineteen points established throughout the Chokecherry-Sierra Madre Wind Resource Area. A total of 433 20-minute fixed-point surveys were completed and 50 bird species were identified.

A total of 2,005 individual bird observations within 1,301 separate groups were recorded during the fixed-point surveys. The most abundant large bird species recorded was the common raven (175 observations) and the most abundant small bird species was horned lark (805). A total of 230 individual raptors were recorded within the Chokecherry-Sierra Madre Wind Resource Area, representing 12 species. The most abundant raptor observed was golden eagle (69 observations).

Use by waterbirds and shorebirds was relatively low (0.10 and 0.01 birds/plot/20-minute survey, respectively) and these bird types were only observed during the spring season. Raptor use was highest during the fall (0.62 birds/plot/20-min survey) and lowest during the winter (0.17). Vultures were only recorded during the fall and spring (0.01 birds/plot/20-minute survey for both seasons). Upland gamebird use, limited to greater sage-grouse, ranged from 0.09 birds/plot/20-minute survey in the winter to zero in the summer. Large corvids had the highest use in the fall (0.73 birds/plot/20-minute survey) and the lowest use in the winter (0.34). Passerine use ranged from 0.02 birds/plot/20-minute survey in winter to 5.00 in spring; however, the focus for small birds was within a 100 meter viewshed and passerine use is not directly comparable to the other bird types, which were recorded out to 800 m.

During the study, 311 single or groups of large birds totaling 467 individuals were observed flying during fixed-point bird use surveys. For all large bird species combined, 67.0% of birds were observed flying below the likely zone of risk, 29.3% were within the zone of risk, and 3.6%

were observed flying above the zone of risk for typical turbines that could be used in the Chokecherry-Sierra Madre Wind Resource Area. Bird types with at least 20 individuals observed flying most often observed flying within the turbine zone of risk were raptors (30.4%) and large corvids (24.8%). A total of 1,046 passerines and other small birds in 596 groups were recorded flying within 100 meters of the survey plots in the proposed wind resource area, with 99.8% flying below the zone of risk, 0.2% within the zone of risk, and none observed above the zone of risk.

For large bird species with at least 25 separate groups of flying birds, golden eagles were observed most often within the zone of risk (45.0%) based on initial observations. Based on the use (measure of abundance) of the study area by each species and the flight characteristics observed for that species, the common raven had the highest probability of turbine exposure, with an exposure index of 0.09. The raptor species with the highest exposure index was the golden eagle, which was ranked second of all species at 0.06. All other raptor species had an exposure index of 0.02 or less. For passerines and other small birds, the species with the highest exposure index was horned lark, though its exposure index was less than 0.01.

Levels of bird use varied within the study area by point. For all large bird species combined, use was highest at point 12, with 3.18 birds/20-minute survey. The higher mean use at point 12 was due mostly to high use by large corvids at this point (2.50 birds/20-minute survey). Use at the other points ranged from 0.32 to 2.55 birds/20-minute survey for large bird species. Waterbird use was highest at point 16, with 0.67 birds/20-minute survey, and mean shorebird use was only recorded at point 17, with 0.17 birds/20-minute survey. Raptor use was highest at point four (0.93 birds/20-minute survey), and ranged from 0.10 to 0.83 birds/20-minute survey at other points. Vultures were only seen at points six and eleven (0.03 and 0.04 birds/20-minute survey, respectively) and upland gamebird use was highest at point 13 (0.14 birds/20-minute survey). Passerine use, limited to birds observed within 100 meters of the survey point, was highest at point 13, with 5.10 birds/20-minute survey, and ranged from 1.81 to 4.70 at the other points.

No obvious flyways or concentration areas were observed. No strong association with topographic features within the study area was noted for raptors or other large birds. Although some differences in bird use were detected among survey points, the differences are not large enough to suggest that any portions of the Chokecherry-Sierra Madre Wind Resource Area should be avoided when siting turbines due to very high bird use.

The objective of incidental wildlife observations was to provide a record of wildlife seen outside of the standardized surveys. There were 12 bird species observed incidentally, totaling 270 individuals within 157 separate groups during the study. The most abundant large bird species recorded incidentally were greater sage-grouse (123 individuals), golden eagle (52 observations), and northern harrier (38 observations). Three bird species were only observed incidentally and were not observed during fixed-point surveys. Four mammal species totaling 3,083 individuals in 304 groups were also observed incidentally at the CSMWRA. The most commonly recorded mammal species was pronghorn antelope with 2,879 observations in 285 groups.

Based on fixed-point bird use data collected for the Chokecherry-Sierra Madre Wind Resource Area, mean annual raptor use was 0.46 raptors/plot/20-minute survey. The annual rate was low relative to raptor use at 36 other wind-energy facilities that implemented similar protocols to the present study and had data for three or four different seasons. Mean raptor use in the Chokecherry-Sierra Madre Wind Resource Area was low compared to the other wind resource areas, ranking twenty-second among the 36 studies.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality (R^2 = 69.9%; Figure 8). Using this regression to predict raptor collision mortality at the CSMWRA, based on an adjusted mean raptor use of 0.46 raptors/plot/20-min survey, yields an estimated fatality rate of 0.04 fatalities/MW/year, or four raptor fatalities per year for each 100-MW of wind-energy development, which would equate to an estimate of 80 raptors per year for a 2,000-MW development. A 90% prediction interval around this estimate is zero to 0.30 fatalities/MW/year. Based on species composition of the most common raptor fatalities at other western wind-energy facilities and species composition of raptors observed at the Chokecherry-Sierra Madre Wind Resource Area during the surveys, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawk, American kestrel and golden eagle. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with the lowest risk in the winter, and highest risk during the fall. However, the winter use estimates were only based on three surveys that were completed prior to the area becoming inaccessible due to snow. Therefore, winter use as based on these three surveys may not be representative of actual use throughout the entire winter, but is the best data available for predicting winter use of the study area by raptors.

Some species considered to be sensitive or of conservation concern were observed within the Chokecherry-Sierra Madre Wind Resource Area. During all surveys and incidental observations, one petitioned species, the greater sage-grouse, was recorded within the proposed wind resource area. Furthermore, 10 other bird species and one mammal species classified by the Wyoming Game and Fish Department as Native Species Status 2, 3, or 4 were also recorded during fixed-point bird use surveys or as incidental wildlife observations. A total of 538 individual birds in 293 groups, representing 11 sensitive bird species, and five white-tailed prairie dogs in one group were recorded. This is a tally that in some cases may represent repeated observations of the same individual. Some potential exists for wind turbines to displace these species within the study area. Research concerning displacement impacts of wind-energy facilities is limited, but some show the potential for small scale displacement of 180 meters (591 feet) or less for small birds, while impacts to densities of small birds at larger scales have not been shown.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming (Figures 1 and 2), capable of producing 2,000 megawatts (MW) of energy with 1,000 wind turbines. To assist with preparing an Environmental Impact Statement for the proposed facility, AECOM contracted Western Ecosystems Technology, Inc. to conduct surveys and monitor wildlife resources in the Chokecherry-Sierra Madre Wind Resource Area (CSMWRA) to estimate the impacts of project construction and operations on wildlife.

The principal objectives of the study were to (1) provide site specific bird use data that would be useful in evaluating potential impacts from the proposed wind-energy facility; (2) provide information that could be used in project planning and design of the facility to minimize impacts to birds; and (3) recommend further studies or potential mitigation measures, if warranted. The protocols for the baseline studies are similar to those used at other wind-energy facilities across the nation, and follow the guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999). The protocols have been developed based on WEST's experience studying wildlife at proposed wind-energy facilities throughout the US; and were designed to help predict potential impacts to bird species (particularly raptors).

Baseline surveys, conducted from June 26, 2008 through June 16, 2009 at the CSMWRA, included fixed-point bird use surveys and incidental observations. Sensitive species of wildlife observed during either the fixed-point surveys or observed incidentally were also recorded. In addition to site-specific data, this report presents existing information and results of studies conducted at other wind-energy facilities. The ability to estimate potential bird mortality at the proposed CSMWRA is greatly enhanced by operational monitoring data collected at existing wind-energy facilities. For several wind-energy facilities, standardized data on fixed-point surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The proposed CSMWRA is located in Carbon County (Figure 1) approximately four miles (6.4 kilometers [km]) south of Rawlins, Wyoming, within T 16 N – T 18N, R 88 W – R 89W and T 19 N – T21N, R 85 W – R 88W. The CSMWRA is comprised of two portions, the Chokecherry Wind Resource Area (WRA) to the north and the Sierra Madre WRA to the south. Approximately 77% of the study area is covered by scrub-scrub habitat, which is dominated primarily by big sagebrush (*Artemisia tridentata*). The remaining areas are covered by grassland (19.3%), evergreen forest (1.4%) deciduous forest (0.7%), and emergent wetlands (0.6%), with smaller patches of open water, developed space, barren habitat, mixed forest, woody wetlands, and pastures (Table 1; Figure 3).

Topography in the Chokecherry WRA is rolling hills throughout much of the Chokecherry WRA, with topography becoming more varied in the southern portion (Figure 2). A distinct rim with a steep cliff face dominates the southern boundary of the Chokecherry WRA. The general land practice is cattle grazing.

The Sierra Madre WRA is dominated by sagebrush steppe with pockets of quaking aspen (*Populus tremuloides*). Topography in the Sierra Madre WRA ranges from gently rolling plains in the northern portion to rolling hills in the southern portion (Figure 2). The escarpment of Miller Hill dominates the northern boundary of the Sierra Madre WRA. Drainages in the southern portion are dominated by willow (*Salix* spp.) and the general land practice is also cattle grazing.

METHODS

Fixed-Point Bird Use Surveys

Fixed-point bird use surveys were used to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors, defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). The points were selected to survey representative habitats and topography of the study area, while providing relatively even coverage. All birds seen during each 20-minute (min) fixed-point survey were recorded.

Bird Use Survey Plots

At the start of the study, 16 points were selected to achieve relatively even coverage of the study area and survey representative habitats and topography within the study area. Due to snow conditions which prevented access to much of the study area, three additional points were added north of the Sierra Madre WRA in the spring, for a total of 19 points (Figure 4). Each survey plot was a variable circular plot, and all birds seen during each survey were recorded. Using this method, all birds that are seen or heard are recorded and later analysis can truncate observations to set distances (Reynolds et al. 1980).

Bird Survey Methods

All species of birds observed during fixed-point surveys were recorded. Observations of large birds beyond 800 m (2,625 feet [ft]) were recorded, but were not included in the statistical analyses; for small birds observations beyond a 100-m (328 ft) radius were excluded. A unique observation number was assigned to each observation.

The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, and cloud cover were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. The behavior of each bird observed, and the vegetation type in which or over which the bird occurred, were recorded based on the point of first observation. Approximate flight height and flight direction at first observation were recorded to the nearest 5-m (16-ft) interval. Other information recorded included whether or not the observation was auditory only and in which of the two 10-min intervals of the 20-min survey it was first observed.

Locations of raptors, other large birds, and species of concern seen during fixed-point bird use surveys were recorded on field maps by observation number. Flight paths and perch locations were digitized using ArcGIS 9.3. Any comments were recorded in the comments section of the data sheet. Any wildlife observations were recorded on the incidental datasheets.

Observation Schedule
Sampling intensity was designed to document bird use and behavior by habitat and season within the study area. Fixed-point surveys were conducted from June 26, 2008, through June 16, 2009. Surveys were conducted approximately once a week during spring (March 16 to May 31) and fall (September 1 to November 15), once every two weeks during summer (June 1 to August 31), and three times during the winter (November 16 to December 31). Only three surveys were completed in winter before snow conditions made the area inaccessible. Surveys were conducted during daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed about the same number of times each season. The three additional points (points 17, 18, and 19) were added during spring surveys because winter snows made much of the CCWRA inaccessible. The purpose of surveying at these three points was to capture south to north migration through the study area.

Incidental Wildlife Observations

Incidental wildlife observations provided a record of wildlife seen outside of the standardized surveys. All raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and, in the case of sensitive species, the Universal Transverse Mercator (UTM) location was recorded with a global positioning system (GPS) unit.

Statistical Analysis

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

Data Compilation and Storage
A Microsoft® ACCESS database was used to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and

data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

Fixed-Point Bird Use Surveys

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists, with the number of observations and the number of groups, were generated by season, including all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/plot/20-min survey). Bird diversity and species richness were compared between seasons for fixed-point bird use surveys.

Bird Use, Composition, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, only observations of large birds detected within the 800-m radius plot were used; small bird observations were limited to 100 m. Estimates of mean bird use (i.e., number of birds/plot/20-min survey) were used to compare differences between bird types, seasons, and other wind-energy facilities. Two different viewsheds were utilized when calculating the various statistics such as species richness, use, percent composition, percent frequency, and exposure index; a circle with a radius of 800 m for large birds and 100 m for small birds.

The frequency of occurrence was calculated as the percent of surveys in which a particular species or bird type was observed. Percent composition was calculated as the proportion of the overall mean use for a particular species or bird type. Frequency of occurrence and percent composition provide relative estimates of species exposure to the proposed wind-energy facility. For example, a species may have high use estimates for an area based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys and therefore, the species may be less likely affected by the wind energy development.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the likely "zone of risk" (ZOR) for collision with turbine blades of 35 m to 130 m (114 – 427 ft) above ground level (AGL), which is the blade height of typical turbines that could be used at the CSMWRA.

Bird Exposure Index

A relative index of collision exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

Where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys, P_f equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely ZOR.

This index is only based on initial flight height observations and relative abundance (defined as the use estimate) and does not account for other possible collision risk factors such as foraging or courtship behavior.

Spatial Use

Data were analyzed by comparing use among plots. Mapped flight paths were qualitatively compared to study area features such as topographic features. The objective of mapping observed bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns within the study area. This information can be useful in turbine layout design or adjustments of individual turbines for micro-siting.

RESULTS

Fifty-three bird species and four mammal species were identified during surveys completed at the CSMWRA. Results of the fixed-point surveys and incidental wildlife observations, and the specific numbers of unique species for each survey type, are discussed in the sections below.

Fixed-Point Bird Use Surveys

Bird Diversity and Species Richness

A total of 433 20-minute fixed-point surveys were conducted at the CSMWRA (Table 2). Fifty unique species were observed over the course of all fixed-point bird use surveys. More unique species were observed during the spring (36 species) and summer (32) than in the fall (25) and winter (six). Mean use was 0.63 birds/plot/20-min survey for large bird species and 1.19 birds/100-m plot/20-min survey for small bird species (Table 2). The mean number of species per plot per survey for large birds was higher in the fall (0.81 species/800-m plot/20-min survey) compared to spring (0.61), summer (0.60), and winter (0.40). For small birds, the mean number of species per plot per survey was higher in the summer (2.05 species/100-m plot/20-min survey) and spring (1.62), compared to the fall (0.43) and winter (0.02; Table 2).

A total of 2,005 individual bird observations within 1,301 separate groups were recorded during the fixed-point surveys (Table 3). One species, horned lark (*Eremophila alpestris*), composed 40.1% of all bird observations. All other species comprised less than 10% of the total observations. The most abundant large bird species recorded was the common raven (*Corvus corax;* 175 observations). A total of 230 individual raptors were recorded within the CSMWRA, representing 12 species (Table 3). The most abundant raptor observed was golden eagle (*Aquila chrysaetos*; 69 observations).

Bird Use, Composition, and Frequency of Occurrence by Season

Mean bird use, percent composition, and frequency of occurrence by season were calculated (Tables 4a and 4b). The highest overall large bird use occurred in the fall (1.37 birds/plot/20-min survey), followed by the summer (1.08), spring (0.98), and winter (0.60; Table 4a). For all small birds, use was highest in the spring (5.00 birds/plot/20-min survey), followed by the summer (4.18), fall (1.57), and winter (0.02; Table 4b).

Waterbirds

Waterbirds were only observed during the spring season (Table 4a), with a mean use of 0.10 birds/plot/20-min survey. Waterbirds accounted for 10.5% of all bird use during the spring and the frequency of occurrence was relatively low (1.4% of spring surveys; Table 4a). The only waterbird species observed were American white pelican (*Pelecanus erythrorhyncos*) and great blue heron (*Ardea herodias*).

Shorebirds

Shorebirds were also only observed during the spring season (Table 4a), with a use of 0.01 birds/plot/20-min survey. Shorebirds accounted for less than 1% of overall bird composition during the spring, and were recorded during less than 1% of spring surveys (Table 4a). The only shorebird species observed was killdeer (*Charadrius vociferous*).

Raptors

Raptor use was highest in the fall (0.62 birds/plot/20-min survey), followed by summer (0.58), spring (0.35) and winter (0.17; Table 4a). Higher use in the summer and spring was primarily due to high use of the area by American kestrels (*Falco sparverius*; 0.18 and 0.12 birds/plot/20-min survey, respectively). Higher use in the fall and winter was primarily due to use of the area by golden eagles (0.25 and 0.14 birds/plot/20-min survey, respectively). Raptors comprised 53.1% of overall bird use during the summer, 45.2% during the fall, 36.1% during the spring, and 27.9% during the winter. Raptors were observed during 37.2% of summer surveys, 36.8% of fall surveys, 28.6% of spring surveys, and 16.7% of winter surveys (Table 4a).

Vultures

Vultures, limited to turkey vulture (*Cathartes aura*), were only recorded during the fall and spring (0.01 birds/plot/20-min survey for both seasons; Table 4a). Vultures accounted for less than 1% of overall bird use and were recorded during less than 1% of all surveys during both seasons (Table 4a).

Upland Gamebirds

Upland gamebird use, limited to greater sage-grouse (*Centrocercus urophasianus*) was highest during the winter (0.09 birds/plot/20-min survey) compared to the spring (0.06), fall (0.01), and summer (0; Table 4a). Greater sage-grouse accounted for 15.1% of all bird use during the winter, 5.9% in the spring, and 1.1% in the fall. Greater sage-grouse were recorded during 5.8% of spring surveys, 4.9% winter surveys, and less than 1% of fall surveys (Table 4a).

Large Corvids

Large corvids, consisting of American crow (*Corvus brachyrhynchos*), black-billed magpie (*Pica pica*), and common raven, had the highest use in the fall (0.73 birds/plot/20-min survey), followed by spring (0.45), summer (0.44) and winter (0.34; Table 4a). Large corvids accounted for 57.0% of all bird use during the winter, 53.2% in the fall, 45.9% in the spring, and 40.5% in the summer. Large corvids were recorded during 29.7% of fall surveys, 20.5% of spring surveys, 16.0% of winter surveys, and 7.7% of summer surveys (Table 4a).

Passerines

A 100-m radius viewshed was used for small bird data analysis, therefore, results are not directly comparable to the other large bird types, which were recorded out to 800 m. Passerine use was highest in spring (4.97 birds/plot/20-min survey), compared to summer (4.04), winter (1.57), and fall (0.02; Table 4b). Horned lark had the highest use by any one species in all seasons (spring 3.38 birds/plot/20-min survey; summer 1.83; fall 1.15; winter 0.02). Passerines were observed during more than 80% of the surveys in the summer and spring, 29.4% of fall surveys, and only 2.1% of winter surveys (Table 4b). After horned lark (805 observations; Table 3), the most common small passerine species recorded were: vesper sparrow (*Pooecetes gramineus*; 121), Brewer's sparrow (*Euphagus cyanocephalus*: 80), western meadowlark (*Sturnella neglecta*; 69), and sage thrasher (*Oreoscoptes montanus*; 65).

Bird Flight Height and Behavior

Flight height characteristics were estimated for both bird types and bird species (Tables 5 and 6). During the study, 311 single large birds or groups totaling 467 individuals were observed flying within the 800-m radius plot (Table 5). Overall, 29.3% of large birds observed flying were recorded within the ZOR for collision with turbine blades (35 to 135 m AGL), 67.0% were below the ZOR, and 3.6% were flying above the ZOR (Table 5). More than half (61.8%) of flying raptors were observed below the ZOR, 30.4% were within the ZOR, and only 7.7% were above the ZOR. Waterbirds had the highest percentage of flying birds within the ZOR (100%), although this was only based on two groups totaling 16 individuals. Fifty percent of turkey vultures were observed flying within the ZOR, but this percentage was based on only two vultures observed flying. Raptors had the third highest percentage of birds within the ZOR, primarily due to 45.2% of eagle observations and 43.6% of buteo observations recorded at this height. Shorebirds, doves/pigeons, large corvids, and upland gamebirds were typically observed flying below the ZOR (Table 5). The majority of passerines within the 100-m plot were observed below the ZOR (99.8%), while 0.2% were recorded within the ZOR and none were recorded above the ZOR (Table 5).

Of all large bird species, five species had at least 25 groups observed flying; golden eagle was the most commonly observed species flying within the likely ZOR based on initial observations (45.0%; Table 6a). Three species were always seen flying within the likely ZOR based on initial; observations; however, these were based on only one or two observations. Of all passerine and small bird species, four species had at least 30 groups observed flying, with only one species, horned lark, recorded flying within the ZOR based on initial observations (Table 6b).

Bird Exposure Index

A relative exposure index was calculated for each bird species (Tables 6a and 6b). Common raven (0.09) and golden eagle (0.06) had exposure indices higher than any other species. All other raptor species had an exposure index of 0.02 or less (Table 6a). The passerine species with the highest exposure index was horned lark, with an index of less than 0.01 (Table 6b). All identified small birds had exposure indices of zero because they were not observed flying within the ZOR based on initial observations.

Spatial Use
For all large bird species combined, use was highest at point 12 (3.18 birds/20-min survey). Bird use at other points ranged from 0.32 to 2.55 birds/20-min survey (Figure 5). The high mean use estimate for point 12 was largely due to high use at this point by large corvids (2.50 birds/20-min survey), and use by large corvids at the remaining points ranged from zero to 1.05 birds/20-min survey. Waterbird use was highest at point 16, with 0.67 birds/20-min survey, and were only observed at one other point (point one; 0.07 birds/20-min survey). Mean shorebird use was only recorded at point 17, with 0.17 birds/20-min survey at this point. Raptor use was highest at point four (0.93 birds/20-min survey), and ranged from 0.10 to 0.83 birds/20-min survey at other points. Vultures were only seen at points six and eleven (0.03 and 0.04 birds/20-min survey, respectively). Upland gamebird use was highest at point 13 (0.14 birds/20-min survey), and ranged from zero to 0.09 bird/20-min survey at other points. Passerine use was highest at point 13 (5.10 birds/20-min survey), and ranged from 1.81 to 4.70 at other points (Figure 5).

Flight paths for waterbirds, waterfowl, shorebirds, raptors, and vultures were digitized and mapped (Figures 6a-f). No obvious flyways or concentration areas were observed for any species. The available data do not indicate that any portions of the study area warrant being excluded from development due to very high bird use.

Sensitive Species Observations
Ten sensitive bird species totaling 269 individuals in 215 groups were observed during fixed-point bird use surveys (Tables 3 and 7). As with all avian surveys, this is a tally that in some cases may represent repeated observations of the same individual. The greater sage-grouse has been petitioned for listing as a federal threatened species (ECOS 2009). A total of 28 greater sage-grouse were recorded during fixed-point bird use surveys within the CSMWRA (Table 7). The greater sage-grouse is also a Wyoming Native Species Status (NSS) 2 species. Nine other NSS2, NSS3, or NSS4 species (WGFD 2005; WYNDD 2009) were also recorded during fixed-point surveys. The most abundant sensitive species recorded during fixed-point surveys were Brewer's sparrow (80 observations), sage thrasher (65), and sage sparrow (*Amphispiza belli*; 59).

Incidental Wildlife Observations

There were 12 bird species observed incidentally, totaling 270 individuals within 157 separate groups during the study (Table 8). Four mammal species totaling 3,083 individuals in 304 groups were also observed incidentally at the CSMWRA.

Bird Observations
The most abundant bird species recorded as an incidental wildlife observation were greater sage-grouse (123 observations), golden eagle (52 observations), and northern harrier (*Circus cyaneus*; 38 observations). All other bird species recorded incidentally had less than 20 observations (Table 8). Three bird species, American goldfinch (*Carduelis tristis*), burrowing owl (*Athene cunicularia*), and snow bunting (*Plectrophenax nivalis*), were only observed incidentally and were not observed during fixed-point surveys.

Mammal Observations
The most commonly recorded mammal species in the CSMWRA was pronghorn antelope (*Antilocapra americana*) with 2,879 observations in 285 groups (Table 8). Three additional mammal species were also recorded incidentally: elk (*Cervus elephus*; 189 observations), mule deer (*Odocoileus hemionus*; 10), and white-tailed prairie dog (*Cynomys leucurus*; five).

Sensitive Species Observations
Six sensitive species totaling 146 individuals in 49 groups were recorded during incidental observations (Table 7; WGFD 2005; ECOS 2009; WYNDD 2009). A total of 123 greater sage-grouse in 29 groups were recorded incidentally within the CSMWRA. All other sensitive bird species, classified as NSS2, NSS3, or NSS4 species, had ten or fewer observations recorded. One sensitive mammal species, the white-tailed prairie dog (NSS4), was also observed incidentally, with a total of five individuals observed in one group.

DISCUSSION AND IMPACT ASSESSMENT

Bird Impacts

Direct Effects
The most probable direct impact to birds from wind-energy facilities is direct mortality or injury due to collisions with turbines or guy wires of meteorological (met) towers. Collisions may occur with resident birds foraging and flying within the study area or with migrant birds seasonally moving through the study area. Project construction could affect birds through loss of habitat, or potential fatalities from construction equipment. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance, and equipment. Potential mortality from construction equipment is expected to be very low. Equipment used in wind-energy facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality to birds from construction is most likely potential destruction of a nest for ground- and shrub-nesting species during initial site clearing.

Substantial data on bird mortality at wind-energy facilities are available from studies in California and throughout the West and Midwest. Of 841 bird fatalities reported from California studies (>70% from the Altamont Pass facility in California), about 39% were diurnal raptors, about 19% were passerines (excluding house sparrows [*Passer domesticus*] and European starlings [*Sturnus vulgaris*]), and about 12% were owls. Non-protected birds, including house sparrows, European starlings, and rock pigeons (*Columba livia*) comprised about 15% of the fatalities. Other bird types generally made up less than 10% of the fatalities (Erickson et al. 2002b). During 12 fatality monitoring studies conducted outside of California, diurnal raptor fatalities comprised about 2% of the wind-energy facility-related fatalities and raptor mortality averaged 0.03 fatalities/turbine/year. Passerines (excluding house sparrows and European starlings) were the most common collision victims, comprising about 82% of the 225 fatalities documented. For all bird species combined, estimates of the number of bird fatalities per turbine per year from individual studies ranged from zero at the Searsburg wind-energy facility in Vermont (Kerlinger 1997) and the Algona facility in Iowa (Demastes and Trainer 2000), to 7.7 at the Buffalo Mountain facility in Tennessee (Nicholson 2003). Using mortality data from a 10-year period from wind-energy facilities throughout the entire United States, the average number of bird collision fatalities is 3.1 fatalities/MW/year, or 2.3 fatalities/turbine/year (NWCC 2004).

Raptor Use and Exposure Risk

The annual mean raptor use at the CSMWRA (0.46 raptors/plot/20-min survey) was compared with other wind-energy facilities that implemented similar protocols and had data for three or four seasons. Similar studies were conducted at 36 other wind-energy facilities. The annual mean raptor use at these wind-energy facilities ranged from 0.09 to 2.34 raptors/plot/20-min survey (Figure 7). Based on the results from these wind-energy facilities, a ranking of seasonal raptor mean use was developed as: low (0 – 0.5 raptors/plot/20-min survey); low to moderate (0.5 – 1.0); moderate (1.0 – 2.0); high (2.0 – 3.0); and very high (> 3.0). Under this ranking, mean raptor use (number of raptors divided by the number of 800-m plots and the total number of surveys) at the CSMWRA is considered to be low, with the CSMWRA ranking twenty-second when compared with the 36 other wind-energy facilities (Figure 7).

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g. Altamont Pass), a review of studies at wind-energy facilities across the United States reported that only 3.2% of casualties were raptors (Erickson et al. 2001a). Indeed, although raptors occur in most areas with the potential for wind-energy development, individual species appear to differ from one another in their susceptibility to collision (NRC 2007). Results from Altamont Pass in California suggest that mortality for some species is not necessarily related to abundance (Orloff and Flannery 1992). American kestrels, red-tailed hawks (*Buteo jamaicensis*), and golden eagles were killed more often than predicted based on abundance. Thus far, only three northern harrier fatalities at existing wind-energy facilities have been reported in publicly available documents, despite the fact they are commonly observed during point counts at these facilities (Erickson et al. 2001a; Whitfield and Madders 2006). Because northern harriers often forage close to the ground, risk of collision with turbine blades is considered low for this species. Relative use by American kestrels at the High Winds facility is almost six times the use by American kestrels at the Altamont Pass facility (Kerlinger 2005). It is likely that many factors, in addition to abundance, are important in predicting raptor mortality.

Exposure indices analysis may also provide insight into what species have a higher likelihood of turbine casualties. The index considers relative probability of exposure based on abundance, proportion of daily activity spent flying, and proportion of flight height of each species within the ZOR for turbines likely to be used at the wind-energy facility. For the CSMWRA, the raptor species with the highest exposure index was the golden eagle, which was ranked second of all species, at 0.06 (Table 6a). The relatively higher exposure index for golden eagle was due to flight height data showing that 45.0% of flying observations were within the ZOR based on initial observations. The exposure index analysis is based on observations of birds during the daylight period and does not take into consideration flight behavior (e.g., during foraging or courtship) or abundance of nocturnal migrants. It also does not take into consideration habitat selection, the ability to detect and avoid turbines, and other factors that may vary among species and influence likelihood for turbine collision. For these reasons, the actual risk for some species may be lower or higher than indicated by this index. Based on species composition of the most common raptor fatalities at other western wind-energy facilities and species composition of raptors observed at the Chokecherry-Sierra Madre Wind Resource Area during the surveys, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawk, American kestrel, and golden eagle. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with the lowest risk in the winter and the highest risk during the fall. However, the winter use estimates were only based on three surveys that were completed prior to the area becoming inaccessible due to snow. Therefore, winter use as based on these three surveys may not be representative of actual use throughout the entire winter, but is the best data available for predicting winter use of the study area by raptors.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality ($R^2 = 69.9\%$; Figure 8). Using this regression to predict raptor collision mortality at the CSMWRA, based on an adjusted mean raptor use of 0.46 raptors/plot/20-min survey, yields an estimated fatality rate of 0.04 fatalities/MW/year. A 90% prediction interval around this estimate is zero to 0.30 fatalities/MW/year. The estimate of 0.04 raptor fatalities/MW/year would equate to an estimate of 80 raptor fatalities per year for a 2,000-MW development. These fatalities would be spread over several species, seasons, and between resident and migrant birds. Nevertheless, this level of fatality might result in a measurable adverse effect on the demographics of the local population of golden eagles.

Non-Raptor Use and Exposure Risk

Most bird species in the US are protected by the Migratory Bird Treaty Act (MBTA 1918). Passerines (primarily perching birds) have been the most abundant bird fatality at wind energy facilities outside California (Erickson et al. 2001a, 2002b), often comprising more than 80% of the bird fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines made up a large proportion of the birds observed during the baseline study, passerines would be expected to make up the largest proportion of fatalities at the CSMWRA. Exposure indices, based on observations within 100 m, indicate that horned lark is the most likely passerine to be exposed to collision from wind turbines at the CSMWRA (Table 6b). Most non-raptors had relatively low exposure indices due to the majority of individuals flying below the likely zone of risk. Due to the low exposure risks at CSMWRA, it is unlikely that non-raptor populations will be adversely affected by direct mortality from the operation of the wind-energy facility.

Wind-energy facilities with year-round use by water dependent species have shown the highest mortality, although the levels of waterfowl/waterbird/shorebird mortality appear insignificant compared to the use of the facilities by these groups. Of 1,033 bird carcasses collected at US wind-energy facilities, waterbirds comprised about 2%, waterfowl comprised about 3%, and shorebirds comprised less than 1% (Erickson et al. 2002b). At the Klondike, Oregon wind-energy facility, only two Canada goose (*Branta canadensis*) fatalities were documented (Johnson et al. 2003) even though 43 groups totaling 4,845 individual Canada geese were observed during pre-construction surveys (Johnson et al. 2002a). The recently constructed Top of Iowa wind-energy facility is located in cropland between three Wildlife Management Areas (WMAs) with historically high bird use, including migrant and resident waterfowl. During a recent study, approximately one million goose-use days and 120,000 duck-use days were recorded in the WMAs during the fall and early winter, and no waterfowl fatalities were documented during concurrent and standardized wind-energy facility fatality studies (Jain 2005). Similar findings were observed at the Buffalo Ridge wind-energy facility in southwestern Minnesota, which is located in an area with relatively high waterfowl/waterbird use and some shorebird use. Snow geese (*Chen caerulescens*), Canada geese, and mallards (*Anas platyrhynchos*) were the most common waterfowl observed. Three of the 55 fatalities observed during the fatality monitoring studies were waterfowl, including two mallards and one blue-winged teal (*Anas discors*). Two American coots (*Fulica americana*), one grebe, and one shorebird fatality were also found (Johnson et al. 2002b). Based on available evidence, waterfowl, waterbirds and shorebirds do not seem especially vulnerable to turbine collisions and significant impacts are not likely.

<u>Sensitive Species Use and Exposure Risk</u>

No federally-listed threatened or endangered species were observed in the CSMWRA during fixed-point bird use surveys (Table 3) or incidentally (Table 8). Thirty-five groups totaling 151 greater sage-grouse were observed (Table 7). This species has been petitioned for listing under the Endangered Species Act (ESA 1973), with a determination expected in February 2010; the greater sage-grouse is also classified by the Wyoming Game and Fish Department (WGFD) as NSS2. Ten other bird species considered sensitive (NSS) by the WGFD were also observed within the CSMWRA. Wyoming sensitive species of most concern are those classified as NSS1 or NSS2. No NSS1 bird species were observed and the only NSS2 species observed was bald eagle (*Haliaeetus leucocephalus*), with a total of six individuals recorded (Table 7). Due to very low use of the CSMWRA by bald eagle, it is unlikely that significant collision mortality would occur. Of those species classified as NSS3 or NSS4, the most frequently observed bird species were Brewer's sparrow (80 individuals), sage thrasher (65), and sage sparrow (59). As with all of the avian surveys, these are tallies that in some cases represent repeated observations of the same individuals. Brewer's sparrows, sage thrashers, and sage sparrows were never observed flying within the turbine ZOR. Therefore, significant risk of collision mortality is not expected for these species. Use of the CSMWRA by the other sensitive species recorded was relatively low and no significant direct impacts are likely to occur.

Indirect Effects

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the project facilities and suitable habitat. Some studies from wind-energy facilities in Europe consider displacement effects to have a greater impact on birds than collision mortality (Gill et al. 1996). However, one study conducted in England to assess displacement of wintering farmland birds by wind turbines located in an agricultural landscape found that only common (ring-necked) pheasants (*Phasianus colchicus*) apparently avoided turbines. The other species/bird groups examined, including granivores, red-legged partridge (*Alectoris rufa*), Eurasian skylark (*Alauda arvensis*), and corvids, showed no displacement from wind turbines. In fact, Eurasian skylarks and corvids showed increased use of areas close to turbines, possibly due to increased food resources associated with disturbed areas (Devereux et al. 2008).

The greatest concern with displacement impacts for wind-energy facilities in the US has been where these facilities have been constructed in grassland or other native habitats (Leddy et al. 1999; Mabey and Paul 2007), While Crockford (1992) suggests that disturbance appears to impact feeding, resting, and migrating birds, rather than breeding birds, results from studies at the Stateline wind-energy facility in Washington and Oregon (Erickson et al. 2004) and the Buffalo Ridge wind-energy facility in Minnesota (Johnson et al. 2000a) suggest that breeding birds are also affected by wind-facility operations.

Raptor Displacement

In addition to possible direct effects on raptors within the study area (discussed above), indirect effects caused by disturbance-type impacts, such as construction activity near an active nest or primary foraging area, also have a potential impact on raptor species. Birds displaced from wind-energy facilities might move to areas with fewer disturbances, but with lower quality habitat, with an overall effect of reducing breeding success. Most studies on raptor displacement at wind-energy facilities, however, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, 2003; Madders and Whitfield 2006). Notable exceptions to this include a study in Scotland that described territorial golden eagles avoiding the entire wind-energy facility area, except when intercepting non-territorial birds (Walker et al. 2005). A study at the Buffalo Ridge wind-energy facility in Minnesota found evidence of northern harriers avoiding turbines on both a small scale (less than 100 m from turbines) and a larger scale in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected.

The only published report of avoidance of wind turbines by nesting raptors occurred at Buffalo Ridge, Minnesota, where raptor nest density on 101 square miles (mi^2; 262 km^2) of land surrounding a wind-energy facility was 5.94 nests/39 mi^2 (5.94 nests/101 km^2), yet no nests were present in the 12 mi^2 (31 km^2) facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumes that raptor nests are uniformly distributed across the landscape, an unlikely event, and even though no nests were found, only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. At a wind-energy facility in eastern Washington, based on extensive monitoring using helicopter flights and ground observations, raptors still nested in the study area at approximately the same levels after construction, and several nests were located within 0.5 miles (0.8 km) of turbines (Erickson et al. 2004). At the Foote Creek Rim Wind-Energy Facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 miles (0.5 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl (*Bubo virginianus*) nest, and one golden eagle nest were located within one mile (1.6 km) of the wind-energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested 0.5 mile from the facility for three different years after it became operational. A Swainson’s hawk also nested within 0.25 mile (0.4 km) of a turbine string at the Klondike I wind-energy facility in Oregon after the facility was operational (Johnson et al. 2003). These observations suggest that there will be limited nesting displacement of raptors at the CSMWRA, although the creation of a buffer surrounding known nests when siting turbines will further reduce any potential disturbance impact, and perhaps reduce the risk of collisions with turbines.

Displacement of Non-Raptor Bird Species

Studies concerning displacement of non-raptor species have concentrated on grassland passerines and waterfowl/waterbirds (Winkelman 1990; Larsen and Madsen 2000; Mabey and Paul 2007). Wind-energy facility construction appears to cause small-scale local displacement of grassland passerines and is likely due to the birds avoiding turbine noise and maintenance activities.

Construction also reduces habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996; Johnson et al. 2000a). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge wind-energy facility in Minnesota, and found mean densities of 10 grassland bird species were four times higher at areas located 180 m (591 feet) from turbines than they were at grasslands nearer turbines. Johnson et al. (2000a) found reduced use of habitat by seven of 22 grassland-breeding birds following construction of the Buffalo Ridge wind energy facility in Minnesota. Results from the Stateline wind-energy facility in Oregon and Washington (Erickson et al. 2004), and the Combine Hills wind-energy facility in Oregon (Young et al. 2005), suggest a relatively small impact of the wind-energy facilities on grassland nesting passerines. Transect surveys conducted prior to and after construction of the wind-energy facilities found that grassland passerine use was significantly reduced within approximately 50 m (164 feet) of turbine strings, but areas further away from turbine strings did not have reduced bird use.

Displacement effects of wind-energy facilities on waterfowl and shorebirds appear to be mixed. Studies from the Netherlands and Denmark suggest that densities of these types of species near turbines were lower compared to densities in similar habitats away from turbines (Winkelman 1990; Pedersen and Poulsen 1991). However, a study from a facility in England, found no effect of wind turbines on populations of cormorant (*Phalacrcorax xarbo*), purple sandpipers (*Calidris maritima*), eiders (*Somateria mollissima*), or gulls, although the cormorants were temporarily displaced during construction (Lawrence et al. 2007). At the Buffalo Ridge wind-energy facility in Minnesota, the abundance of several bird types, including shorebirds and waterfowl, were found to be significantly lower at survey plots with turbines than at reference plots without turbines (Johnson et al. 2000a). The report concluded that the area of reduced use was limited primarily to those areas within 100 m of the turbines. Disturbance tends to be greatest for migrating birds while feeding and resting (Crockford 1992; NRC 2007).

Much debate has occurred recently regarding the potential impacts of wind-energy facilities on prairie grouse, including greater sage-grouse. Under a set of voluntary guidelines, the US Fish and Wildlife Service (USFWS) has taken a precautionary approach and recommends wind turbines be placed at least five miles (eight km) from known prairie grouse lek locations (USFWS 2003). The USFWS argues that because prairie grouse evolved in habitats with little vertical structure, placement of tall man-made structures, such as wind turbines, in occupied prairie grouse habitat may result in a decrease in habitat suitability (USFWS 2004). While the potential exists for wind turbines to displace greater sage-grouse from occupied habitat, well-designed studies examining the potential impacts of wind turbines on prairie grouse are currently lacking. Ongoing research conducted by Kansas State University to examine response of greater prairie-chickens (*Tympanuchus cupido*) to wind-energy development in Kansas, and by WEST, Inc. to examine response of greater sage-grouse to wind-energy development in Wyoming, will help address the potential for impacts to prairie grouse.

CONCLUSIONS AND RECOMMENDATIONS

Based on data collected during this study, raptor and all bird use of the CSMWRA is generally similar to most WRAs evaluated throughout the western and midwestern US using similar methods. Based on the results of the studies to date, bird mortality at the CSMWRA would likely be similar or lower than that documented at other wind-energy facilities located in the western and Midwestern US, where bird collision mortality has been relatively low.

Currently, few published studies are available from the western US that compare bird use to bird mortality rates. Based on research conducted at wind-energy facilities throughout the US, raptor use at the CSMWRA is generally lower than levels recorded at other wind-energy facilities. Raptor fatality rates are expected to be within the range of fatality rates observed at other facilities where raptor use levels are lower. To date, no relationships have been observed between overall use by other bird types, and fatality rates of those bird types at wind-energy facilities. However, the flight characteristics and foraging habits of some species may result in increased exposure for these species at the CSMWRA. The surveys conducted for the proposed CSMWRA also do not address the impacts of the proposed facility to nocturnal migrants, such as passerines. To date, overall fatality rates for birds (including nocturnal migrants) at wind-energy facilities have been relatively low and consistent in the West. As more research is conducted at facilities in the West, more information regarding the potential direct impacts of wind-energy facilities to bird species will be obtained.

The proposed wind-energy facility is comprised of native habitats such as scrub-shrub and grasslands (Table 1, Figure 3). Several species considered to be sensitive were observed breeding within these habitats at the CSMWRA, and some potential exists for wind turbines to displace breeding birds. Research concerning displacement impacts to passerines, waterfowl, and waterbirds associated with wind-energy facilities is limited, but some studies show the potential for small scale (200 m [656 ft] or less) displacement, while impacts to densities of birds at larger scales have not been shown.

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Table 1. The land cover types, coverage, and composition within the Chokecherry-Sierra Madre Wind Resource Area.

Habitat	Acres	% Composition
Scrub-Shrub	171,092.00	76.9
Grassland	42,948.20	19.3
Evergreen Forest	3,067.66	1.4
Deciduous Forest	1,607.75	0.7
Emergent Wetlands	1,222.09	0.6
Barren	948.87	0.4
Woody Wetlands	386.59	0.2
Developed, Open Space	385.12	0.2
Open Water	383.29	0.2
Pasture/Hay	332.81	0.2
Developed, Low Intensity	154.4	0.1
Mixed Forest	44.33	<0.1
Developed, Medium Intensity	25.25	<0.1
Developed, High Intensity	4.88	<0.1
Total	**222,603.24**	**100**

Data from the National Landcover Database (USGS NLCD 2001).

Table 2. Summary of species richness (species/plot[a]/20-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Number	# Surveys	# Unique	Species Richness	
Season	**of Visits**	**Conducted**	**Species**	**Large Birds**	**Small Birds**
Summer	9	142	32	0.60	2.05
Fall	9	142	25	0.81	0.43
Winter	3	31	6	0.40	0.02
Spring	10	118	36	0.61	1.62
Overall	**31**	**433**	**50**	**0.63**	**1.19**

[a] 800-m radius for large birds and 100-m radius for small birds.

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**0**	**0**	**0**	**0**	**0**	**0**	**2**	**16**	**2**	**16**
American white pelican	*Pelecanus erythrorhyncos*	0	0	0	0	0	0	1	14	1	14
great blue heron	*Ardea herodias*	0	0	0	0	0	0	1	2	1	2
Shorebirds		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
killdeer	*Charadrius vociferus*	0	0	0	0	0	0	1	1	1	1
Raptors		**77**	**86**	**80**	**88**	**3**	**3**	**51**	**53**	**211**	**230**
Accipiters		*0*	*0*	*5*	*5*	*0*	*0*	*1*	*1*	*6*	*6*
Cooper's hawk	*Accipiter cooperii*	0	0	2	2	0	0	0	0	2	2
sharp-shinned hawk	*Accipter striatus*	0	0	1	1	0	0	1	1	2	2
unidentified accipiter		0	0	2	2	0	0	0	0	2	2
Buteos		*23*	*26*	*20*	*21*	*1*	*1*	*11*	*12*	*55*	*60*
ferruginous hawk	*Buteo regalis*	1	1	2	2	1	1	1	1	5	5
red-tailed hawk	*Buteo jamaicensis*	14	16	6	6	0	0	7	8	27	30
rough-legged hawk	*Buteo lagopus*	0	0	9	9	0	0	2	2	11	11
Swainson's hawk	*Buteo swainsoni*	7	8	0	0	0	0	1	1	8	9
unidentified buteo		1	1	3	4	0	0	0	0	4	5
Northern Harrier		*15*	*15*	*19*	*22*	*0*	*0*	*5*	*5*	*39*	*42*
northern harrier	*Circus cyaneus*	15	15	19	22	0	0	5	5	39	42
Eagles		*17*	*19*	*33*	*37*	*2*	*2*	*13*	*14*	*65*	*72*
bald eagle	*Haliaeetus leucocephalus*	0	0	0	0	0	0	2	2	2	2
golden eagle	*Aquila chrysaetos*	17	19	32	36	2	2	11	12	62	69
unidentified eagle		0	0	1	1	0	0	0	0	1	1
Falcons		*22*	*26*	*3*	*3*	*0*	*0*	*20*	*20*	*45*	*49*
American kestrel	*Falco sparverius*	21	25	2	2	0	0	16	16	39	43
prairie falcon	*Falco mexicanus*	1	1	1	1	0	0	4	4	6	6
Other Raptors		*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
osprey	*Pandion haliaetus*	0	0	0	0	0	0	1	1	1	1

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Vultures		**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**2**
turkey vulture	*Cathartes aura*	0	0	1	1	0	0	1	1	2	2
Upland Gamebirds		**0**	**0**	**1**	**2**	**3**	**24**	**2**	**2**	**6**	**28**
greater sage grouse	*Centrocercus urophasianus*	0	0	1	2	3	24	2	2	6	28
Doves/Pigeons		**8**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**10**
mourning dove	*Zenaida macroura*	8	10	0	0	0	0	0	0	8	10
Large Corvids		**14**	**65**	**62**	**105**	**9**	**15**	**30**	**60**	**115**	**245**
American crow	*Corvus brachyrhynchos*	4	49	0	0	0	0	2	16	6	65
black-billed magpie	*Pica pica*	0	0	2	3	2	2	0	0	4	5
common raven	*Corvus corax*	10	16	60	102	7	13	28	44	105	175
Passerines		**467**	**600**	**95**	**255**	**2**	**4**	**379**	**588**	**943**	**1,447**
American robin	*Turdus migratorius*	1	1	0	0	0	0	0	0	1	1
barn swallow	*Hirundo rustica*	0	0	0	0	0	0	2	2	2	2
Brewer's blackbird	*Euphagus cyanocephalus*	8	9	0	0	0	0	2	26	10	35
Brewer's sparrow	*Spizella breweri*	51	57	5	5	0	0	14	18	70	80
Clark's nutcracker	*Nucifraga columbiana*	1	1	0	0	0	0	0	0	1	1
cliff swallow	*Petrochelidon pyrrhonota*	0	0	0	0	0	0	1	1	1	1
grasshopper sparrow	*Ammodramus savannarum*	0	0	0	0	0	0	4	4	4	4
green-tailed towhee	*Pipilo chlorurus*	1	1	0	0	0	0	0	0	1	1
horned lark	*Eremophila alpestris*	177	264	48	172	1	1	224	368	450	805
house wren	*Troglodytes aedon*	8	13	3	3	0	0	0	0	11	16
lark bunting	*Calamospiza melanocorys*	3	3	0	0	0	0	1	12	4	15
lark sparrow	*Chondestes grammacus*	0	0	2	2	0	0	0	0	2	2
Lincoln's sparrow	*Melospiza lincolnii*	0	0	0	0	0	0	2	2	2	2
loggerhead shrike	*Lanius ludovicianus*	2	2	0	0	0	0	2	2	4	4
mountain bluebird	*Sialia currucoides*	3	4	4	16	0	0	7	14	14	34
rock wren	*Salpinctes obsoletus*	7	7	0	0	0	0	4	6	11	13
sage sparrow	*Amphispiza belli*	7	7	0	0	0	0	48	52	55	59

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
sage thrasher	*Oreoscoptes montanus*	52	55	2	2	0	0	6	8	60	65
Say's phoebe	*Sayornis saya*	1	1	0	0	0	0	1	1	2	2
song sparrow	*Melospiza melodia*	0	0	2	3	0	0	0	0	2	3
Townsend's solitaire	*Myadestes townsendi*	0	0	1	1	0	0	0	0	1	1
tree swallow	*Tachycineta bicolor*	3	3	0	0	0	0	0	0	3	3
unidentified blackbird		0	0	1	4	0	0	0	0	1	4
unidentified passerine		28	43	16	30	1	3	1	6	46	82
unidentified sparrow		9	9	3	5	0	0	0	0	12	14
unidentified swallow		4	4	0	0	0	0	0	0	4	4
unidentified wren		2	2	0	0	0	0	0	0	2	2
vesper sparrow	*Pooecetes gramineus*	65	79	3	4	0	0	32	38	100	121
western kingbird	*Tyrannus verticalis*	1	1	1	1	0	0	0	0	2	2
western meadowlark	*Sturnella neglecta*	33	34	4	7	0	0	28	28	65	69
Other Birds		**10**	**22**	**0**	**0**	**0**	**0**	**3**	**4**	**13**	**26**
common nighthawk	*Chordeiles minor*	5	6	0	0	0	0	0	0	5	6
northern flicker	*Colaptes auratus*	1	1	0	0	0	0	1	1	2	2
unidentified hummingbird		2	2	0	0	0	0	0	0	2	2
white-throated swift	*Aeronautes saxatalis*	2	13	0	0	0	0	2	3	4	16
Overall		**576**	**783**	**239**	**451**	**17**	**46**	**469**	**725**	**1,301**	**2,005**

[a] Regardless of distance from observer.

Table 4a. Mean bird use (number of birds/800-plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				**% Composition**				**% Frequency**			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Waterbirds	**0**	**0**	**0**	**0.10**	**0**	**0**	**0**	**10.5**	**0**	**0**	**0**	**1.4**
American white pelican	0	0	0	0.09	0	0	0	9.0	0	0	0	0.6
great blue heron	0	0	0	0.02	0	0	0	1.6	0	0	0	0.8
Shorebirds	**0**	**0**	**0**	**0.01**	**0**	**0**	**0**	**0.8**	**0**	**0**	**0**	**0.8**
killdeer	0	0	0	0.01	0	0	0	0.8	0	0	0	0.8
Raptors	**0.58**	**0.62**	**0.17**	**0.35**	**53.1**	**45.2**	**27.9**	**36.1**	**37.2**	**36.8**	**16.7**	**28.6**
Accipiters	*0*	*0.03*	*0*	*0.01*	*0*	*2.3*	*0*	*0.6*	*0*	*2.4*	*0*	*0.6*
Cooper's hawk	0	0.01	0	0	0	0.8	0	0	0	1.0	0	0
sharp-shinned hawk	0	0.01	0	0.01	0	0.5	0	0.6	0	0.7	0	0.6
unidentified accipiter	0	0.01	0	0	0	1.0	0	0	0	1.4	0	0
Buteos	*0.18*	*0.15*	*0.03*	*0.08*	*16.8*	*11.1*	*4.7*	*8.0*	*14.1*	*8.7*	*2.8*	*7.3*
ferruginous hawk	0.01	0.01	0.03	0.01	0.7	1.0	4.7	1.5	0.7	1.4	2.8	1.4
red-tailed hawk	0.11	0.04	0	0.04	10.3	3.1	0	3.9	8.4	2.9	0	3.8
rough-legged hawk	0	0.07	0	0.02	0	4.8	0	2.0	0	5.1	0	2.0
Swainson's hawk	0.06	0	0	0.01	5.2	0	0	0.6	4.9	0	0	0.6
unidentified buteo	0.01	0.03	0	0	0.6	2.2	0	0	0.7	2.2	0	0
Northern Harrier	*0.10*	*0.16*	*0*	*0.03*	*9.0*	*11.5*	*0*	*3.3*	*8.3*	*10.1*	*0*	*2.4*
northern harrier	0.10	0.16	0	0.03	9.0	11.5	0	3.3	8.3	10.1	0	2.4
Eagles	*0.11*	*0.26*	*0.14*	*0.08*	*10.4*	*19.1*	*23.3*	*8.3*	*9.6*	*20.3*	*13.9*	*6.1*
bald eagle	0	0	0	0.01	0	0	0	1.3	0	0	0	1.3
golden eagle	0.11	0.25	0.14	0.07	10.4	18.5	23.3	7.0	9.6	19.6	13.9	5.4
unidentified eagle	0	0.01	0	0	0	0.5	0	0	0	0.7	0	0
Falcons	*0.18*	*0.02*	*0*	*0.15*	*16.8*	*1.3*	*0*	*15.2*	*14.0*	*1.8*	*0*	*13.4*
American kestrel	0.18	0.01	0	0.12	16.2	0.8	0	12.1	13.3	1.1	0	11.1
prairie falcon	0.01	0.01	0	0.03	0.6	0.5	0	3.1	0.7	0.7	0	3.0
Other Raptors	*0*	*0*	*0*	*0.01*	*0*	*0*	*0*	*0.6*	*0*	*0*	*0*	*0.6*
osprey	0	0	0	0.01	0	0	0	0.6	0	0	0	0.6

Table 4a. Mean bird use (number of birds/800-plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Vultures	**0**	**0.01**	**0**	**0.01**	**0**	**0.5**	**0**	**0.8**	**0**	**0.7**	**0**	**0.8**
turkey vulture	0	0.01	0	0.01	0	0.5	0	0.8	0	0.7	0	0.8
Upland Gamebirds	**0**	**0.01**	**0.09**	**0.06**	**0**	**1.1**	**15.1**	**5.9**	**0**	**0.7**	**4.9**	**5.8**
greater sage grouse	0	0.01	0.09	0.06	0	1.1	15.1	5.9	0	0.7	4.9	5.8
Doves/Pigeons	**0.07**	**0**	**0**	**0**	**6.4**	**0**	**0**	**0**	**4.9**	**0**	**0**	**0**
mourning dove	0.07	0	0	0	6.4	0	0	0	4.9	0	0	0
Large Corvids	**0.44**	**0.73**	**0.34**	**0.45**	**40.5**	**53.2**	**57.0**	**45.9**	**7.7**	**29.7**	**16.0**	**20.5**
black-billed magpie	0	0.02	0.05	0	0	1.7	8.1	0	0	1.5	4.9	0
common raven	0.10	0.71	0.29	0.34	9.1	51.5	48.8	35.1	5.7	29.0	13.9	19.1
American crow	0.34	0	0	0.11	31.4	0	0	10.8	2.1	0	0	1.4
Overall	**1.08**	**1.37**	**0.60**	**0.98**	**100**	**100**	**100**	**100**				

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Passerines	**4.04**	**1.57**	**0.02**	**4.97**	**96.8**	**100.0**	**100.0**	**99.5**	**83.4**	**29.4**	**2.1**	**89.2**
American robin	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
barn swallow	0	0	0	0.02	0	0	0	0.3	0	0	0	1.6
Brewer's blackbird	0.06	0	0	0.14	1.4	0	0	2.7	4.3	0	0	1.1
Brewer's sparrow	0.39	0.03	0	0.12	9.4	1.8	0	2.4	24.1	1.7	0	7.6
Clark's nutcracker	0	0	0	0	0	0	0	0	0	0	0	0
cliff swallow	0	0	0	0.01	0	0	0	0.1	0	0	0	0.5
grasshopper sparrow	0	0	0	0.03	0	0	0	0.5	0	0	0	1.9
green-tailed towhee	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
horned lark	1.83	1.15	0.02	3.38	43.7	73.1	100.0	67.6	55.6	19.8	2.1	79.2
house wren	0.09	0.02	0	0	2.2	1.3	0	0	4.2	1.4	0	0
lark bunting	0.02	0	0	0.12	0.5	0	0	2.4	2.1	0	0	1.0
lark sparrow	0	0.01	0	0	0	0.9	0	0	0	0.7	0	0
Lincoln's sparrow	0	0	0	0.01	0	0	0	0.3	0	0	0	1.3
loggerhead shrike	0.01	0	0	0.01	0.2	0	0	0.3	0.7	0	0	0.6
mountain bluebird	0.01	0.11	0	0.19	0.4	6.7	0	3.8	1.5	2.5	0	9.4
rock wren	0.05	0	0	0.05	1.2	0	0	1.1	3.6	0	0	2.6
sage sparrow	0.05	0	0	0.37	1.2	0	0	7.5	4.4	0	0	20.6
sage thrasher	0.32	0.01	0	0.06	7.6	0.9	0	1.2	27.0	1.4	0	3.9
Say's phoebe	0.01	0	0	0.01	0.2	0	0	0.2	0.7	0	0	1.0
song sparrow	0	0.02	0	0	0	1.4	0	0	0	1.4	0	0
Townsend's solitaire	0	0.01	0	0	0	0.4	0	0	0	0.7	0	0
tree swallow	0.02	0	0	0	0.5	0	0	0	2.2	0	0	0
unidentified blackbird	0	0	0	0	0	0	0	0	0	0	0	0
unidentified passerine	0.29	0.10	0	0.03	6.8	6.3	0	0.6	14.8	6.4	0	0.5
unidentified sparrow	0.06	0.04	0	0	1.4	2.2	0	0	5.7	2.1	0	0
unidentified swallow	0.03	0	0	0	0.7	0	0	0	2.8	0	0	0

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
unidentified wren	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
vesper sparrow	0.56	0.03	0	0.23	13.4	1.8	0	4.6	26.2	2.1	0	11.5
western kingbird	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
western meadowlark	0.23	0.05	0	0.19	5.4	3.2	0	3.9	17.5	2.2	0	15.4
Other Birds	**0.13**	**0**	**0**	**0.03**	**3.2**	**0**	**0**	**0.5**	**4.4**	**0**	**0**	**2.0**
common nighthawk	0.01	0	0	0	0.3	0	0	0	1.4	0	0	0
northern flicker	0.01	0	0	0.01	0.2	0	0	0.2	0.8	0	0	0.8
unidentified hummingbird	0.01	0	0	0	0.3	0	0	0	0.7	0	0	0
white-throated swift	0.10	0	0	0.02	2.3	0	0	0.4	1.5	0	0	1.3
Overall	**4.18**	**1.57**	**0.02**	**5.00**	**100**	**100**	**100**	**100**				

Table 5. Flight height characteristics by bird type during fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009. Large bird observations were limited to within 800 m and small birds were limited to within 100 m.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight Height Categories 0-35 m	35-130 m	> 130 m
Waterbirds	2	16	87.50	100	0	100	0
Shorebirds	1	1	10.00	100	100	0	0
Raptors	192	207	52.65	92.8	61.8	30.4	7.7
Accipiters	*6*	*6*	*23.33*	*100*	*66.7*	*33.3*	*0*
Buteos	*51*	*55*	*51.39*	*94.8*	*50.9*	*43.6*	*5.5*
Northern Harrier	*37*	*40*	*12.97*	*97.6*	*90.0*	*10.0*	*0*
Eagles	*57*	*62*	*106.75*	*91.2*	*35.5*	*45.2*	*19.4*
Falcons	*40*	*43*	*19.05*	*87.8*	*86.0*	*11.6*	*2.3*
Other Raptors	*1*	*1*	*20.00*	*100*	*100*	*0*	*0*
Vultures	2	2	27.50	100	50.0	50.0	0
Upland Gamebirds	4	6	2.25	75.0	100	0	0
Doves/Pigeons	4	5	4.25	50.0	100	0	0
Large Corvids	106	230	23.49	95.8	74.8	24.8	0.4
Large Birds Overall	**311**	**467**	**41.36**	**93.4**	**67.0**	**29.3**	**3.6**
Passerines	586	1,023	4.25	71.0	99.8	0.2	0
Other Birds	10	23	13.30	95.8	100	0	0
Small Birds Overall	**596**	**1,046**	**4.40**	**71.4**	**99.8**	**0.2**	**0**

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 35-130 m above ground level (AGL).

Table 6a. Relative exposure index and flight characteristics by large bird species during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
common raven	98	0.35	95.9	27.6	0.09	42.9
golden eagle	55	0.14	92.3	45.0	0.06	68.3
American crow	5	0.14	98.5	18.8	0.03	18.8
American white pelican	1	0.02	100	100	0.02	100
red-tailed hawk	25	0.06	96.4	29.6	0.02	55.6
rough-legged hawk	11	0.02	100	72.7	0.02	100
Swainson's hawk	8	0.02	100	66.7	0.01	88.9
northern harrier	37	0.08	97.6	10.0	0.01	22.5
American kestrel	34	0.09	86.0	8.1	0.01	16.2
great blue heron	1	<0.01	100	100	<0.01	100
prairie falcon	6	0.01	100	33.3	<0.01	66.7
unidentified accipiter	2	<0.01	100	100	<0.01	100
ferruginous hawk	5	0.01	100	20.0	<0.01	20.0
unidentified buteo	2	0.01	60.0	33.3	<0.01	100
turkey vulture	2	<0.01	100	50.0	<0.01	50.0
bald eagle	2	<0.01	100	50.0	<0.01	50.0
greater sage grouse	4	0.03	75.0	0	0	0
mourning dove	4	0.02	50.0	0	0	0
black-billed magpie	3	0.01	60.0	0	0	0
sharp-shinned hawk	2	<0.01	100	0	0	0
Cooper's hawk	2	<0.01	100	0	0	0
killdeer	1	<0.01	100	0	0	0
unidentified eagle	0	<0.01	0	0	0	0
osprey	1	<0.01	100	0	0	100

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 35-130 m above ground level (AGL).

Table 6b. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
horned lark	381	1.78	89.1	0.1	<0.01	1.3
unidentified passerine	38	0.12	87.8	1.4	<0.01	1.4
vesper sparrow	39	0.25	38.8	0	0	2.1
Brewer's sparrow	39	0.16	55.0	0	0	0
western meadowlark	8	0.14	13.0	0	0	0
sage thrasher	10	0.12	15.4	0	0	0
sage sparrow	12	0.12	23.7	0	0	0
mountain bluebird	10	0.08	55.9	0	0	0
Brewer's blackbird	10	0.05	100	0	0	0
lark bunting	3	0.04	93.3	0	0	0
white-throated swift	4	0.04	100	0	0	87.5
house wren	2	0.03	31.3	0	0	0
rock wren	3	0.03	30.8	0	0	0
unidentified sparrow	11	0.03	92.9	0	0	0
unidentified swallow	4	0.01	100	0	0	25.0
tree swallow	3	0.01	100	0	0	0
grasshopper sparrow	0	0.01	0	0	0	0
song sparrow	1	0.01	33.3	0	0	0
loggerhead shrike	3	0.01	100	0	0	0
Say's phoebe	2	<0.01	100	0	0	0
northern flicker	1	<0.01	50.0	0	0	0
common nighthawk	3	<0.01	100	0	0	50.0
unidentified hummingbird	2	<0.01	100	0	0	0
barn swallow	2	<0.01	100	0	0	0
lark sparrow	1	<0.01	50.0	0	0	0
Lincoln's sparrow	1	<0.01	50.0	0	0	0
American robin	1	<0.01	100	0	0	0

Table 6b. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
green-tailed towhee	0	<0.01	0	0	0	0
unidentified wren	0	<0.01	0	0	0	0
western kingbird	1	<0.01	50.0	0	0	0
Townsend's solitaire	0	<0.01	0	0	0	0
cliff swallow	1	<0.01	100	0	0	100

ZOR: The likely “zone of risk” for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 7. Summary of sensitive species observed at the Chokecherry-Sierra Madre Wind Resource Area during fixed-point bird use surveys (FP) and as incidental wildlife observations (Inc.), June 26, 2008 – June 16, 2009.

			FP		Inc.		Total	
Species	**Scientific Name**	**Status**	**# of grps**	**# of obs**	**# of grps**	**# of obs**	**# of grps**	**# of obs**
greater sage-grouse	*Centrocercus urophasianus*	NSS2, P	6	28	29	123	35	151
Brewer's sparrow	*Spizella breweri*	NSS4	70	80	0	0	70	80
sage thrasher	*Oreoscoptes montanus*	NSS4	60	65	0	0	60	65
sage sparrow	*Amphispiza belli*	NSS4	55	59	0	0	55	59
Swainson's hawk	*Buteo swainsoni*	NSS4	8	9	7	10	15	19
lark bunting	*Calamospiza melanocorys*	NSS4	4	15	0	0	4	15
ferruginous hawk	*Buteo regalis*	NSS3	5	5	8	8	13	13
bald eagle	*Haliaeetus leucocephalus*	NSS2	2	2	4	4	6	6
grasshopper sparrow	*Ammodramus savannarum*	NSS4	4	4	0	0	4	4
great blue heron	*Ardea herodias*	NSS4	1	2	0	0	1	2
burrowing owl	*Athene cunicularia*	NSS4	0	0	1	1	1	1
Bird Subtotal	**11 species**		**215**	**269**	**49**	**146**	**293**	**538**
white-tailed prairie dog	*Cynomys leucurus*	NSS4	0	0	1	5	1	5
Total	**12 species**		**215**	**269**	**50**	**151**	**294**	**543**

P= petitioned for Federal listing.
NSS1= Populations greatly restricted or declining, extirpation possible OR ongoing significant loss of habitat.
NSS2= Populations declining, extirpation possible; habitat restricted or vulnerable but no recent or ongoing significant loss; species likely sensitive to human disturbance OR populations declining or restricted in numbers or distribution, extirpation not imminent; ongoing significant loss of habitat.
NSS3= Populations greatly restricted or declining, extirpation possible; habitat not restricted, vulnerable but no loss; species not sensitive to human disturbance OR populations declining or restricted in numbers or distribution, extirpation not imminent; habitat restricted or vulnerable but no recent or ongoing significant loss; species likely sensitive to human disturbance OR species widely distributed; population status or trends unknown but suspected to be stable; on-going significant loss of habitat.
NSS4= Populations greatly restricted or declining, extirpation possible; habitat stable and not restricted OR populations declining or restricted in numbers or distribution, extirpation not imminent; habitat not restricted, vulnerable but no loss; species not sensitive to human disturbance OR species widely distributed, population status or trends unknown but suspected to be stable; habitat restricted or vulnerable but no recent or on-going significant loss; species likely sensitive to human disturbance OR populations stable or increasing and not restricted in numbers or distribution; on-going significant loss of habitat
(From Wyoming Game and Fish Department [WGFD 2005] and Wyoming's Natural Diversity Database [WYNDD 2009]).

Table 8. Incidental wildlife observed while conducting all surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	Scientific Name	#grps	# obs
American goldfinch	*Carduelis tristis*	1	1
bald eagle	*Haliaeetus leucocephalus*	4	4
burrowing owl	*Athene cunicularia*	1	1
ferruginous hawk	*Buteo regalis*	8	8
golden eagle	*Aquila chrysaetos*	44	52
greater sage-grouse	*Centrocercus urophasianus*	29	123
northern harrier	*Circus cyaneus*	34	38
prairie falcon	*Falco mexicanus*	8	8
red-tailed hawk	*Buteo jamaicensis*	14	18
rough-legged hawk	*Buteo lagopus*	6	6
snow bunting	*Plectrophenax nivalis*	1	1
Swainson's hawk	*Buteo swainsoni*	7	10
Bird Subtotal	**12 species**	**157**	**270**
elk	*Cervus elephus*	14	189
white-tailed prairie dog	*Cynomys leucurus*	1	5
mule deer	*Odocoileus hemionus*	4	10
pronghorn	*Antilocapra americana*	285	2,879
Mammal Subtotal	**4 species**	**304**	**3,083**

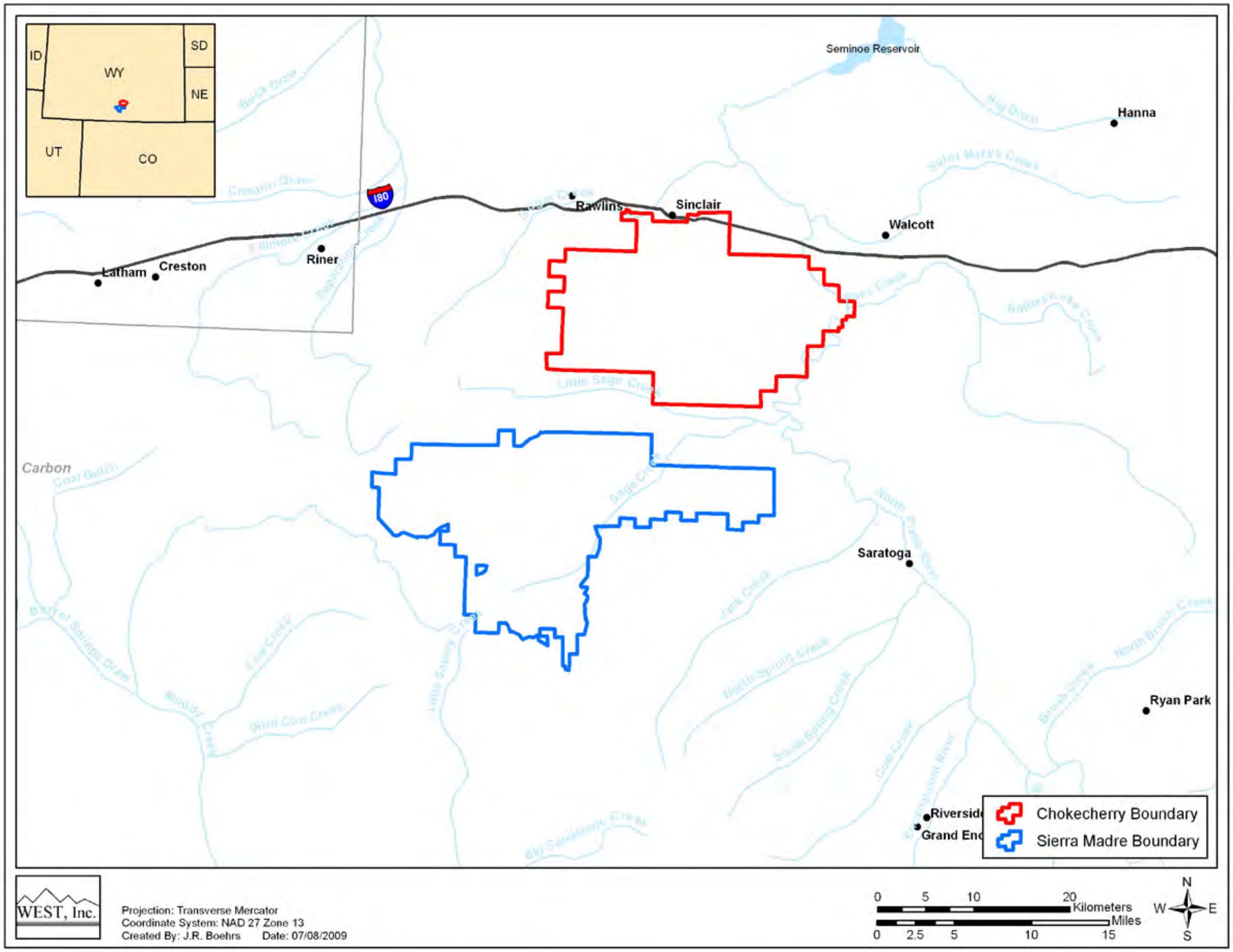


Figure 1. Location of the Chokecherry-Sierra Madre Wind Resource Areas.

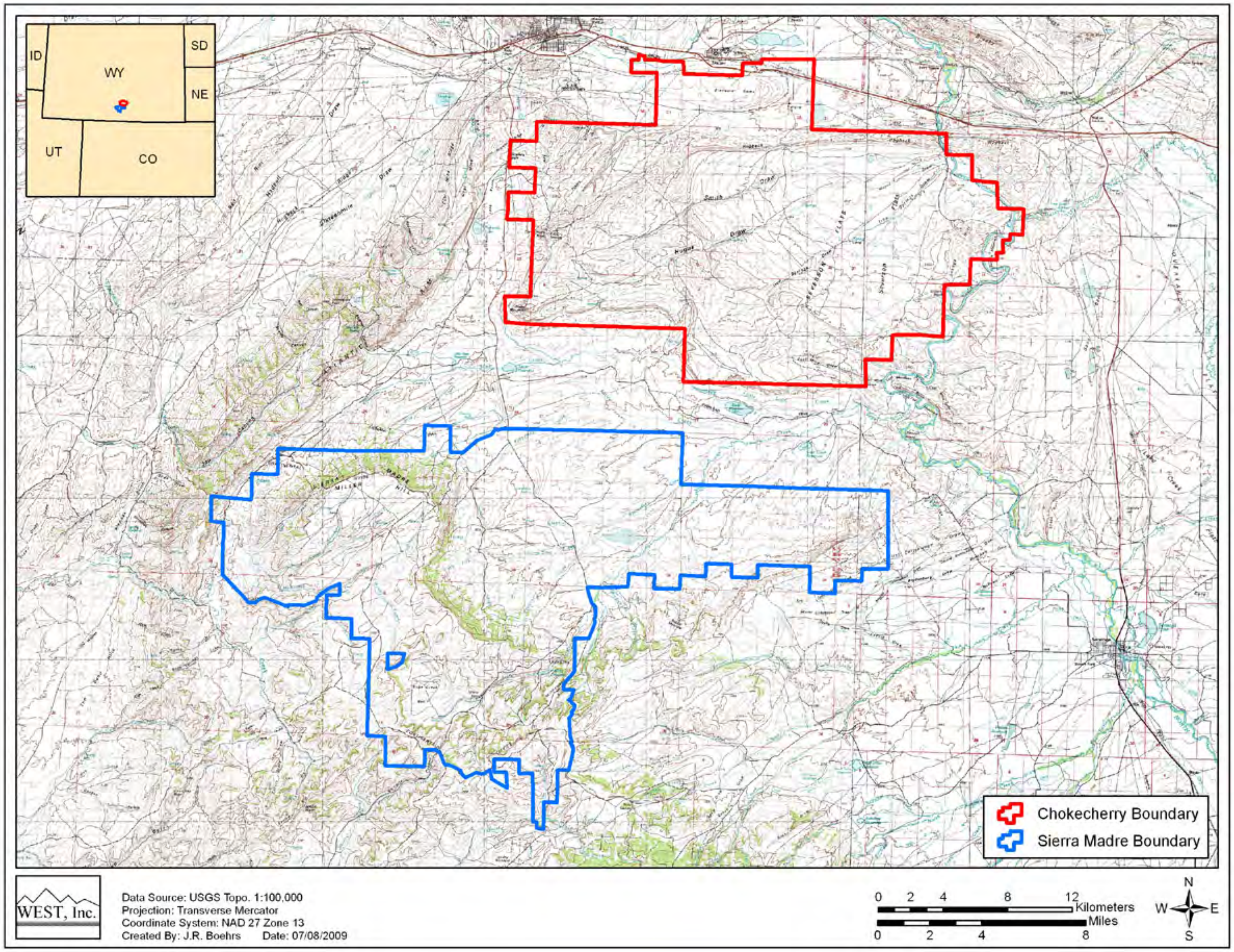


Figure 2. Elevation and topography of the Chokecherry-Sierra Madre Wind Resource Areas.

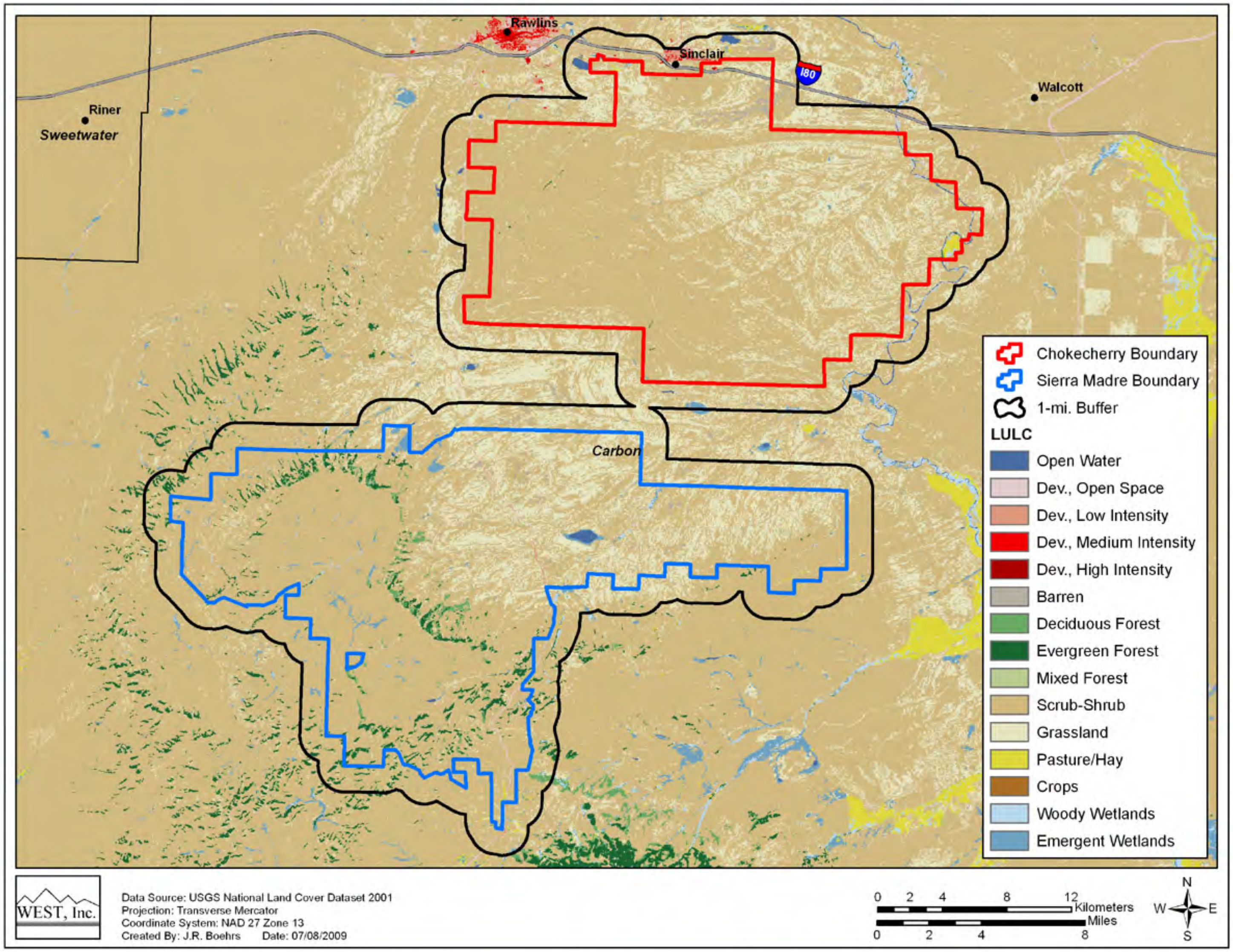


Figure 3. The land cover types and coverage within the Chokecherry-Sierra Madre Wind Resource Areas (USGS NLCD 2001).

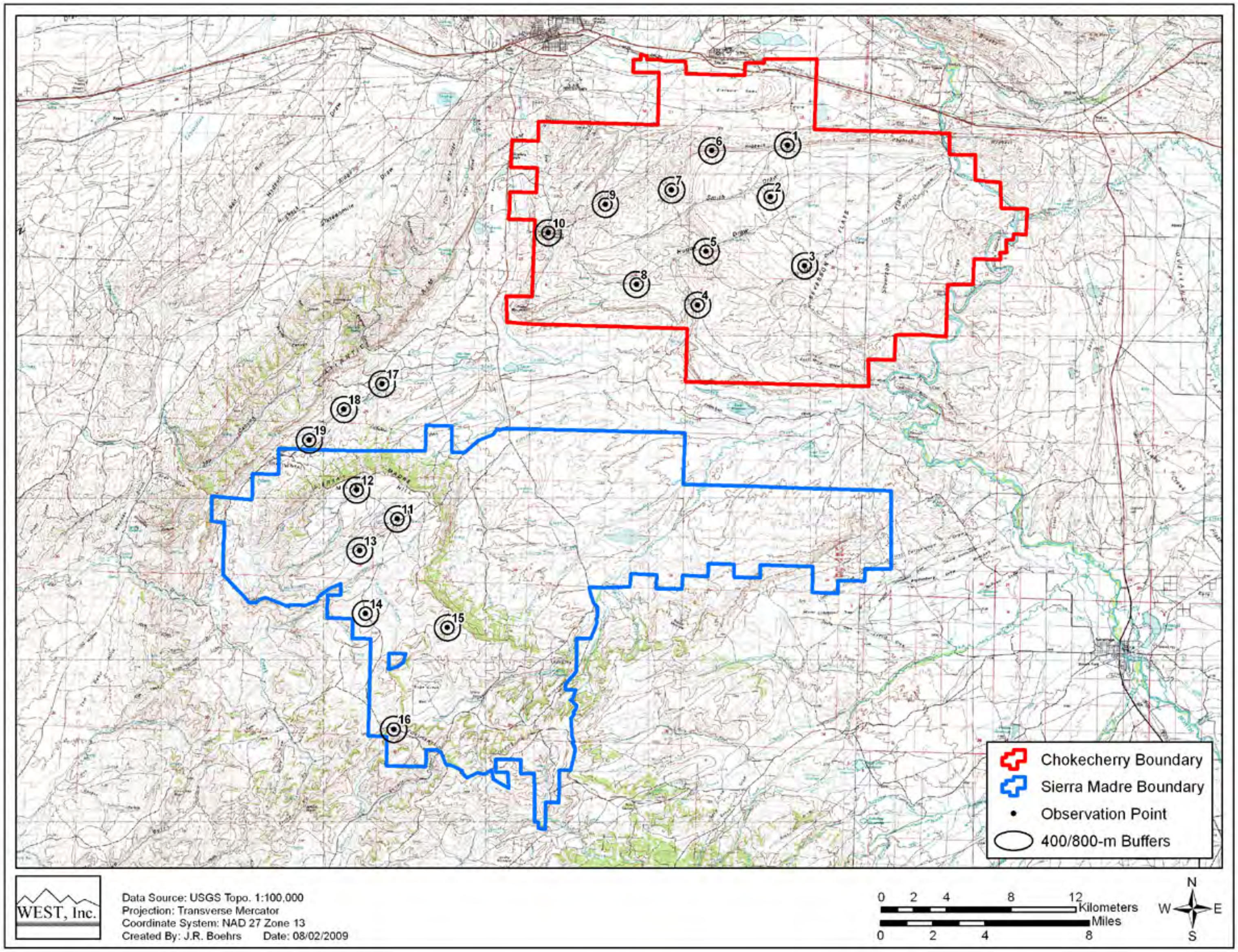


Figure 4. Fixed-point bird use survey points at the Chokecherry-Sierra Madre Wind Resource Areas.

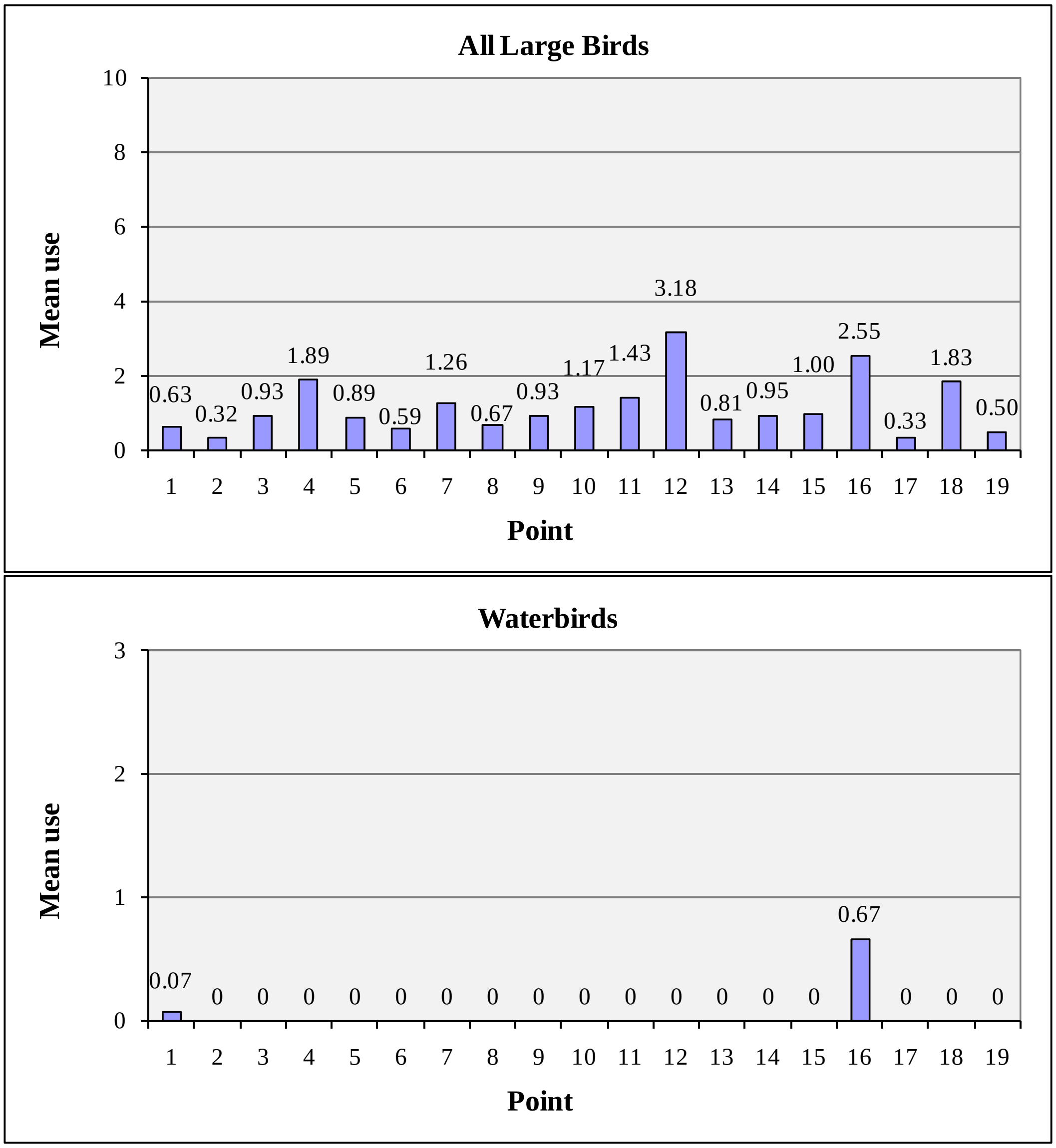
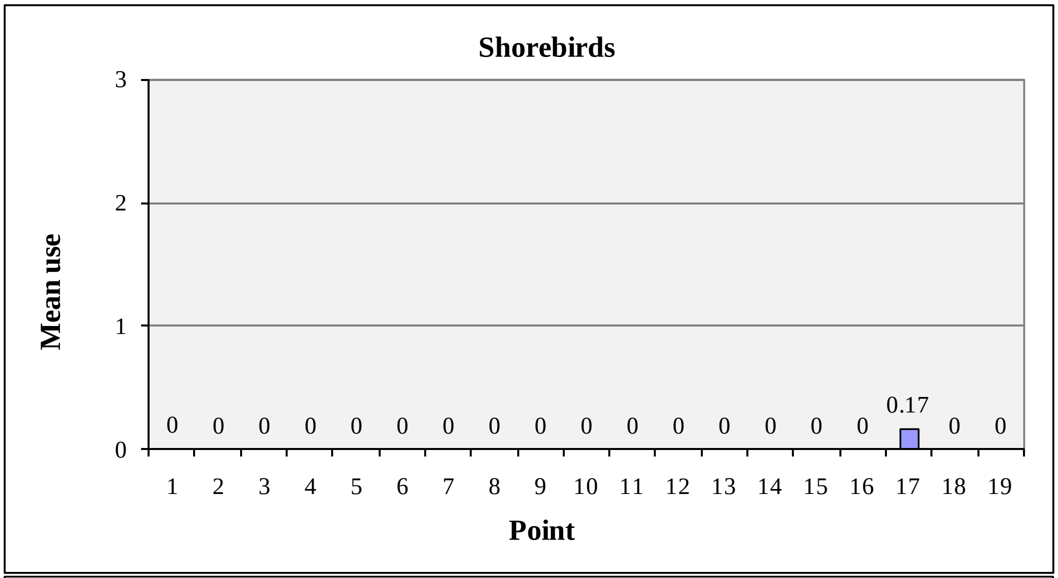


Figure 5. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



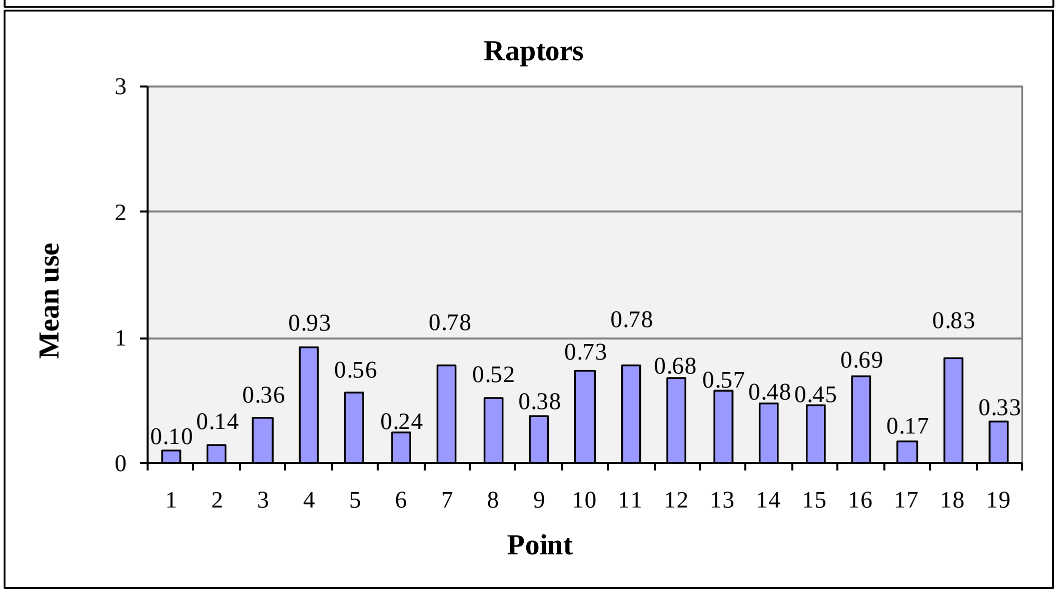
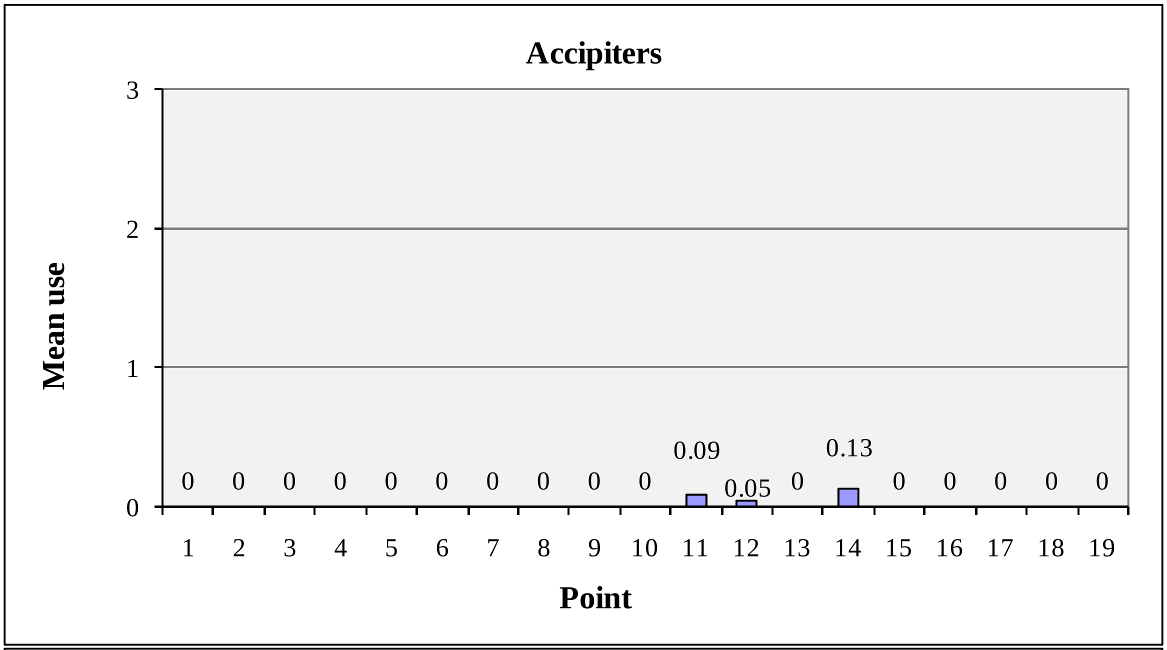


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



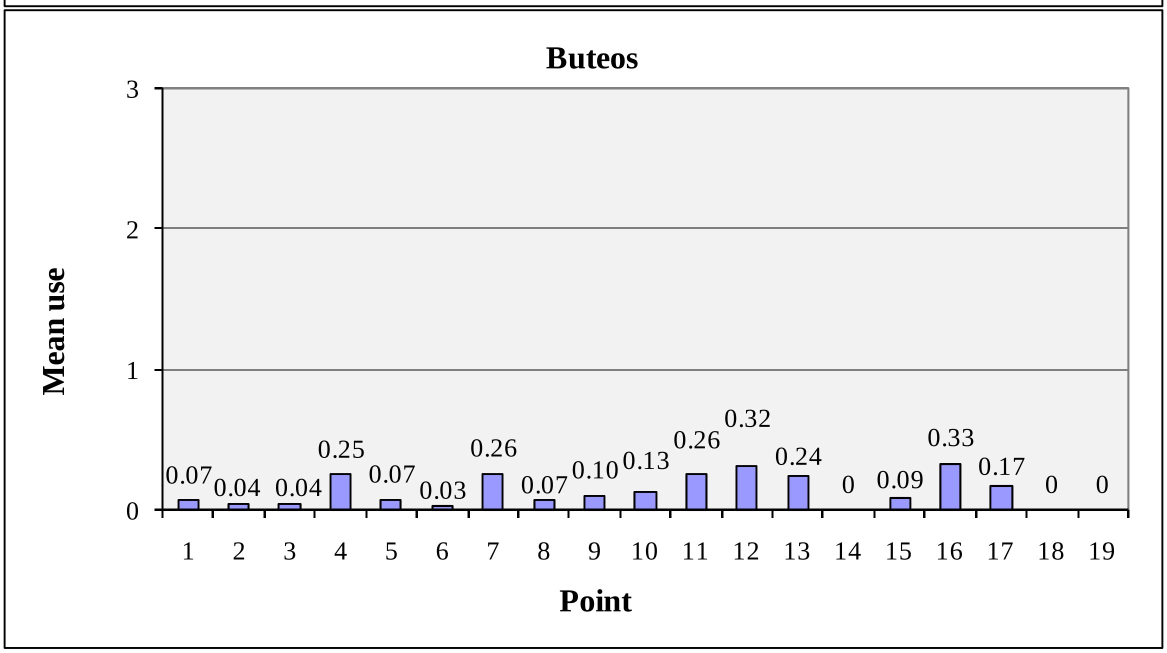
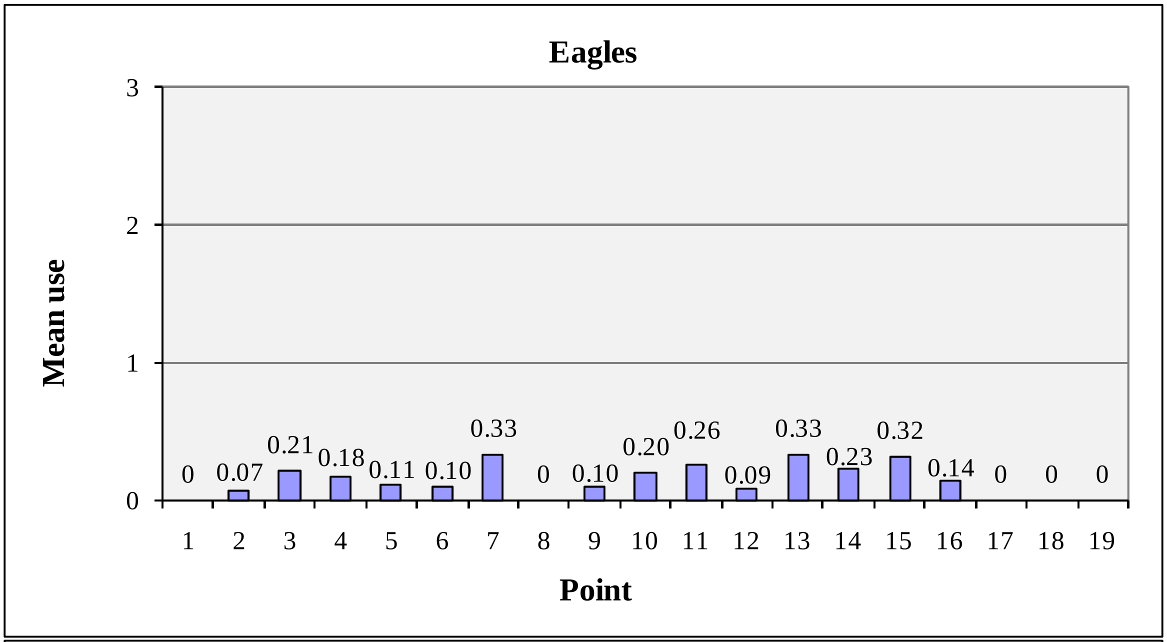


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



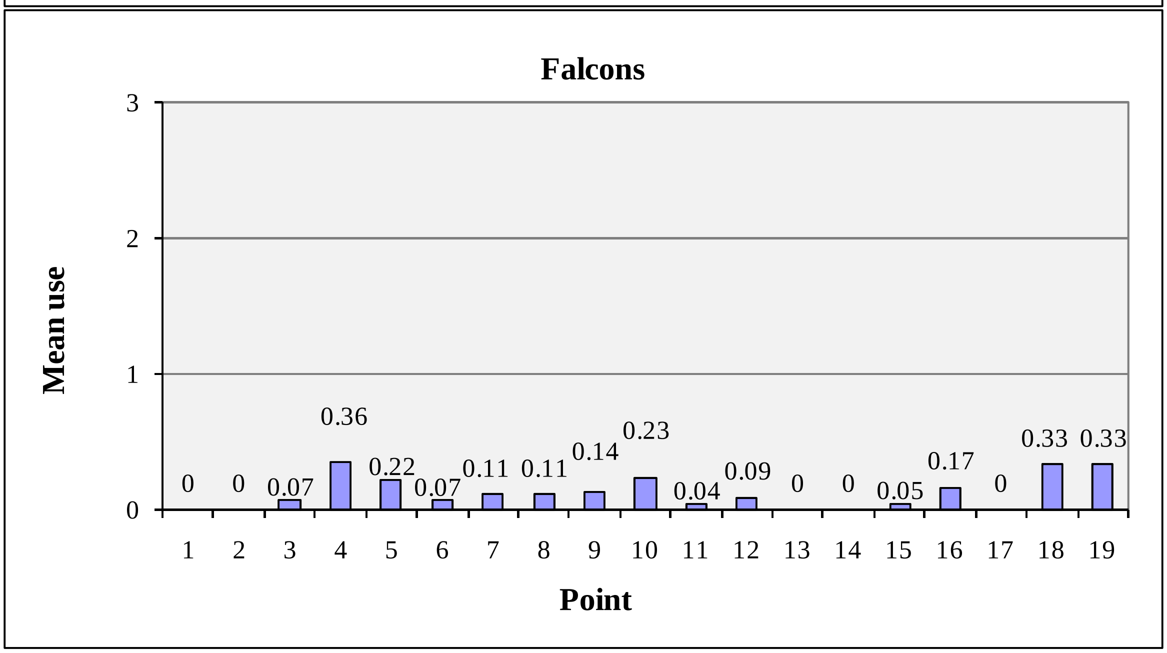


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.

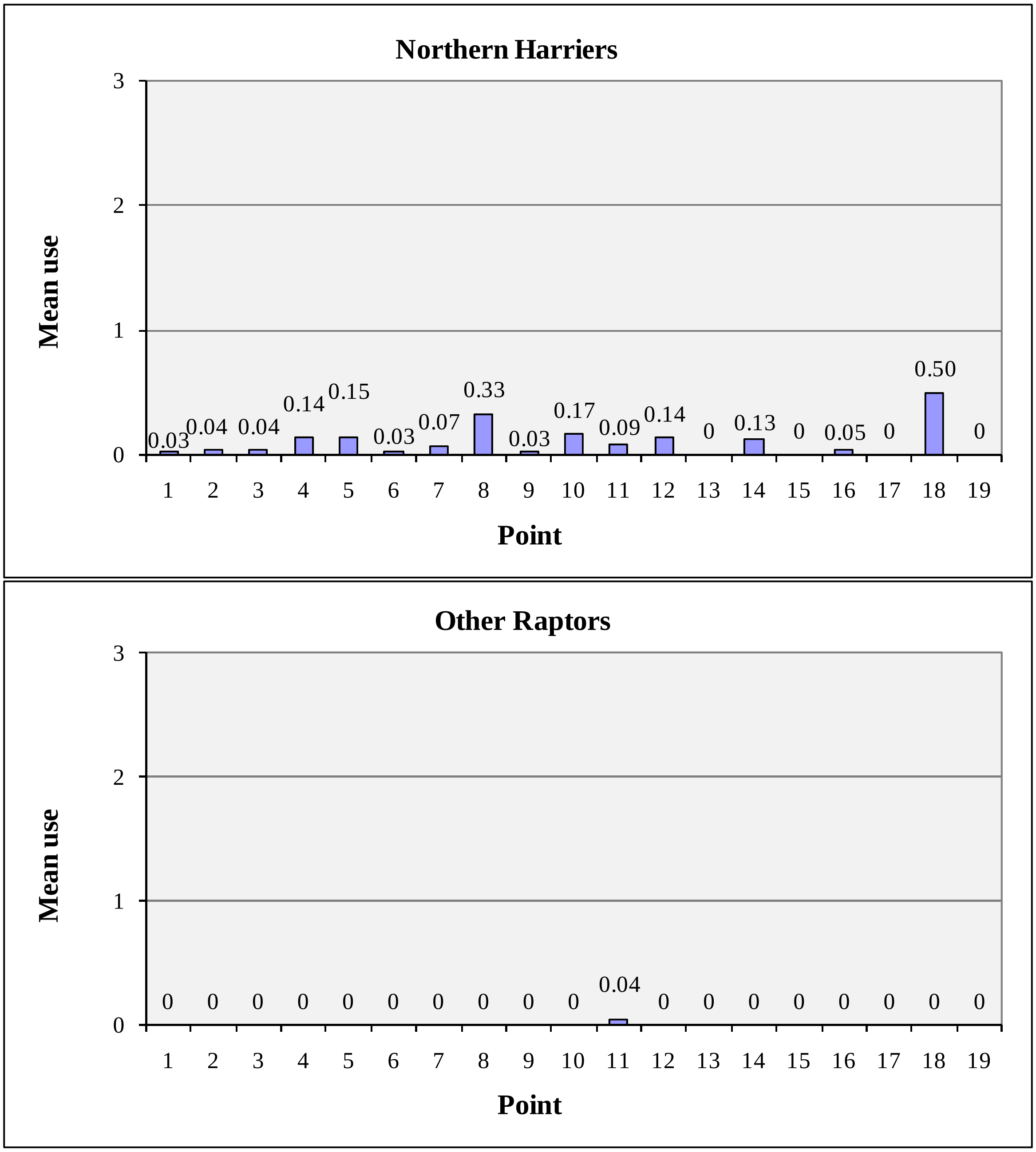
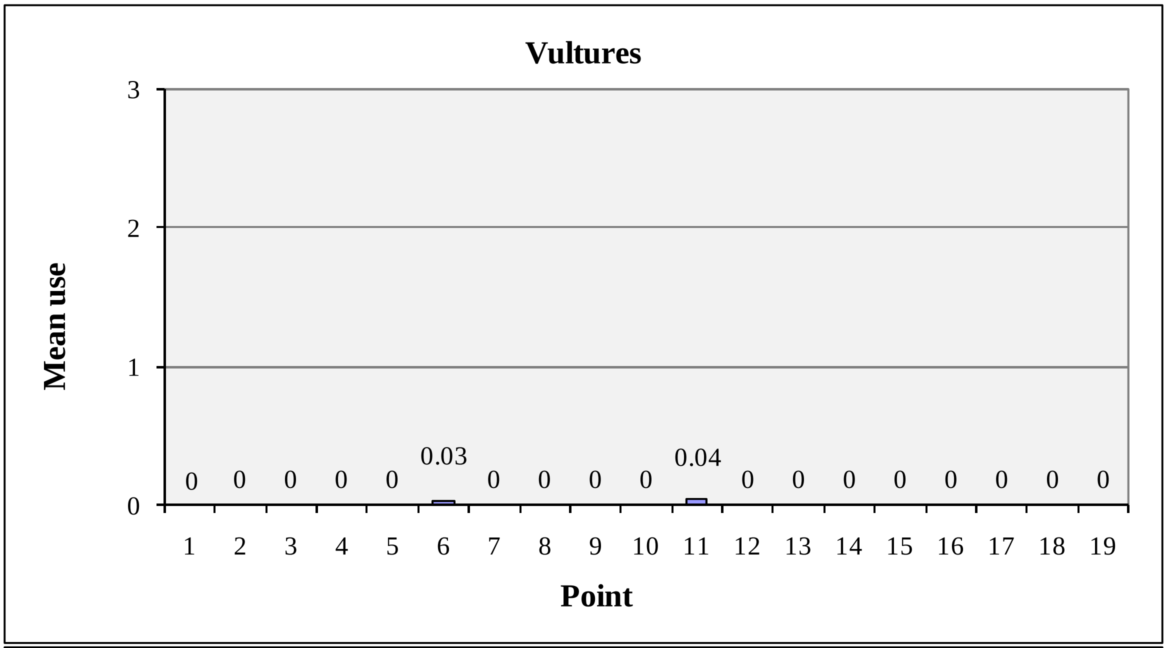
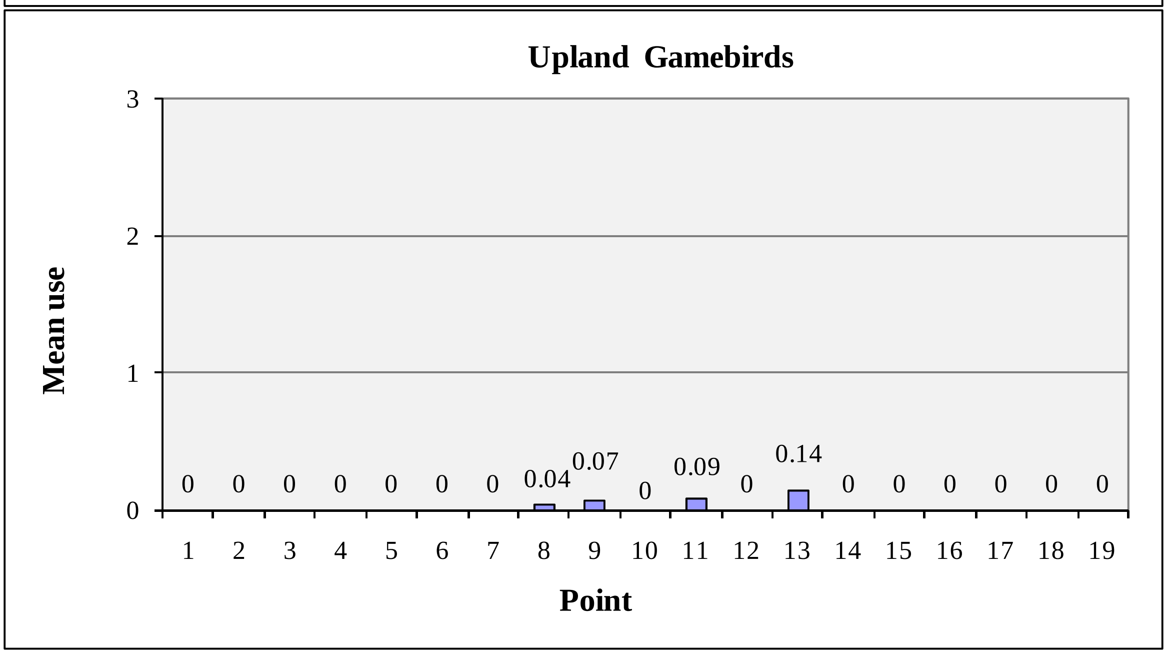


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.





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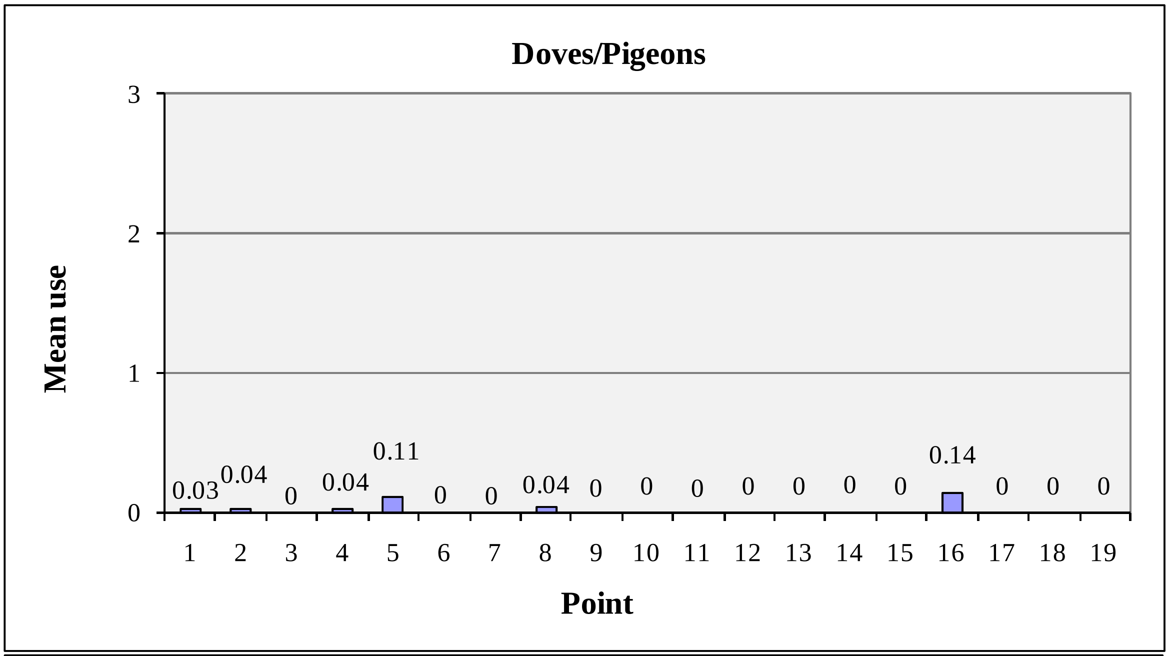


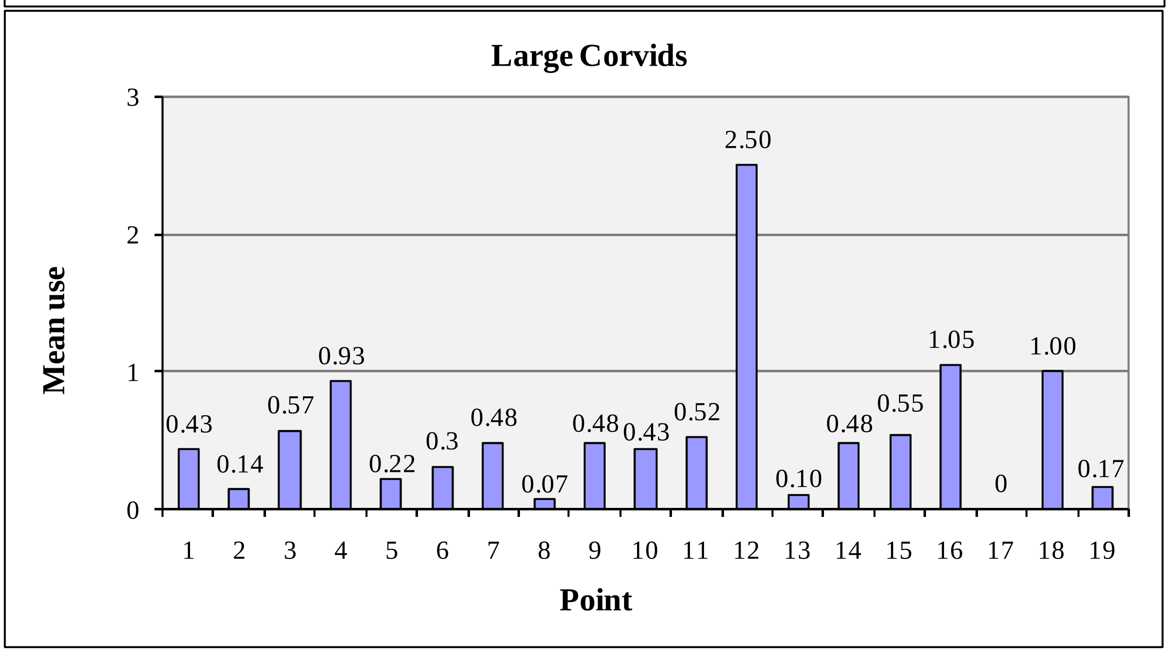
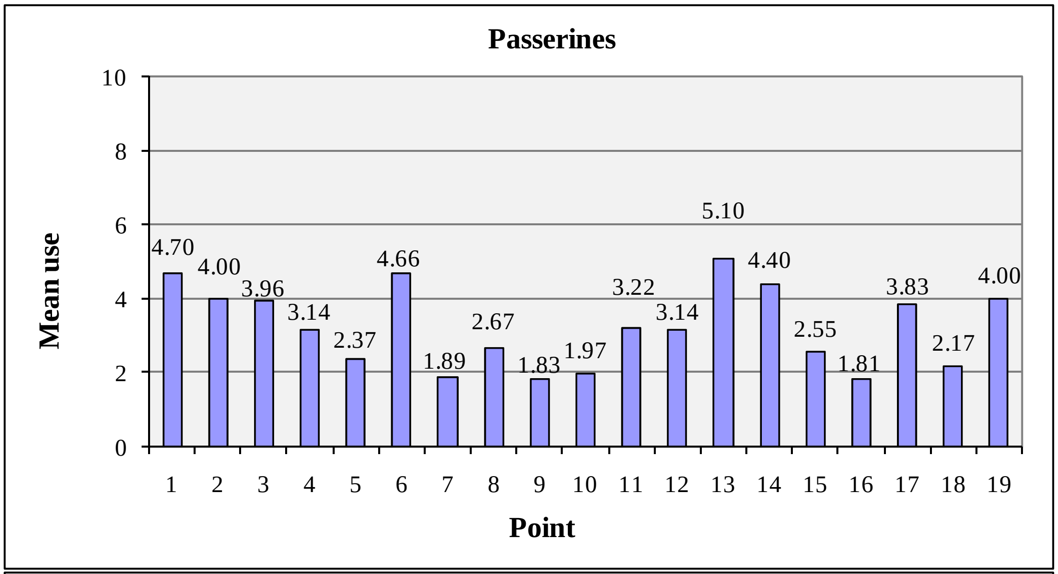


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



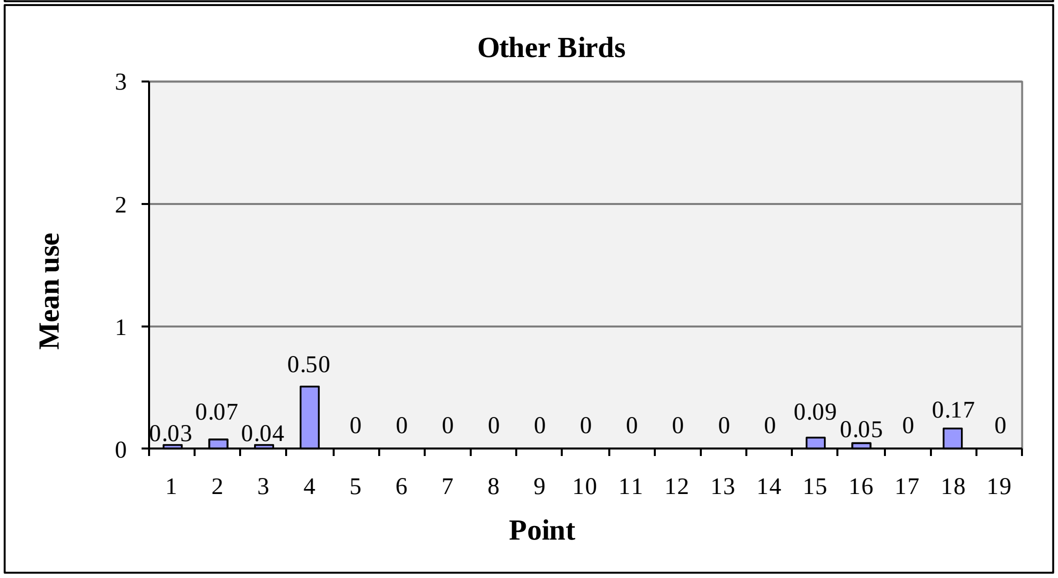


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area. Passerine and other bird observations were focused within 100-m viewsheds.

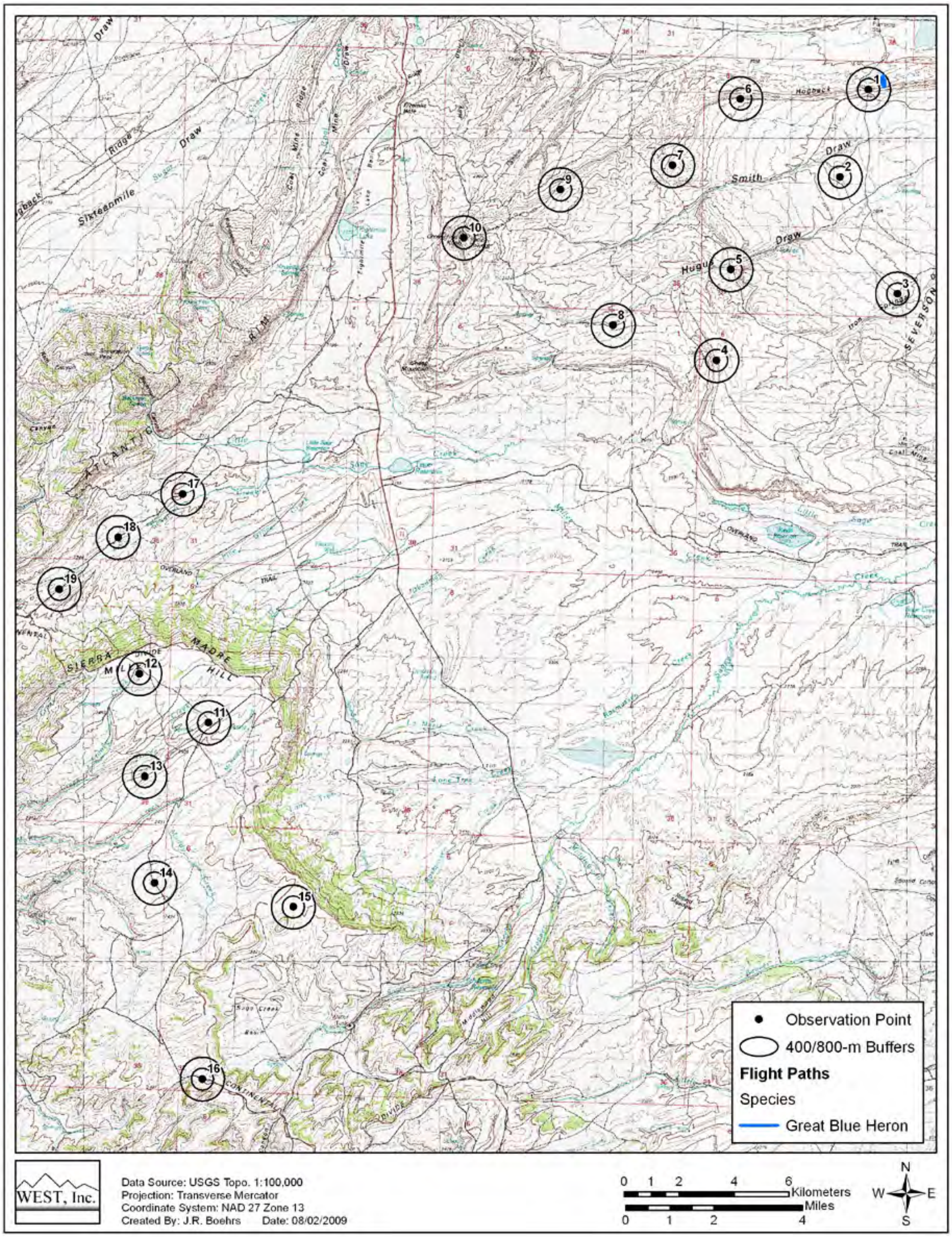


Figure 6a. Flight paths of waterbirds at the Chokecherry-Sierra Madre Wind Resource Area.

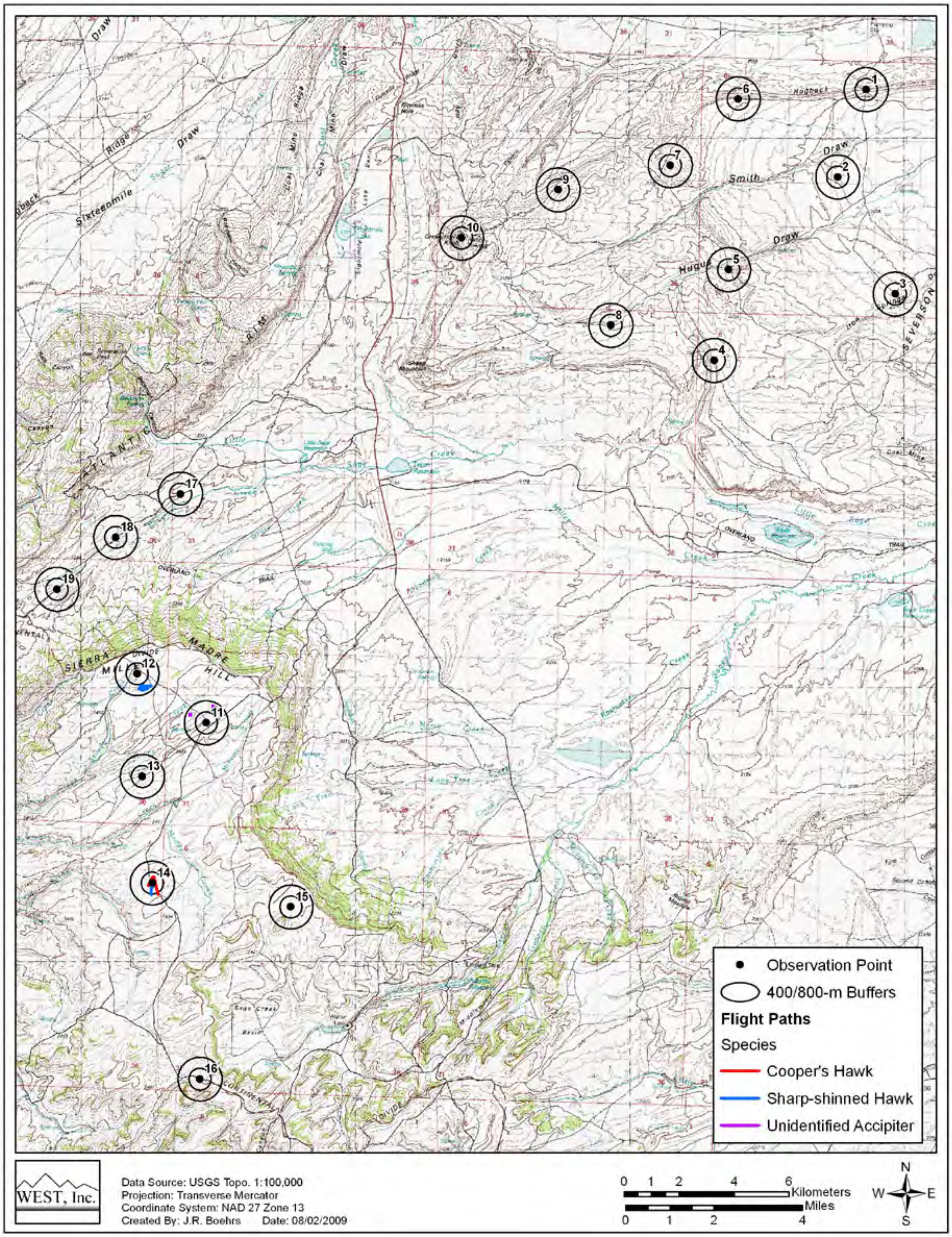


Figure 6b. Flight paths of accipiters at the Chokecherry-Sierra Madre Wind Resource Area.

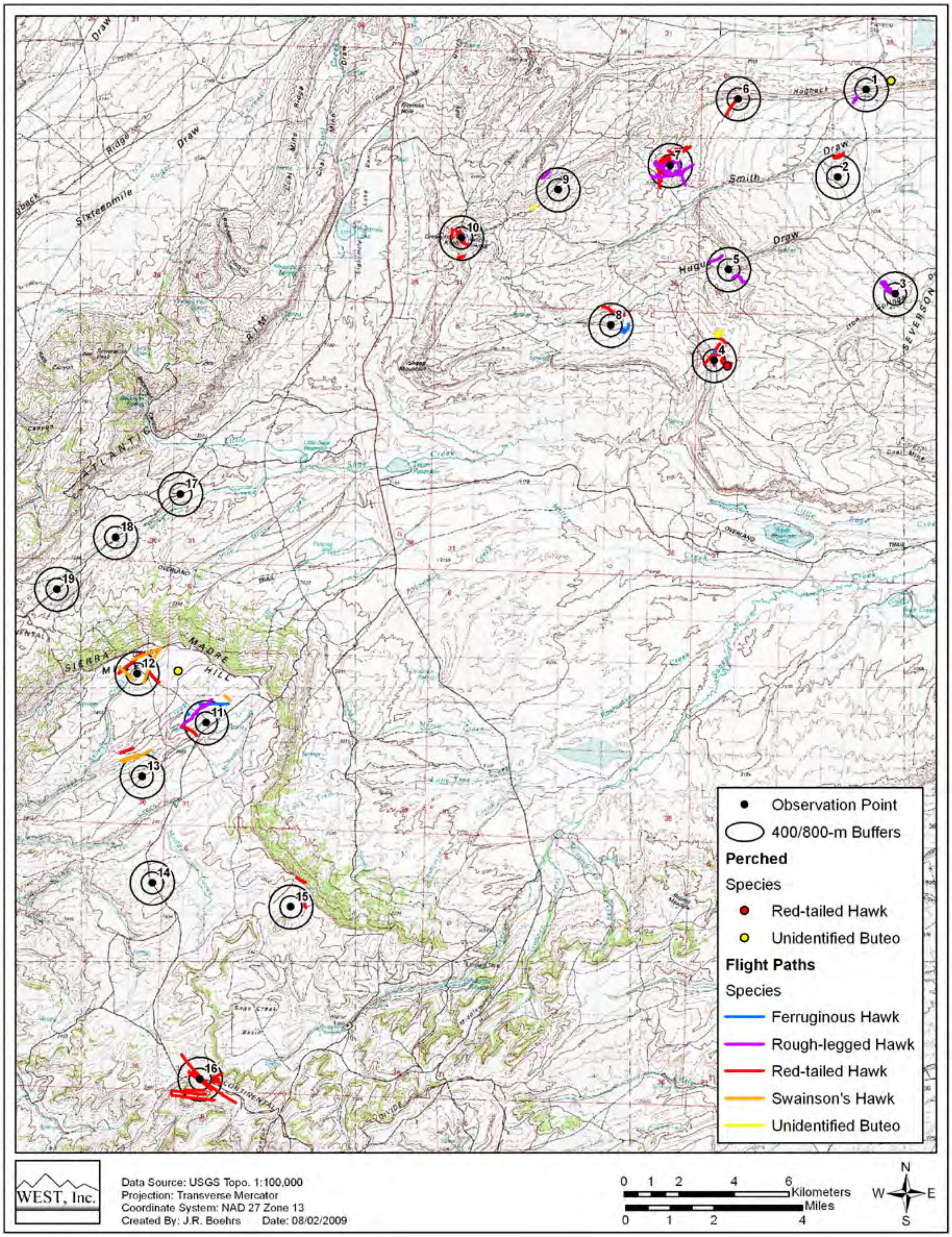


Figure 6c. Flight paths of buteos at the Chokecherry-Sierra Madre Wind Resource Area.

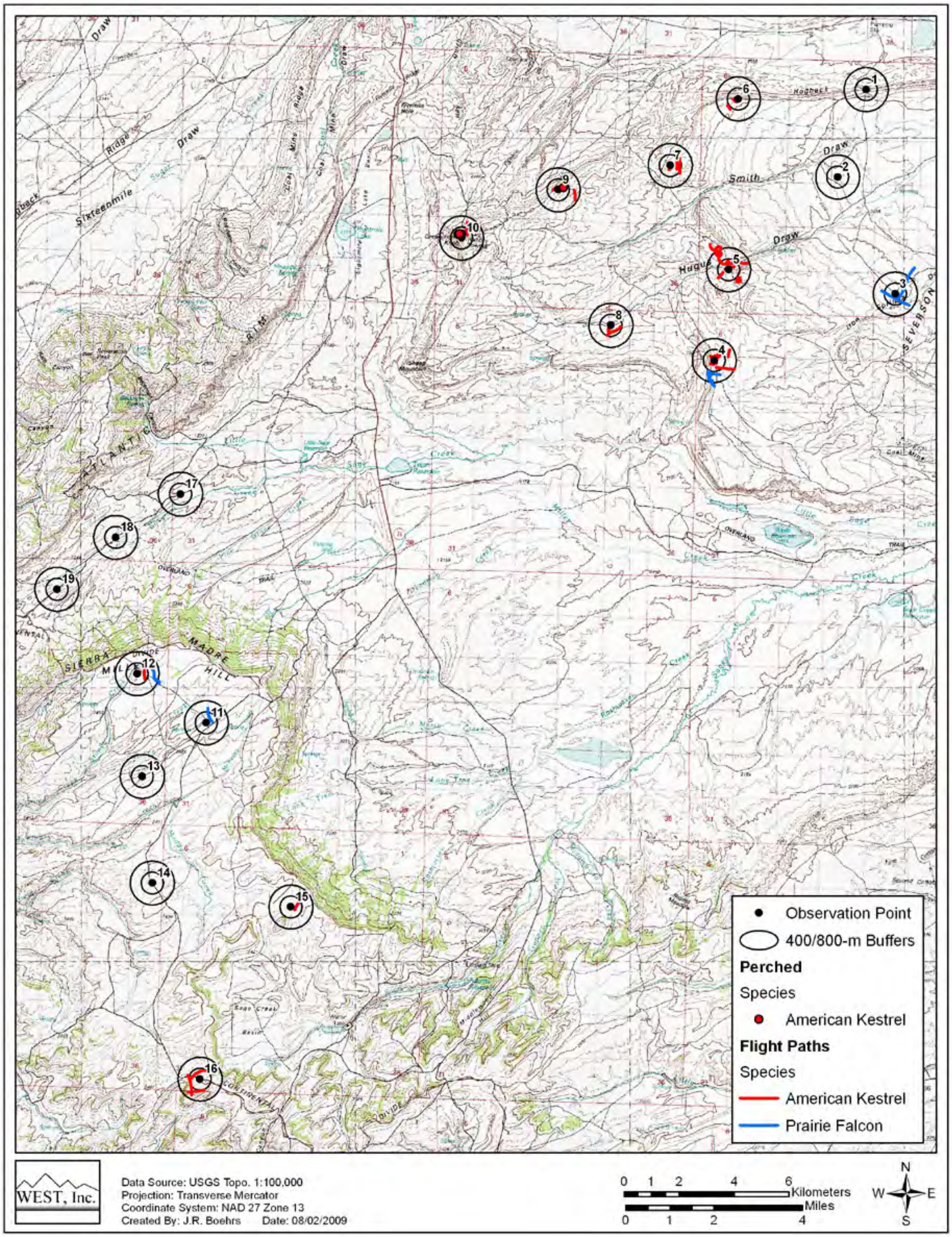


Figure 6d. Flight paths of falcons at the Chokecherry-Sierra Madre Wind Resource Area.

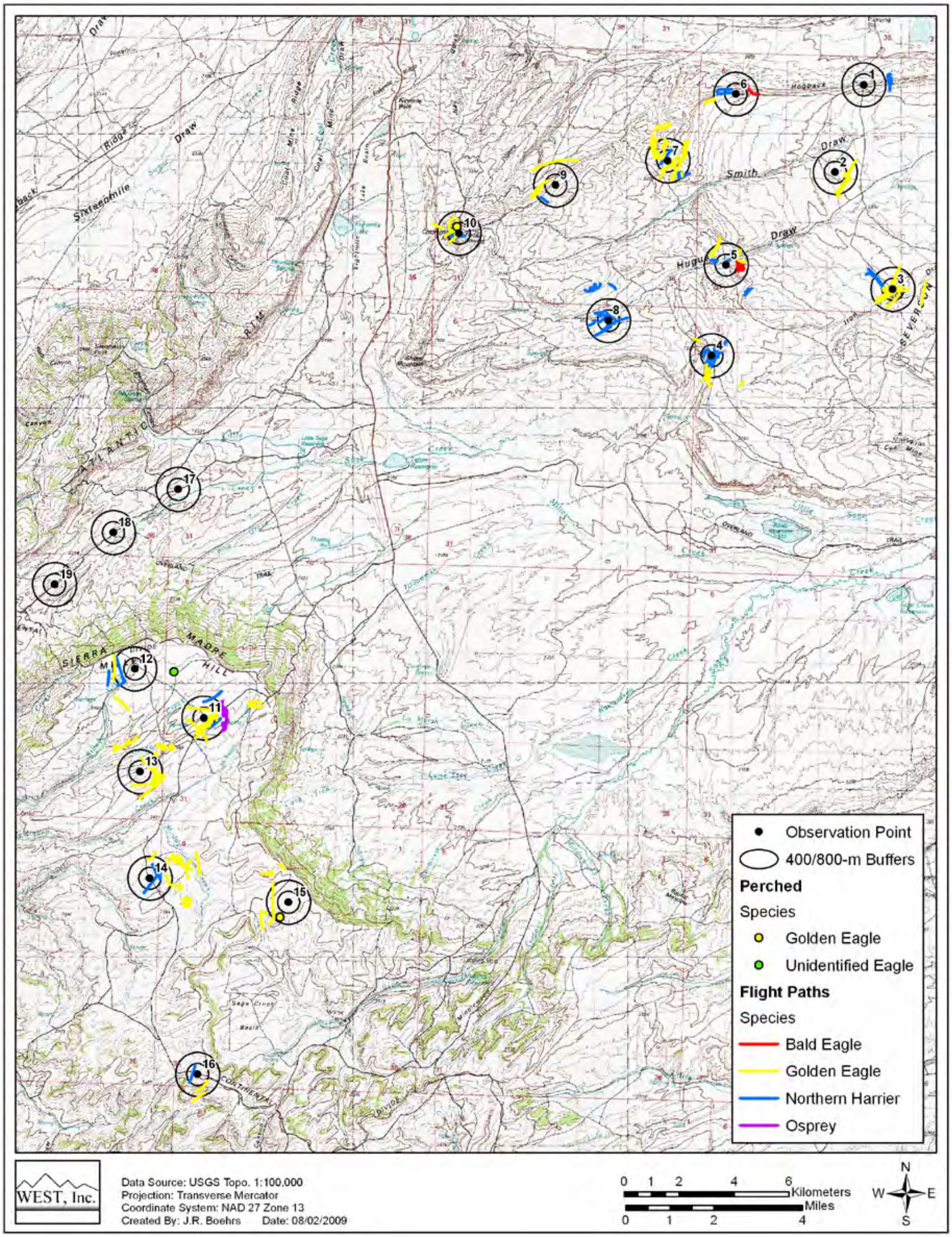


Figure 6e. Flight paths of eagles, northern harriers, and other raptors at the Chokecherry-Sierra Madre Wind Resource Area.

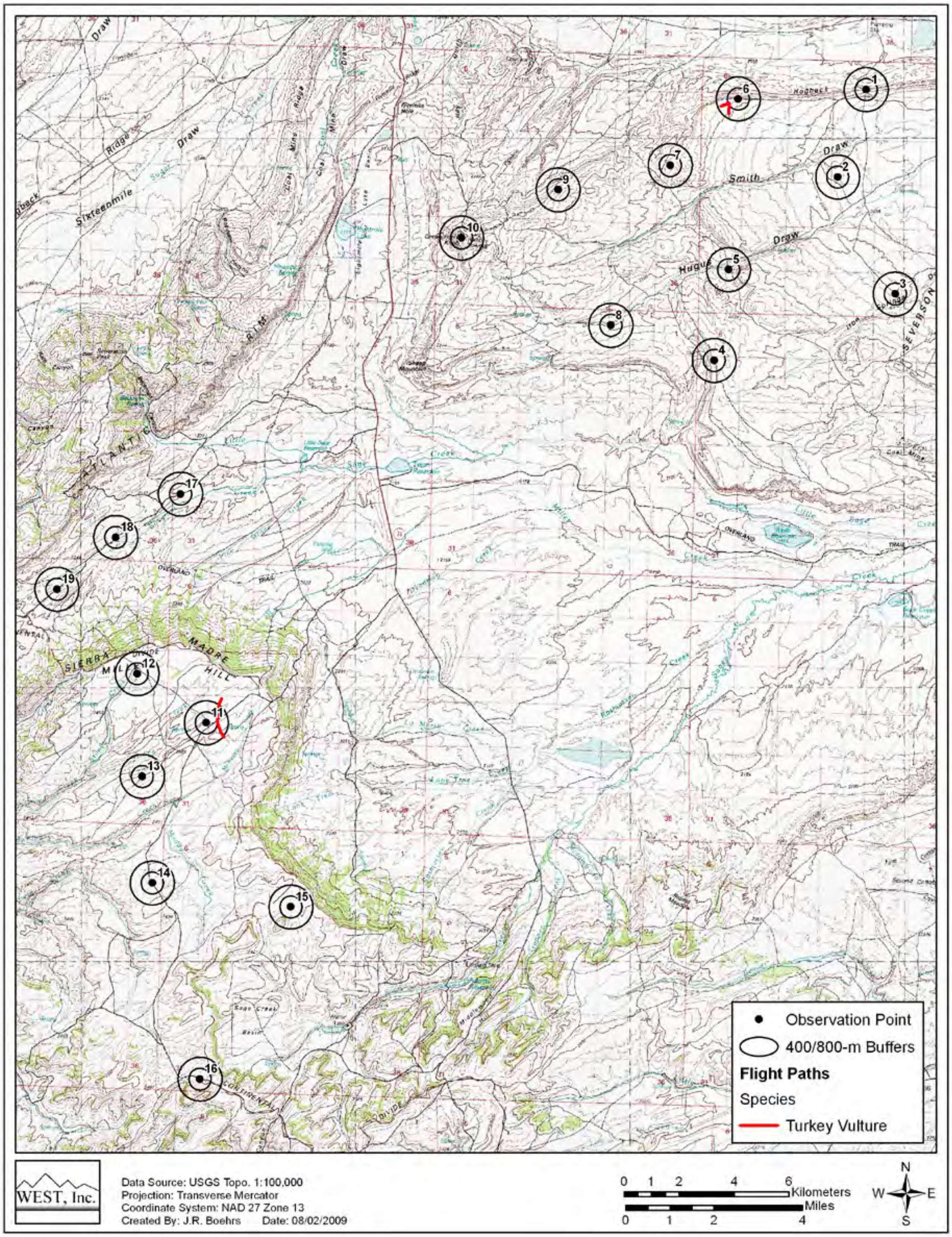


Figure 6f. Flight paths of vultures at the Chokecherry-Sierra Madre Wind Resource Area.

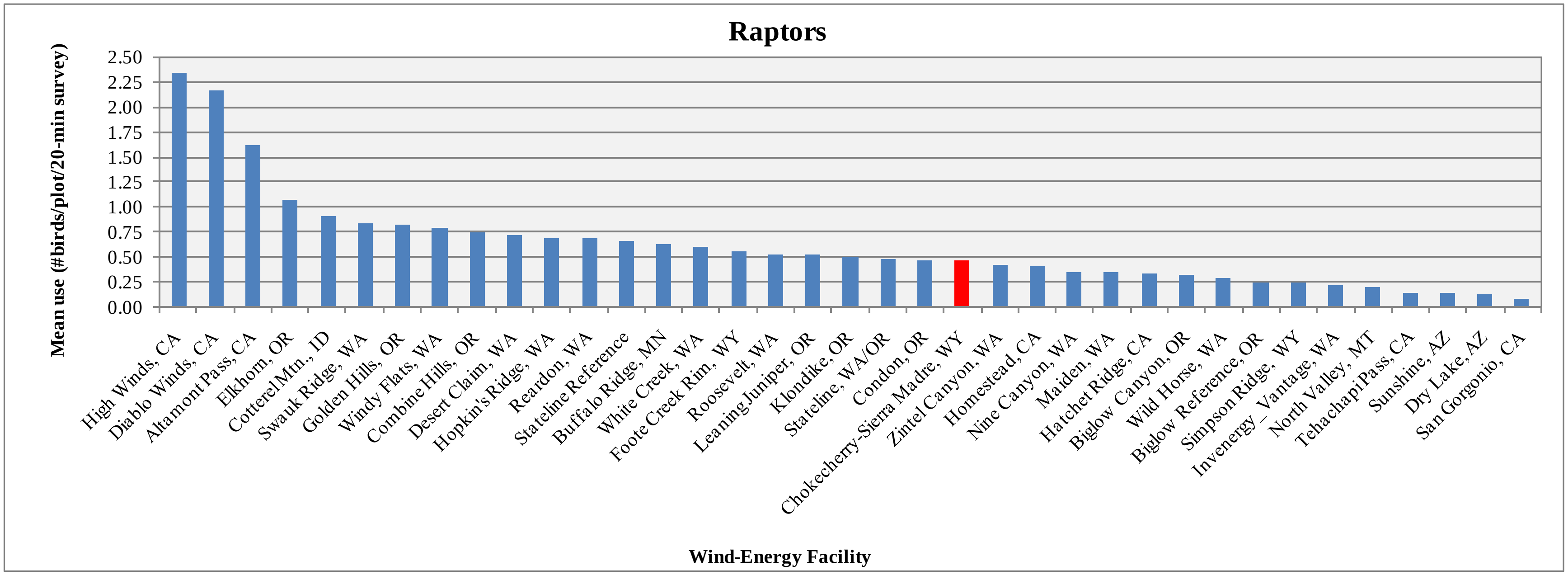
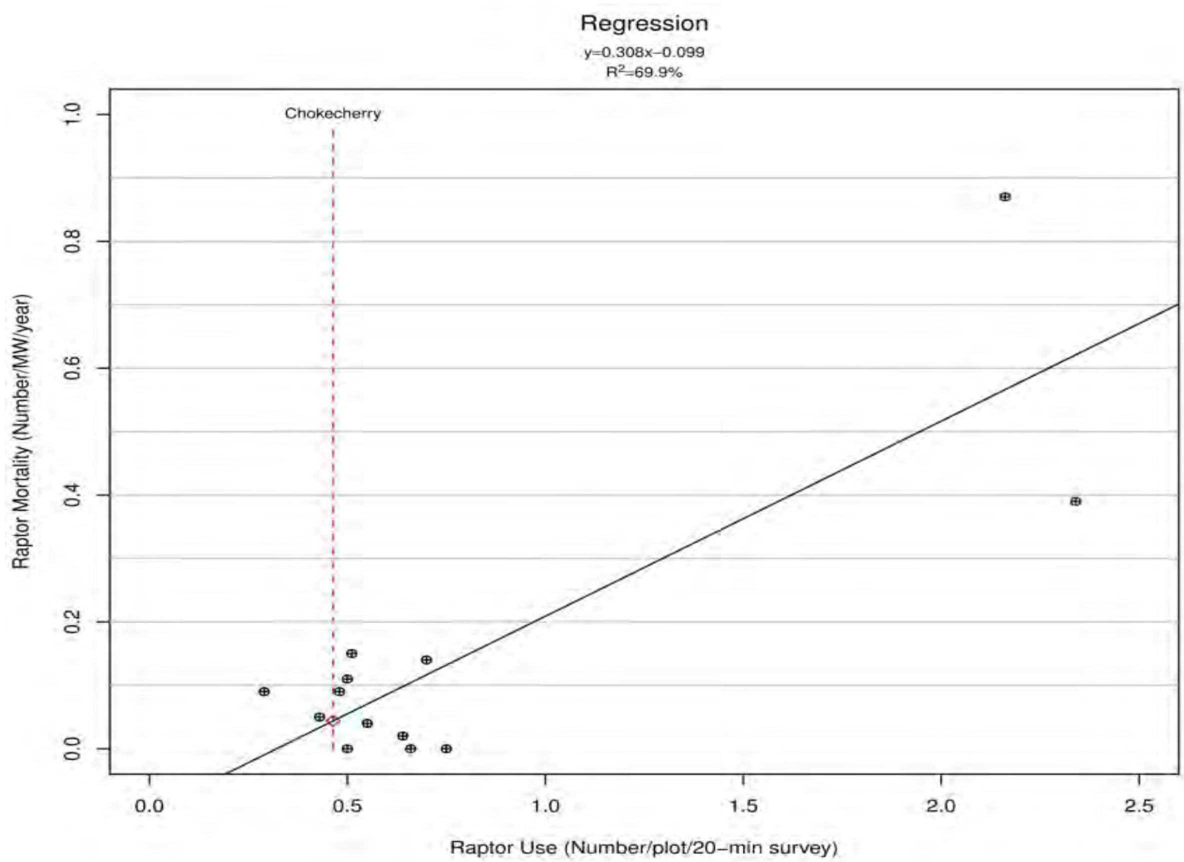


Figure 9. Comparison of annual raptor use between the Chokecherry-Sierra Madre Wind Resource Area and other US wind-energy facilities.

Data from the following sources:

Chokecherry-Sierra Madre, WY	This study.				
High Winds, CA	Kerlinger et al. 2005	Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b
Diablo Winds, CA	WEST 2006a	Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b
Altamont Pass, CA	Erickson et al. 2002b	White Creek, WA	NWC and WEST 2005a	Biglow Canyon, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Foote Creek Rim, WY	Erickson et al. 2002b	Wild Horse, WA	Erickson et al. 2003a
Cotterel Mtn., ID	Cooper et al. 2004	Roosevelt, WA	NWC and WEST 2004	Biglow Reference, OR	WEST 2005c
Swauk Ridge, WA	Erickson et al. 2003b	Leaning Juniper, OR	NWC and WEST 2005b	Simpson Ridge, WY	Johnson et al. 2000b
Golden Hills, OR	Jeffrey et al. 2008	Klondike, OR	Johnson et al. 2002a	Invenergy_Vantage, WA	WEST 2007
Windy Flats, WA	Johnson et al. 2007	Stateline, WA/OR	Erickson et al. 2002b	North Valley, MT	WEST 2006b
Combine Hills, OR	Young et al. 2003c	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Erickson et al. 2002b
Desert Claim, WA	Young et al. 2003b	Zintel Canyon, WA	Erickson et al. 2002a	Sunshine, AZ	WEST and the CPRS 2006
Hopkin's Ridge, WA	Young et al. 2003a	Homestead, CA	WEST et al. 2007	Dry Lake, AZ	Young et al. 2007c
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001b	San Gorgonio, CA	Erickson et al. 2002b



Overall Raptor Use 0.46
Predicted Fatality Rate 0.04 fatalities/MW/year
90.0% Prediction Interval (0, 0.30 fatalities/MW/year)

Figure 10. Regression analysis comparing raptor use estimates versus estimated raptor mortality.

Data from the following sources:

Study and Location	Raptor Use (birds/plot /20-min survey)	Source	Raptor Mortality (fatalities/MW/yr)	Source
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003c	0.00	Young et al. 2005
Diablo Winds, CA	2.161	WEST 2006a	0.87	WEST 2006a
Foote Creek Rim, WY	0.55	Erickson et al. 2002b	0.04	Erickson et al. 2002b
High Winds, CA	2.34	Kerlinger et al. 2005	0.39	Kerlinger et al. 2006
Hopkins Ridge, WA	0.70	Young et al. 2003a	0.14	Young et al. 2007a
Klondike II, OR	0.50	Johnson 2004	0.11	NWC and WEST 2007
Klondike, OR	0.50	Johnson et al. 2002a	0.00	Johnson et al. 2003
Stateline, WA/OR	0.48	Erickson et al. 2002b	0.09	Erickson et al. 2002b
Vansycle, OR	0.66	WCIA and WEST 1997	0.00	Erickson et al. 2002b
Wild Horse, WA	0.29	Erickson et al. 2003a	0.09	Erickson et al. 2008
Zintel, WA	0.43	Erickson et al. 2002a	0.05	Erickson et al. 2002b
Bighorn, WA	0.51	Johnson and Erickson 2004	0.15	Kronner et al. 2008

April 2011–March 2012 Supplemental Wildlife Report
Chokecherry and Sierra Madre Wind Energy Project

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Between April 2011 and March 2012, SWCA Environmental Consultants (SWCA) performed a second year of avian and bat surveys for the Power Company of Wyoming, LLC (PCW) within the Chokecherry and Sierra Madre Wind Energy Project (Project) site. These Year Two survey efforts included long-watch raptor surveys, aerial raptor nest surveys within 5-miles of the Project, migratory bird point counts, breeding bird grid surveys, waterbird surveys, greater sage-grouse monitoring, and acoustic bat monitoring. Year One surveys were conducted between June 2008 and June 2009 with the primary intent of collecting data for the development of an Environmental Impact Statement (EIS) for the Project. Year One surveys consisted primarily of 20-minute avian point counts, aerial raptor nest surveys within 1-mile of the Project, greater sage-grouse monitoring, and acoustic bat monitoring.

All protocols and survey methodologies used to assess wildlife in the Project site during Year Two surveys were developed in consultation with the U.S. Fish and Wildlife Service (Service), and are in accordance with recommendations made by the Service, the Bureau of Land Management (BLM), and the Wyoming Game and Fish Department (WGFD). Many of the Year Two data pertaining to eagles, raptors, nests, and greater sage-grouse have been previously analyzed and presented in the Project Eagle Conservation Plan (ECP), Bird and Bat Conservation Strategy (BBCS), 2011 and 2012 Summary Nest Reports, and Sage-grouse Conservation Plan, respectively. More detailed summaries of data from other survey efforts are contained herein.

RAPTOR SURVEYS

Bi-weekly long-watch raptor surveys were completed at 15 sites between April 4 and November 16, 2011. Monthly surveys were completed between December 2011 and March 2012. Long-watch raptor surveys were conducted at 4,000-meter (m) radius plots strategically distributed across the Chokecherry and Sierra Madre Wind Development Areas (WDAs). Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for the purposes of identifying high-use areas while maintaining observer confidence in species identification. For the purposes of this report, only a brief summary is presented for raptor surveys; more detailed summaries and analyses for eagles and raptors are provided in the Project ECP and BBCS, respectively.

Year Two surveys were conducted for a total of 129,750 minutes, or 49.4% of the total 262,800 daylight minutes in the year. During Year Two, 324 long-watch raptor surveys were conducted between April 2011 and March 2012. Of the 324 total surveys, 109 were conducted in the spring, 45 in the summer, 110 in the fall, and 60 during the winter (Table 1). The total 129,750 minutes of survey conducted during all Year Two long-watch surveys were evenly distributed between sites and between spring and fall; however, summer and winter survey minutes were lower because the survey effort was scaled down between July 2 and August 14, and between November 17 and March 31.

Table 1. Summary of Observations from Year Two Long-watch Surveys.

Season	Surveys	Raptor Observations
Spring	109	486
Summer	45	94
Fall	110	341
Winter	60	102
Total	**324**	**1,023**

In total, 178 surveys were conducted in the Chokecherry WDA, while 146 surveys were conducted in the Sierra Madre WDA. Across all seasons, 1,023 raptor observations were made at all long-watch locations; however, most of the observations were likely the same birds being observed multiple times per survey date. This is often detailed in observational notes taken by field personnel during raptor surveys, and is further exemplified by the raptor use calculations presented in the Project BBCS, as well as information presented in the 2011 and 2012 Summary Nest Reports. The Raptor use calculations presented in the BBCS show relatively consistent use between all seasons during Year Two, which indicates there are not large influxes of migrant raptors moving into the Project during the spring and fall months. Additionally, the results presented in the 2011 and 2012 Summary Nest Reports show relatively low numbers of nesting raptors occurring in the Project site and immediate surrounding area. These data indicate that the majority of the 1,023 raptor observations are likely repeat observations of the same resident individuals as there does not appear to be strong raptor migration through the area, nor are there high numbers of nesting raptors occurring in the Project.

MIGRATORY BIRD SURVEYS

Migratory bird point count surveys were completed in conjunction with the long-watch raptor surveys, and therefore the number of sites as well as the weekly scheduling was identical to the raptor surveys. Each migratory bird survey point was established in representative habitat near each raptor monitoring site at sufficient distance to ensure that the observer for the raptor surveys would not likely impact migratory bird species behavior at the point count location.

Point count surveys were conducted across all daylight hours to account for time-of-day effects. For any individual point, surveys were conducted between 7:30 am and 6:30 pm on a pre-determined, systematic schedule. All birds detected within a 200-m radius were recorded during the point count surveys. The data collected during these counts included species, number of individuals, radial distance from observer, behavior, and general demographic data. Standard survey and environmental data (e.g., time, date, wind speed, temperature) were also collected.

The metrics used to characterize avian use are number of species, number of individuals, number of flocks, species frequency (the percentage of 20-minute surveys on which a species was observed), occurrence frequency (percentage of surveys with at least one bird detection), and mean use (average number of individuals per 20-minute survey).

Vegetation data collected across 500 transect surveys conducted by SWCA in 2009 was used to characterize major habitat types at each point. Table 2 summarizes the percentage of major habitat types (minimum 5% of total acreage) within the 200-m radius survey area (31.03 acres) of each location center.

Table 2. Percentage of Major Habitat Categories within 200-m Radius of Migratory Bird Survey Points (Minimum 5%).

Survey Site	Habitat Category							
	Aspen-Mixed Conifer	Dense Sagebrush	Sagebrush Steppe	Salt Desert Shrub	Upland Grassland	Sparsely Vegetated	Lowland Mesic Zone	Montane Shrubland
1		18	74		6			
2				95				
3	39		54					
4	23		30		30	5		6
5			62	6	30			
6			67		31			
7			52		43			
8		16	69		14			
9			75	9	11			
10			89	7				
11		11	75		9			
12			45		51			
13		17	70				8	
14			16	63		18		
15		13	45	37				

Note: Due to rounding error and minimum requirement of 5% coverage, total habitat coverage may not equal 100%.

Sagebrush steppe comprised a substantial portion (≥30%) of 13 survey sites. Salt desert shrub dominated at survey sites 2 and 14 (95% and 63%, respectively). Aspen-mixed conifer was well-represented at survey sites 3 and 4 (39% and 23%, respectively), as was upland grassland with ≥30% coverage at survey sites 4, 5, 6, 7, and 12. Dense sagebrush, sparsely vegetated, lowland mesic zone, and montane shrubland were also identified with >5% coverage at several survey sites. Barren ground was the only major habitat category to not register at least 5% coverage on any site.

Between April 4, 2011, and March 27, 2012, 295 migratory bird surveys were conducted. Point count locations were each surveyed 16 to 23 times, with the variation in number of surveys due to safety and accessibility concerns arising from inclement weather. These same factors are also the cause of differences in the overall number of migratory bird surveys relative to long-watch raptor surveys.

In sum, 1,518 individuals in 969 flocks representing 43 species were recorded during all surveys combined in the 12-month survey period (Table 3). Of the 295 surveys completed, no birds were recorded on 74 of the surveys for an occurrence frequency of 75% (221 of 295 surveys). Mean use was 5.1 individuals/survey. Horned lark (*Eremophila alpestris*) dominated the number of observations, accounting for 951 (62%) individuals with a mean use of 3.2 individuals/survey. Horned lark was also the most frequently encountered species on surveys, with the species recorded on 67% of surveys.

Table 3. The Number of Individuals, Flocks, Species Frequency, and Mean Use for All Migratory Bird Survey Point Locations Combined, April 2011–March 2012.

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Horned Lark	935	530	67	3.2
Brewer's Sparrow	70	65	13	0.2
Vesper Sparrow	68	67	15	0.2
American Crow	55	2	<1	0.2
Rock Wren	43	40	11	0.1
Sage Thrasher	41	39	11	0.1
Sage Sparrow	42	34	6	0.1
Common Raven	34	27	8	0.1
Western Meadowlark	29	25	6	0.1
Sparrow sp.	29	19	6	0.1
American Robin	18	10	3	0.1
Greater Sage-grouse	18	3	1	0.1
Mountain Bluebird	16	11	4	0.1
Common Nighthawk	12	9	2	0.0
Undetermined sp.	12	11	3	0.0
Passerine sp.	9	6	2	0.0
American Kestrel	8	7	2	0.0
Green-tailed Towhee	7	7	3	0.0
White-throated Swift	6	1	<1	0.0
Barn Swallow	5	3	1	0.0
Black-billed Magpie	5	3	1	0.0
Tree Swallow	5	4	1	0.0
American Goldfinch	4	4	2	0.0
Song Sparrow	4	4	2	0.0
Violet-green Swallow	4	4	1	0.0
Warbler sp.	4	2	1	0.0
Chipping Sparrow	3	3	1	0.0
Evening Grosbeak	3	3	<1	0.0
Mourning Dove	3	2	1	0.0
Savannah Sparrow	3	3	1	0.0
Brown-headed Cowbird	2	2	1	0.0
Dark-eyed Junco	2	2	1	0.0
Northern Flicker	2	2	1	0.0
Gray-crowned Rosy-Finch	2	1	<1	0.0
Turkey Vulture	2	1	<1	0.0
Brewer's Blackbird	1	1	1	0.0
Golden Eagle	1	1	<1	0.0
House Finch	1	1	<1	0.0
House Wren	1	1	1	0.0
Killdeer	1	1	<1	0.0

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Loggerhead Shrike	1	1	<1	0.0
Northern Harrier	1	1	<1	0.0
Red-tailed Hawk	1	1	<1	0.0
Rufous Hummingbird	1	1	<1	0.0
Sharp-shinned Hawk	1	1	<1	0.0
Swallow sp.	1	1	<1	0.0
Western Kingbird	1	1	<1	0.0
Woodpecker sp.	1	1	<1	0.0
Total (43)	**1,518**	**969**	**75***	**5.1**

* Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Note: Because of rounding error, mean use values may not equal total shown.

Summary results for individual point count locations are presented in Table 4. Values for number of species (range = 6–18), number of individuals (range = 26–168), number of flocks (range = 23–94), and mean use (range = 1.3–8.1) varied between sites.

Table 4. Summary of Key Metrics for Individual Migratory Bird Point Count Locations, April–November 2011.

Survey Site	# of Surveys	# of Species	# of Individuals	# of Flocks	% of Surveys w/ Bird Detections	Mean Use[1]
1	20	6	86	60	60	4.3
2	20	6	26	23	70	1.3
3	16	17	120	57	81	7.5
4	19	11	76	50	84	4.0
5	20	9	113	76	70	5.7
6	20	10	111	94	70	5.6
7	20	7	67	41	70	3.4
8	21	11	118	93	81	5.6
9	19	6	94	64	79	4.9
10	20	12	161	72	80	8.1
11	20	10	88	71	75	4.4
12	19	10	99	70	74	5.2
13	23	18	168	91	74	7.3
14	19	8	116	50	79	6.1
15	19	9	75	57	79	3.9
Total	**295**	**43**[2]	**1,518**	**969**	**75%**[3]	**5.1**

[1] Because of rounding error, mean use values may not equal total shown.

[2] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

[3] Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Survey site 2 had relatively few birds (26 individuals; mean use = 1.3) recorded on the 20 surveys conducted at that site. Survey sites 10 and 13 had the highest number of individuals (161 and 168, respectively), and sites 3 and 10 had the highest mean use (7.5 and 8.1, respectively). All sites had at least three surveys when no birds were recorded.

BREEDING BIRD SURVEYS

SWCA established and conducted 15 breeding bird survey grids in the Project site following protocols established in Rocky Mountain Bird Observatory's *Field Protocol for Spatially Balanced Sampling of Landbird Populations* (Hanni et al. 2010). This study design allows for analyses of population trends for diurnal, regular-breeding landbird species. Its application in the Project site would allow for integration into and comparison with Rocky Mountain Bird Observatory's similar efforts in the Atlantic Rim Natural Gas Development Project Area (Van Lanen et al. 2011), as well those across broader landscapes where similar studies are conducted (see White et al. 2011).

Survey areas for each grid were selected using generalized random-tessellation stratification (GRTS), a spatially balanced sampling algorithm (Stevens and Olsen 2004), without sample weighting (i.e., not accounting for any factor expected to influence a species' distribution [e.g., habitat type]). By using GRTS, data-embedded information on spatial autocorrelation can increase density estimate precision. This spatially balanced sampling design also allows for adjustment of sampling effort among years while preserving a random sampling design (Hanni et al. 2010).

Each survey site consisted of 16 point count locations in a 4 × 4 grid, with 250 m spacing between points. Each grid was surveyed once in June 2011. Surveys were initiated within 30 minutes of local sunrise and were completed by 10:00 am. Habitat information was collected at each point count location prior to conducting the avian count to allow birds time to adjust to the presence of field personnel. Habitat data collected included proximity to human-made structures (e.g., roads, fences) and variables used to describe overstory, shrub layer, and groundcover components. Standard weather (e.g., wind speed, cloud cover) variables were also collected prior to starting the avian survey. Upon completion of the habitat data collection, biologists conducted an avian survey at each point for 6 minutes. All bird detections were recorded regardless of distance. Data for each detection included species, number of individuals, horizontal distance from observer, age, sex, and how detected.

The 15 grids of 16 point counts were surveyed in June 2011 for a total of 240 individual sampling points. For all sites combined, 1,944 individuals representing 63 species were recorded (Table 5). The most prevalent species, based on total number of individuals recorded and frequency of detection (on grids and individual points), was horned lark (411 individuals, 100% occurrence on the 15 grids, and on 73% of the 240 point counts). Following horned lark, in order of prevalence, were Brewer's sparrow (*Spizella breweri*; 283, 100%, 65%), vesper sparrow (*Pooecetes gramineus*; 216, 93%, 55%), and sage thrasher (*Oreoscoptes montanus*; 138, 80%, 46%), all species closely associated with sagebrush communities. These four species combined for 1,048 individuals or 54% of all detections.

Table 5. Summary Statistics for Grid-based Breeding Bird Surveys, June 2011.

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Horned Lark	411	100	73
Brewer's Sparrow	283	100	65
Vesper Sparrow	216	93	55
Sage Thrasher	138	80	46
Green-tailed Towhee	116	87	35
Rock Wren	104	67	31
Sage Sparrow	89	47	25
Western Meadowlark	58	60	15
Brown-headed Cowbird	49	60	13
American Robin	47	40	16
Common Raven	41	73	13
Sparrow sp.	32	93	10
Common Nighthawk	28	53	10
Greater Sage-grouse	23	13	<0.5
Warbling Vireo	23	27	8
House Wren	22	20	6
American Goldfinch	21	27	5
Yellow Warbler	21	20	6
Red-winged Blackbird	17	13	5
MacGillivray's Warbler	16	27	5
Mountain Bluebird	15	33	4
Chipping Sparrow	14	20	3
Dusky Flycatcher	11	7	3
Sora	10	13	3
Orange-crowned Warbler	9	13	3
Brewer's Blackbird	8	7	3
Killdeer	8	20	2
Mourning Dove	8	20	2
Savannah Sparrow	8	13	3
Northern Flicker	7	20	3
N. Rough-winged Swallow	7	20	1
Red-tailed Hawk	7	27	2
Undetermined sp.	7	27	3
Song Sparrow	6	20	2
Broad-tailed Hummingbird	5	20	2
Common Yellowthroat	4	7	1
Say's Phoebe	4	13	1
Tree Swallow	4	20	2
Wilson's Snipe	4	7	1
Ruby-crowned Kinglet	3	7	1
Western Wood-Pewee	3	7	1
American Kestrel	2	13	<0.5
Bald Eagle	2	7	1

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Black-capped Chickadee	2	7	1
Black-crowned Night Heron	2	7	<0.5
Common Merganser	2	7	<0.5
Common Poorwill	2	13	1
Dark-eyed Junco	2	13	<0.5
Hermit Thrush	2	13	1
Lark Sparrow	2	7	<0.5
Northern Harrier	2	7	<0.5
Yellow-rumped Warbler	2	7	<0.5
Barn Swallow	1	7	<0.5
Bewick's Wren	1	7	<0.5
Black-billed Magpie	1	7	<0.5
Blackbird sp.	1	7	<0.5
Blue-gray Gnatcatcher	1	7	<0.5
Cliff Swallow	1	7	<0.5
Empidonax sp.	1	7	<0.5
Hammond's Flycatcher	1	7	<0.5
Loggerhead Shrike	1	7	<0.5
Mountain Chickadee	1	7	<0.5
Oriole sp.	1	7	<0.5
Swainson's Thrush	1	7	<0.5
Violet-green Swallow	1	7	<0.5
Wilson's Warbler	1	7	<0.5
Yellow-breasted Chat	1	7	<0.5
Total (63)	**1,944**	**100**	**99***

* One point count survey resulted in zero bird detections; although rounding to the nearest whole number would result in a 100% frequency (239 of 240 = 99.58%); this table shows 99% to recognize the single point count with no birds.

The number of species and number of individuals varied between survey grid sites (Table 6). The mean number of species per grid was 16 (range of 9–30), while the mean number of individuals was 130 (range of 58–182). Although the number of species at four survey locations (sites 42, 49, 94, and 263) differed from the mean by more than 50%, only one site (163) differed by 50% from the mean in the number of individuals recorded.

Table 6. The Number of Species and Number of Individuals per Grid-based Breeding Bird Survey Site, June 2011.

Grid Identifier	# of Species	# of Individuals
42	30	182
49	29	131
94	30	157
151	10	113
163	11	58
208	10	92
224	9	121
263	28	169
321	15	143
335	15	173
358	13	155
470	12	119
482	12	121
575	12	123
605	10	87
Total	**63[1]**	**1,944**

[1] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

WATERBIRD SURVEYS

Waterbird surveys were conducted in 2011 during spring (April 26–May 4), summer (August 23–24), and fall (October 20–21) at each of the four major reservoirs (Kindt, Rasmussen, Sage Creek, and Teton) occurring within the Project site and surrounding area. These surveys were conducted to help build a baseline of potential prey species and assess their spatiotemporal abundance in the Project site at locations with the potential to attract and/or concentrate eagles and other raptor species. Surveys were conducted using spotting scopes to maximize coverage from a minimal number of viewing locations, as well as to facilitate species identification. Along with standard survey information (i.e., date, location, observer, time, weather conditions), species-specific data collected included species, age, sex, and number of individuals.

SPRING SURVEYS

Spring waterbird surveys were conducted between April 26 and May 4, 2011. These surveys resulted in a total count of 1,415 individuals representing 35 species (Table 7). American coot (*Fulica americana*) was the most abundant species accounting for 364 individuals (26% of total count). Scaup (*Aythya* sp.), *Aechmophorus* grebes (i.e., western and Clark's), and eared grebe (*Podiceps nigricollis*) were the next most abundant species with 351, 209, and 113 individuals, respectively. Collectively, those four groups accounted for 1,037 individuals or 73% of all birds detected.

Table 7. Species, Number of Individuals, and Spring Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 5/2/11	Rasmussen 5/4/11	Sage Creek 4/26/11	Teton 5/4/11	Total Count
Aechmophorus sp.		71			**71**
American Avocet	2	4	2		**8**
American Coot	198	5	100	61	**364**
American White Pelican	2	1		3	**6**
American Wigeon	5	1			**6**
Bufflehead	6	2	1	1	**10**
Calidris sp.	3				**3**
Canada Goose				5	**5**
Canvasback	4				**4**
Cinnamon Teal				3	**3**
Clark's Grebe				1	**1**
Common Loon		4	1		**5**
Common Merganser	53		7	14	**74**
Double-crested Cormorant				6	**6**
Eared Grebe	59	31	6	17	**113**
Gadwall	8	8	5	11	**32**
Greater Scaup	4				**4**
Greater Yellowlegs	2				**2**
Green-winged Teal	2	6		6	**14**
Horned Grebe			1		**1**
Killdeer	16		5	1	**22**
Least Sandpiper	1				**1**
Lesser Scaup	84	19			**103**
Lesser Yellowlegs	1				**1**
Mallard	4			2	**6**
Marbled Godwit	7	1			**8**
Northern Pintail	2			1	**3**
Northern Shoveler		2		6	**8**
Pied-billed Grebe			1		**1**
Redhead	69	11		5	**85**
Ring-billed Gull		1		1	**2**
Ring-necked Duck	8	2		16	**26**
Ruddy Duck	9				**9**
Scaup sp.	200	44			**244**
Western Grebe	39	50	34	14	**137**
White-faced Ibis		3			**3**
Willet	17	2	2		**21**
Wilson's Phalarope	3				**3**
Total	**808**	**268**	**165**	**174**	**1,415**
Number of Species	**25**	**18**	**12**	**19**	**35**

More species and individuals were counted at Kindt Reservoir (25 species, 808 individuals) than the other three reservoirs (Table 7). The fewest species and number of individuals (12 species, 165 individuals) were recorded at Sage Creek Reservoir during spring surveys.

SUMMER SURVEYS

A total of 1,708 individuals representing 29 species were recorded on summer waterbird surveys conducted on August 23 and 24, 2011 (Table 8). Redhead (*Aythya americana*) had the highest number of individuals (815) accounting for 48% of all birds detected during summer surveys. Lesser scaup (*Aythya affinis*), mallard (*Anas platyrhynchos*), and American coot were the next most abundant species with 157, 149, and 99 individuals, respectively. Collectively, those four species accounted for 1,221 individuals or 71% of all birds detected.

The highest number of individuals (920) was recorded at Rasmussen Reservoir, where 89% (780 individuals) were redheads (Table 8). Nearly all of the season's redheads (780 of 815) were recorded at Rasmussen Reservoir. Despite the high number of birds recorded at Rasmussen Reservoir, biologists recorded the fewest number of species (12) at that location.

Table 8. Species, Number of Individuals, and Summer Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
American Avocet	10	4	5	6	**25**
American Coot	30		45	24	**99**
American White Pelican	10		12	2	**24**
American Wigeon	2		4	5	**11**
Black-crowned Night Heron			4	3	**7**
Blue-winged Teal		14	6		**20**
California Gull				2	**2**
Canada Goose	16	12			**28**
Common Loon		2			**2**
Common Merganser	1	16			**17**
Double-crested Cormorant			5	6	**11**
Eared Grebe	27	9	7	7	**50**
Gadwall	26			10	**36**
Great Blue Heron			1	1	**2**
Green-winged Teal	26			42	**68**
Herring Gull	3				**3**
Killdeer	1	5	1	3	**10**
Lesser Scaup	80	18	59		**157**
Mallard	102	13	25	9	**149**
Northern Pintail	4		6		**10**
Pied-billed Grebe	3			7	**10**
Redhead		780	35		**815**
Ring-billed Gull		4	2		**6**
Ruddy Duck			9		**9**

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
Snowy Egret			1		**1**
Spotted Sandpiper	2		2		**4**
Unknown dabbling duck			35	12	**47**
Unknown gull		13		1	**14**
Western Grebe	3	30	24	10	**67**
Willet	1				**1**
Wilson's Phalarope				3	**3**
Total	**347**	**920**	**288**	**153**	**1,708**
Number of Species	**18**	**12**	**19**	**16**	**29**

FALL SURVEYS

Surveys during the fall migration period on October 20 and 21, 2011, resulted in a total of 11,473 individuals of 29 species recorded (Table 9). Similar to spring, in the fall American coot accounted for the majority of individuals (8,024, 70% of total individuals). A total of 1,692 American wigeon (*Anas americana*) were also recorded. Combined, American coot and American wigeon accounted for 9,716 individuals (85% of all individuals).

More individuals (8,773) and species (22) were recorded at Kindt Reservoir during fall surveys than at other reservoirs (Table 9). Of the 8,024 American coots and 1,692 American wigeons recorded at all reservoirs combined, the survey at Kindt Reservoir accounted for 5,810 coots (66%) and 1,690 wigeon (99%).

Table 9. Species, Number of Individuals, and Fall Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
American Avocet			8		**8**
American Coot	5,810	2,088		126	**8,024**
American Wigeon	1,690	1	1		**1,692**
Bufflehead	2			1	**3**
Canada Goose	38		5		**43**
Canvasback	5		1		**6**
Common Loon		2			**2**
Common Merganser			64	6	**70**
Eared Grebe	3	98	9		**110**
Gadwall	554	20	3		**577**
Greater Yellowlegs	4				**4**
Green-winged Teal	10	33	44		**87**
Herring Gull		1		2	**3**
Hooded Merganser			3		**3**
Horned Grebe	16	13	5		**34**
Lesser Scaup	24				**24**

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
Long-billed Dowitcher	4				**4**
Mallard	121	20	8	3	**152**
Northern Pintail	50	4	3		**57**
Northern Shoveler	1	1	11		**13**
Pectoral Sandpiper	1				**1**
Pied-billed Grebe	6	3			**9**
Redhead	328	27	4		**359**
Ring-billed Gull	1	7	11	9	**28**
Ring-necked Duck	84				**84**
Ruddy Duck	17	13	4		**34**
Surf Scoter		6			**6**
Western Grebe	4	25	3	1	**33**
White-winged Scoter		3			**3**
Total	**8,773**	**2,365**	**187**	**148**	**11,473**
Number of Species	**22**	**18**	**17**	**7**	**29**

ACOUSTIC BAT MONITORING

Anabat (Titley Electronics, Australia) is a bat detection system that uses a broadband microphone that can detect ultrasonic sounds and record them onto a compact flash data card. This system uses a frequency division technique called Zero-Crossings Analysis to produce sonograms that can be viewed on a PDA or computer screen using the AnalookW program. These sonograms display the shape of individual pulses on a frequency graph plotted against time. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in the sonograms. Sonograms produced through Zero-Crossings Analysis generally have enough information to label a pulse sequence as belonging to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat [*Lasiurus cinereus*]) (Kunz et al. 2007). In North America, *Myotis* bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics and pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

An index of bat activity was calculated by counting the number of bat passes per detector-hour past sunset (Kunz et al. 2007) for data collected in 2011. The number of detector-hours per night was calculated by summing the number of minutes surveyed between sunset and sunrise and dividing by 60 for each night surveyed. A bat pass was defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by >1 second from the next pulse (White and Gehrt 2001). An index of activity is used because the number of bats cannot be quantified from acoustic data (Kunz et al. 2007). Individual bats are not identifiable in an acoustical dataset as pulses may have been produced by the same or different individuals over the course of a single night survey period (Hayes 2000 in Kunz et al. 2007). All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities (Weller and

Baldwin 2012). Individual passes were labeled by characteristic frequency type (e.g., 25 kHz, 30 kHz, 40 kHz), then grouped into low (<25 kHz), mid- (30–40 kHz), and high (>50 kHz) characteristic frequency groups. Diagnostic call sequences were labeled by species. For reporting purposes, except where indicated, species-specific passes were combined with the appropriate frequency group.

In 2011, four locations (sites 2-1, 3-1, 3-2, and 4-1) were surveyed for nightly bat activity. Table 10 provides the level of effort (number of nights and number of survey-hours), the total number of bat passes, and the number of passes per survey-hour.

Table 10. Level of Effort and Bat Pass Summary for Locations Surveyed in 2011.

Site	Date Span	# of Survey Nights	# of Survey-Hours	Total # of Bat Passes	# of Bat Passes per Survey-Hour
2-1	Jun 15–27	13	114.4	19	0.2
3-1	Jun 30–Jul 26	27	244.9	79	0.3
3-2	Jul 27–Aug 22	27	267.1	33	0.1
4-1	Sep 23–Oct 20	28	349.7	7	0.0
Total	**Jun 15–Oct 20**	**95**	**976.1**	**138**	**0.1**

The average number of bat passes per survey-hour across a season may be beneficial to delineate approximate dates of local bat activity, including arrival of spring migrants and departure of fall migrants. Furthermore, variation in the number of bat passes per night at an individual site may be useful in identifying migratory pulses.

Activity levels were inconsistent during the survey period (Figure 1). This inconsistency is likely due to lack of recognizable foraging areas (e.g., slow-moving streams, ponds, wooded sites) at the survey locations and the seemingly random occurrence of a bat traveling between roost and foraging sites being detected by the Anabat. The steep increase in the number of bat passes on July 24 (26 bat passes in 9.3 survey-hours = 2.8 bat passes/survey-hour) is four times higher than the next highest average count at that site. Activity levels decreased in mid-August. No survey data were collected from August 23 to September 22 due to system error. Activity levels were low during the September 23 to October 20 survey period with no more than 0.1 bat pass per survey-hour on any given night.

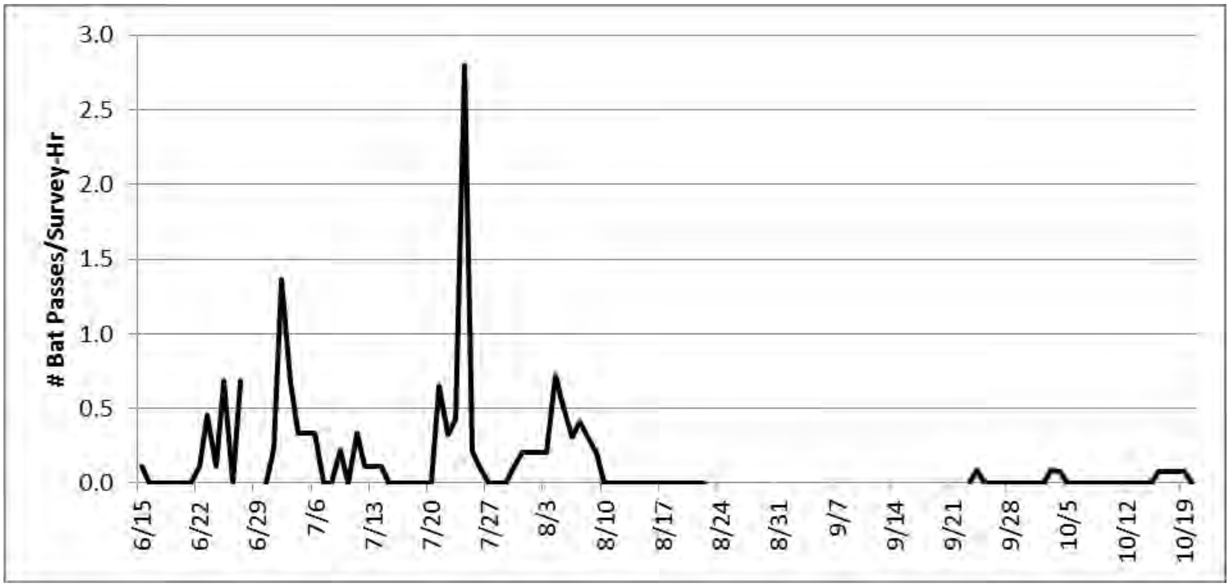

Figure 1. Average number of bat passes per survey-hour, June 15–October 20, 2011.

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Bat Survey Report

Chokecherry and Sierra Madre Wind Energy Project

Prepared for

Power Company of Wyoming, LLC

Prepared by

SWCA Environmental Consultants

May 2015

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Chokecherry and Sierra Madre Wind Energy Project

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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INTRODUCTION

Power Company of Wyoming LLC (PCW) proposes to construct, operate, maintain and decommission the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project), located in Carbon County, Wyoming. The CCSM Project will consist of 1,000 wind turbines capable of generating up to 3,000 megawatts (MW) of clean, renewable wind energy. PCW is developing the CCSM Project in two phases (Figure 1). Phase I will include 500 wind turbine generators located in the western portions of two Wind Development Areas (WDAs) referred to as "Chokecherry" and "Sierra Madre" and associated infrastructure including the Road Rock Quarry, West Sinclair Rail Facility and Phase I Haul Road and Facilities. Phase II will include 500 wind turbine generators and associated infrastructure located in the eastern portions of the Chokecherry and Sierra Madre WDAs.

This Bat Survey Report (Report) describes surveys conducted by PCW to characterize bat use across the CCSM Project for purposes of informing siting decisions and reducing potential impacts on bats and their habitats. In 2012, the U.S. Fish and Wildlife Service (USFWS) issued its Land-Based Wind Energy Guidelines (USFWS 2012). The guidelines seek to assist developers in identifying species of concern that may potentially be affected by a proposed project and recommend a "tiered approach" for assessing potential adverse effects to those species and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions (USFWS 2012). To identify potential risks to bats from the CCSM Project, PCW collected baseline data for bat use across the CCSM Project Site. Specifically, PCW conducted monitoring for bats in 2008, 2011, 2012, and 2013 through the use of AnaBat passive acoustic monitors and a DeTect Merlin radar system.

ENVIRONMENTAL SETTING

The CCSM Project is located south of the city of Rawlins, primarily within the bounds of the Overland Trail Ranch (Ranch). Current land use across the Ranch consists of agricultural operations, including cattle grazing and hay production. The Ranch, including the CCSM Project Site, is dominated by three topographic features, Chokecherry Plateau, Miller Hill, and Sage Creek Rim, separated by the Sage Creek Basin (Figure 1). Chokecherry Plateau is the most topographically varied, consisting of ridges and rolling hills that generally slope northeasterly towards the North Platte River. Miller Hill and Sage Creek Rim are relatively level and gently sloped in a southwesterly direction. The Sage Creek Basin is a flat, high desert basin.

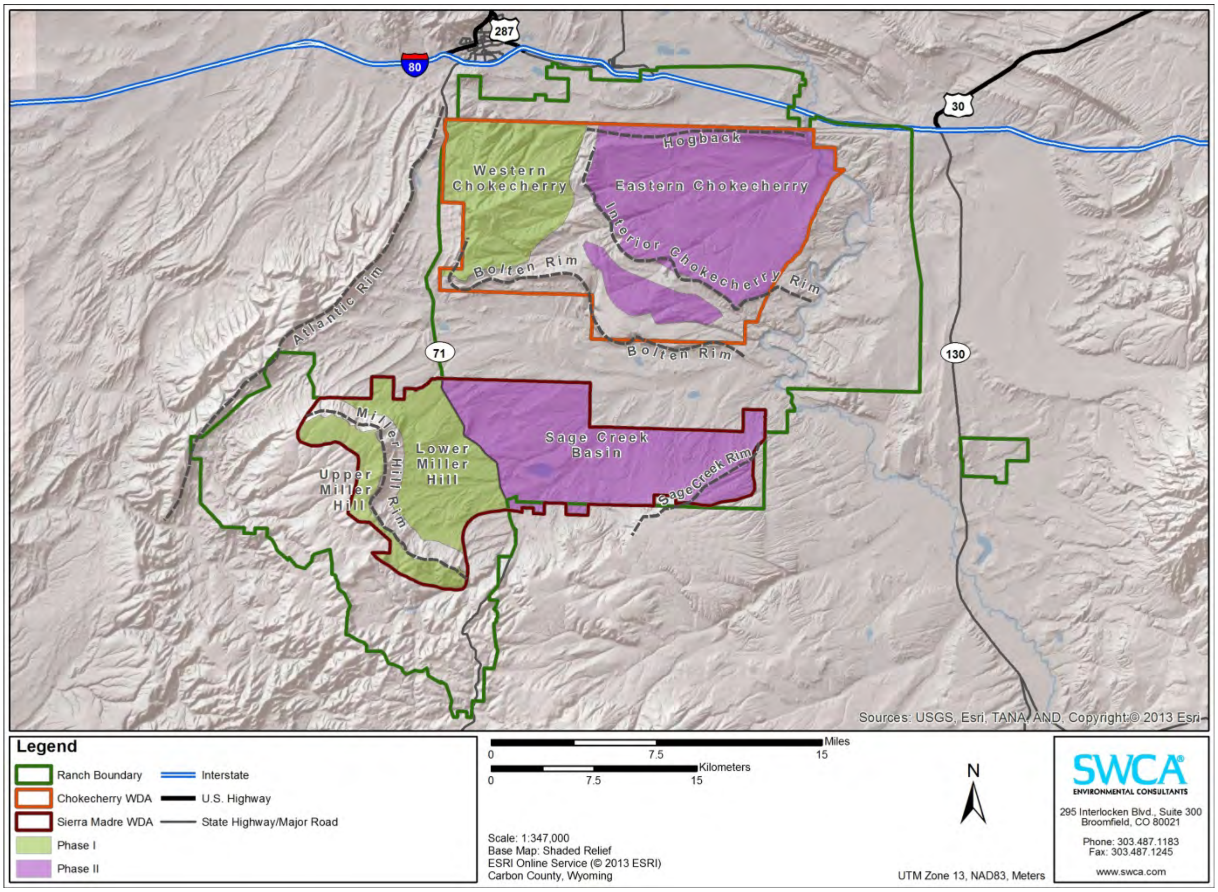

Figure 1. CCSM Project overview.

Vegetation cover in the CCSM Project Site is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt desert shrub basins, and foothill shrublands (Chapman et al. 2004). Sagebrush steppe communities are interspersed with bunchgrass/rhizomatous grass communities and allied shrubs, and generally have relatively low forb cover. Surface water sources on the Ranch include the North Platte River and several small tributaries. In addition, several small ephemeral streams and a few isolated springs are located throughout the Ranch. There are also reservoirs located within Sage Creek Basin, including Kindt, Rasmussen, Sage Creek, and Teton Reservoirs.

Of the eight bat species or subspecies in the contiguous U.S. currently listed or proposed for listing under the Endangered Species Act (USFWS 2014), none are expected to occur in the vicinity of the CCSM Project. The Bureau of Land Management (BLM 2010) lists fringed myotis, long-eared myotis, spotted bat (*Euderma maculatum*), and Townsend's big-eared bat as Sensitive Species. According to Orabona et al. (2012), bat species that have been observed or acoustically detected in the general vicinity of the CCSM Project (Latilong 25 in Orabona et al. 2012) include, California myotis (*Myotis californicus*), western small-footed myotis (*M. ciliolabrum*), long-eared myotis (*M. evotis*), little brown myotis (*M. lucifugus*), fringed myotis (*M. thysanodes*), long-legged myotis (*M. volans*), Yuma myotis (*M. yumanensis*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and pallid bat (*Antrozous pallidus*). In fact, a recent survey conducted in southern Wyoming, including areas near the CCSM Project, found all of these species, except California myotis (Griscom et al. 2012).

METHODS

Acoustic Survey

AnaBat detection systems manufactured by Titley Electronics were used for acoustic bat surveys conducted on the CCSM Project Site. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in sonograms. AnaBat systems are capable of detecting and recording these ultrasonic sounds and producing sonograms, individual pulses on a frequency graph plotted against time. AnaBat sonograms generally have enough information to label a pulse sequence to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat) (Kunz et al. 2007). In North America, *Myotis* bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics; therefore these pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

For acoustic bat surveys conducted on the CCSM Project Site, a standard index of bat activity was generated by counting the number of bat passes per detector-night at each survey location (Hayes 1997; Kunz et al. 2007). A bat pass is defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by more than 1 second from the next pulse (White and Gehrt 2001). Individual bats are not identifiable in an acoustical dataset since pulses may have been produced by the same or different individuals over the course of a single night survey period (Hayes 2000 in Kunz et al. 2007); therefore, an index of activity is used because the exact number of bats cannot be quantified from acoustic data (Kunz et al. 2007).

All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities as demonstrated by Weller and Baldwin (2012). Bat passes were classified as pertaining to low (<35 kilohertz [kHz]) or high (>35 kHz) characteristic frequency groups in 2008, and further subdivided into low (≤25 kHz), mid (~30-40 kHz), and high (≥40 kHz) frequency groups for subsequent surveys. Further refinement in the dataset was intended to provide more differentiation as to what species may be represented in the low frequency group. The low frequency category in the 2008 dataset may also have included some bat species with a characteristic frequency around 30 kHz, such as long-eared myotis, fringed myotis, Townsend's big-eared bat, and pallid bat (Griscom et al. 2012; Keinath undated). Diagnostic call sequences in the datasets were labeled only for hoary bat as that species has a unique call pattern easily distinguished from other bat species.

Radar Survey

A DeTect Merlin radar system was used to map avian and bat use from March 2011 through March 2013 at multiple locations within the CCSM Project Site. The radar is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10-kilowatt (kW) vertically operating X-band open array radar. The horizontal scanning radar (HSR) has a range of up 4.6 miles in a 360-degree pattern around the unit. The HSR is able to record how targets use topographic features within the CCSM Project Site by collecting accurate location data for each target as it moves through the radar scanning area. The vertical scanning radar (VSR) has a 24-degree beam width and detects flight paths heights to 2.0 miles or more above the unit. The HSR does not collect altitudinal data for biological targets; however, the elevation of targets may be collected if they pass through the footprint of the VSR. These data are useful for determining the relative percentage of targets passing through the rotor swept zone (RSZ) versus those flying above and below the RSZ. The radar ran continuously, collecting data for movements of birds throughout the day, and birds and bats at night.

Current avian radar technology and software are not able to distinguish between taxonomic groups (e.g., bird or bat). Rather, data for each target is recorded in a series of more than 60 variables based on different measures of recorded pixel size and shape. These variables can differ greatly within species and even for a single individual. It is not possible to determine a target's specific identity from the dataset recorded by the radar system. Targets could be grouped based upon their relative size, but this is also problematic due to variance in the size of individuals and overlap in variable values between small bird and bat species. Though the radar dataset did not help in quantifying species-specific use on the CCSM Project Site, it did prove useful for analysis of nocturnal broad-front migratory patterns and flight heights.

RESULTS AND DISCUSSION

2008 Acoustic Survey Results

Passive acoustic bat surveys were conducted from July 13 to October 13, 2008 (Solick et al. 2008). Six sites were surveyed with eight AnaBat units (Figure 1), two of which were placed on meteorological towers approximately 45 meters above the ground, with the remaining six AnaBat units being ground-based. The study resulted in 3,021 bat passes across 669 detector-nights for an average of 4.52 bat passes/detector-night. However, this mean value is heavily influenced by site A3 located in Hugus Draw (Figure 2) which comprised 63% of all bat passes recorded during 2008 (average 20.62 passes/detector-night). Site A3 is located near a wetland/stock pond within a defined Turbine No-Build Area[1]. As no impacts to bats will occur at site A3 because of its location within a Turbine No-Build Area, it was removed from the dataset as an outlier. After removal of site A3, the remaining seven AnaBat sites demonstrated more consistent bat use with an average of 1.9 bat passes per detector-night (Table 1).

Bat activity in 2008 was highest from July 13 through the end of August, with activity peaks on July 27 and August 22. Very low activity was recorded in September and October. Temporal variation was similar among AnaBat sites across the CCSM Project.

Approximately 63% of all bat passes recorded were of high-frequency bats. Ground-based AnaBat units recorded similar ratios of low- and high-frequency bats, though there was variation between sites and across the survey period. However, elevated units deployed on meteorological towers consistently recorded disproportionately high numbers of low-frequency bat passes than high-frequency, with hoary bat comprising 7% of all bat passes. Trends in activity for hoary bat were concordant with patterns observed for all bat frequency groups, including a peak in activity on August 22.

Table 1. Number of bat passes per detector night for 2008, 2010, and 2011 passive acoustic bat surveys.

Year	Mid and High Frequency Bat Passes	Low Frequency Bat Passes	Hoary Bat Passes	Total Bat Passes	Detector Nights	Bat Passes/ Night
2008[2]	1909	895	217	1124	577	1.9
2011	156	22	7	185	95	1.9
2012	115	9	10	134	62	2.2
Total	**2180**	**926**	**234**	**1443**	**734**	**2.0**

[1] Designated areas where turbines would not be constructed or overhang (PCW 2015).

[2] 2008 data do not include bat passer or detector nights for bat monitoring site A3

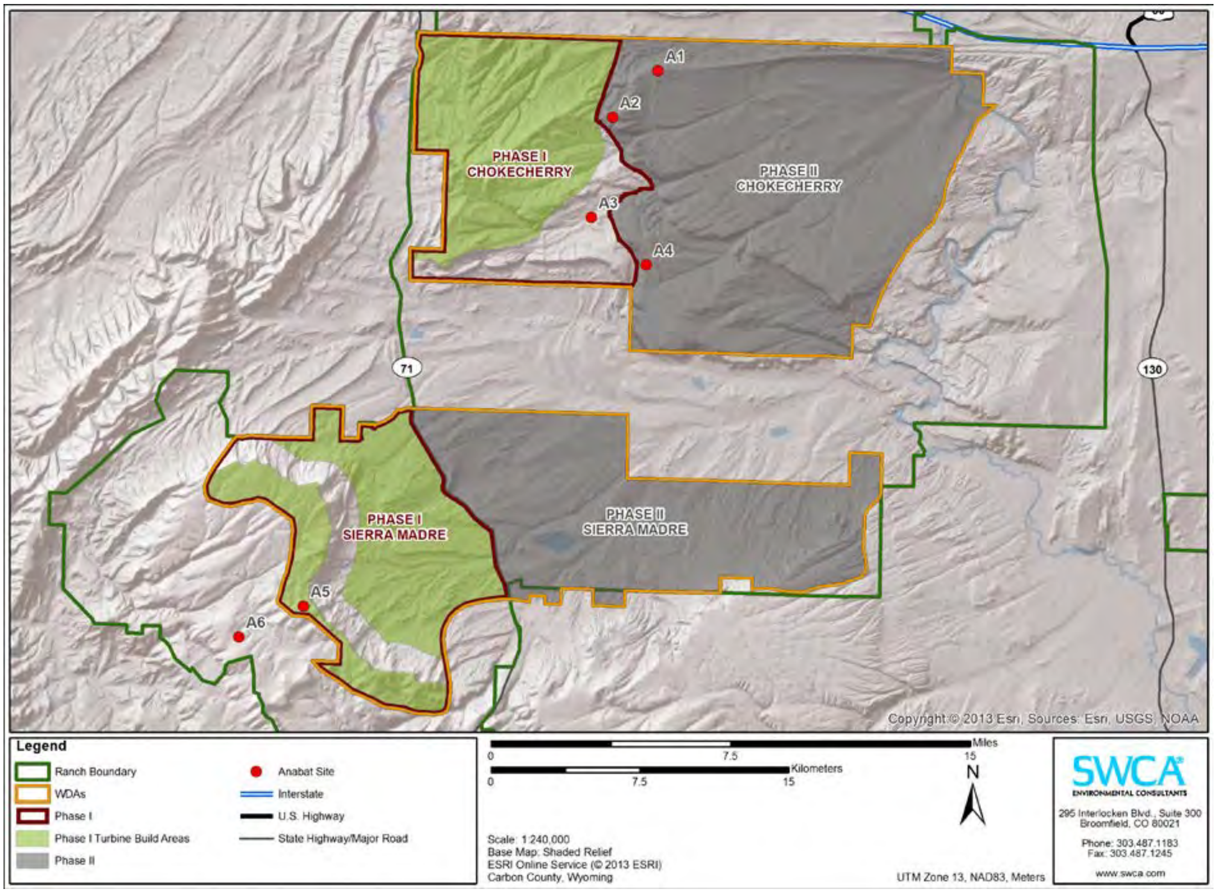

Figure 2. AnaBat sites surveyed in 2008.

2011 and 2012 Acoustic Survey Results

Bat surveys in 2011 and 2012 consisted of passive acoustic monitoring with ground-based AnaBats conducted in coordination with radar surveys. To complement data collected by the radar, acoustic bat monitoring was conducted at five locations collocated with the radar system (Chokecherry Bench, Smith Draw, Upper Iron Springs, McKinney Creek, and Pine Grove) (Figure 3) to characterize nightly bat activity during periods from June 15 to October 20, 2011, and June 27 to August 29, 2012. Collectively, sites were surveyed for 95 detector-nights in 2011 and 62 detector-nights in 2012. In total, 185 and 134 bat passes were recorded in 2011 and 2012, respectively, for an average of 2.0 bat passes/detector-night across years, nearly identical to the 1.9 bat passes/detector-night (after removal of the A3 site located in Hugus Draw) documented in 2008 (Table 1).

Activity levels were variable during the 2011 and 2012 survey periods. There was a spike in the number of bat passes on July 24, 2011 (26 total bat passes) and over the nights of July 11, 2012 (17 bat passes) and July 12, 2012 (15 bat passes). These peaks in activity are similar in timing to a spike in activity on July 27, 2008 (Solick et al. 2008).

In 2011, activity levels decreased in mid-August and remained low from September 23 to October 20, averaging less than 1 bat pass/detector-night. This low activity is similar to that reported for the September to October period in 2008. The 2011 surveys recorded more mid- and high-frequency (156; 84% of all bat passes) than low-frequency (29; 16%) bat passes. Hoary bat comprised 4% of all bat passes and was specifically identified in the data on four nights (July 30, and August 12–14). Surveys in 2012 had trends similar to the 2011 surveys with mid- and high-frequency bat passes accounting for 115 (86%) of the 134 total bat passes. Ten bat passes were attributable to hoary bat (7% of all bat passes) evenly spaced across seven nights between July 26 and August 29, 2012.

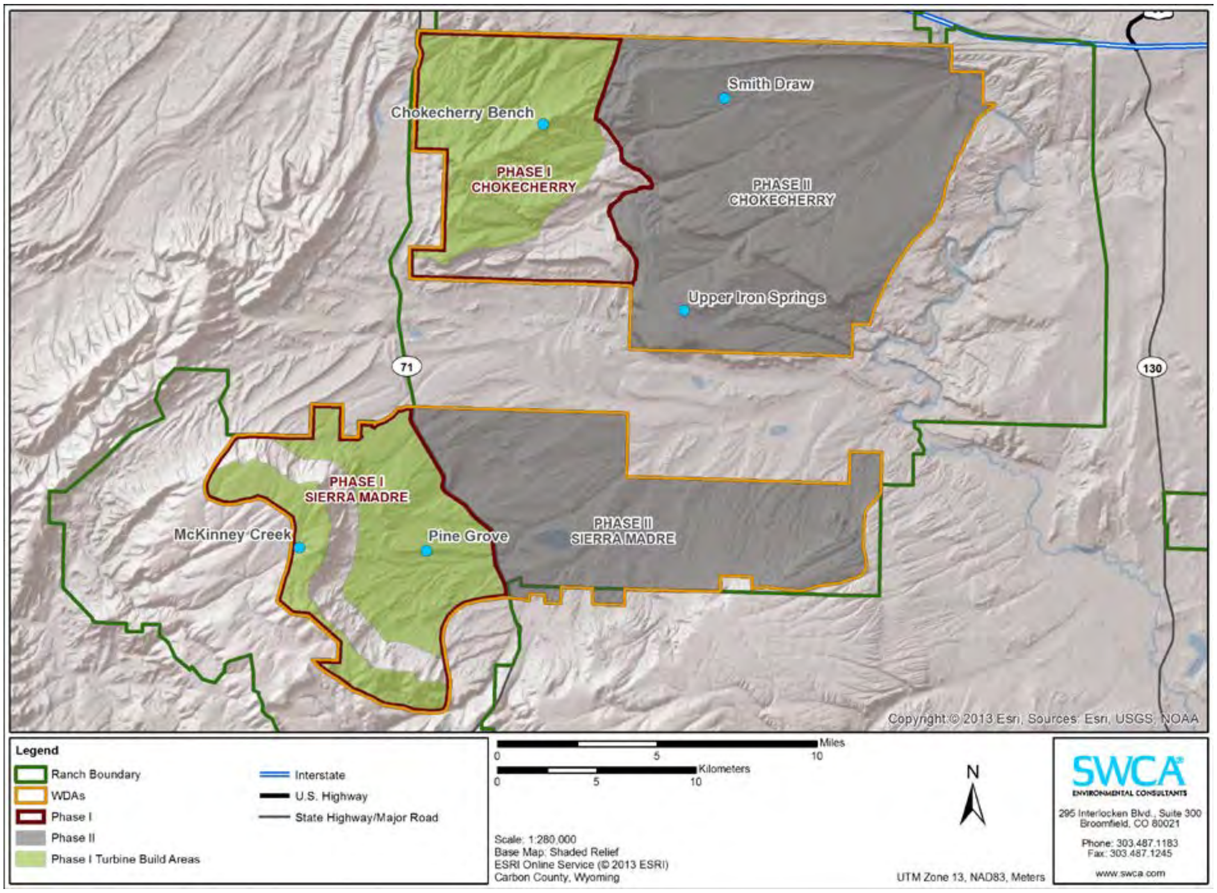

Figure 3. AnaBat sites surveyed in 2011 and 2012.

2011 through 2013 Radar Surveys

Bird and bat activity detected by the radar system does not correlate to the ground-based bat activity detected by the AnaBat unit. In fact, radar data collected during periods of increased AnaBat activity show a trend towards a period of low activity (DeTect 2013). However, the radar dataset is useful for analysis of broad-front migratory patterns of avian and bat species. The radar data consistently demonstrate that the highest average number of targets detected per hour on the CCSM Project Site occur at night during the spring and fall seasons. The summer seasons showed lower numbers of targets per hour distributed more evenly during the day and night, while the winter seasons showed a large decrease in the number of targets recorded per hour. This is consistent with expected avian and bat migratory events passing over the area. Further, the radar data show that 90% to 95% of all targets detected by the radar, which includes both birds and bats, were flying above the wind turbine rotor swept zone at altitudes where there is no risk of collision.

SUMMARY

Acoustic bat surveys were conducted for the CCSM Project during the summer and fall seasons in 2008, 2011, and 2012. The average number of bat passes per night was consistent between survey years at 1.9 in 2008 (after removal of the A3 site outlier), 1.9 in 2011 and 2.2 in 2012. These bat passage rates are consistent with the 2.2 bat passes per night observed at the nearby Foote Creek Rim wind project (Gruver 2002). All three years of acoustic survey show the highest bat activity occurred in July and August during favorable weather conditions. Further, the surveys show that bat activity was relatively low in September and October indicating that resident bat activity as well as bat migration is tapering off during that period. In addition, data collected by the radar between 2011 and 2013 for all biological targets, including avian and bat species, showed that 90% to 95% of the flight paths occur above the wind turbine rotor swept zone; demonstrating that these targets would not be at risk of collision. Therefore, because ground level bat activity measured using passive acoustic monitoring on the CCSM Project site is relatively low and the recorded flight heights of any potential migrating bats or avian species are well above the rotor swept zone, impacts to bat species are expected to be minimal for the CCSM Project.

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APPENDIX F

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FINAL REPORT

Raptor Nest Surveys for the Chokecherry and Sierra Madre Wind Resource Areas Carbon County, Wyoming

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION AND BACKGROUND

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming, capable of producing 2,000 megawatts (MW) of energy with 1,000 wind turbines. The wind-energy facility will be constructed in two project areas, referred to as the Chokecherry and Sierra Madre Wind Resource Areas (WRAs; Figure 1). Both WRAs are a mixture of Bureau of Land Management (BLM), State of Wyoming, and private lands.

In the preferred alternative of the Environmental Impact Statement (EIS) prepared for the new Resource Management Plan for the Rawlins District (BLM 2008), the “no surface occupancy” buffer for raptor nests is 1,200 feet (ft; 0.23 miles; 0.37 kilometers [km]) for ferruginous hawks (*Buteo regalis*) and 825 ft (0.16 miles; 0.25 km) for all other raptor species. In addition, no construction activities are allowed within one mile (1.61 km) of active golden eagle (*Aquila chrysaetos*) and ferruginous hawk nests or within 0.75 miles (1.20 km) of all other raptor species during the nesting season. Depending on species, the seasonal timing restrictions to protect nesting raptors covers the period February 1 to July 31. The objectives of this study were to locate and map raptor nests in and within one mile of the WRAs so that nest locations can be considered when siting wind energy facilities, planning construction activities, and characterizing use of the WRAs by nesting raptors.

STUDY AREA

The proposed WRAs are located in Carbon County (Figure 1) approximately four miles (6.4 kilometers [km]) south of Rawlins, Wyoming, within T 16 N – T 18N, R 88 W – R 89W and T 19 N – T21N, R 85 W – R 88W. The Chokecherry WRA is dominated by sagebrush steppe and mixed grass prairie. Topography in the area is rolling hills throughout much of the WRA, with topography becoming more varied in the southern portion (Figure 1). A distinct rim with a steep cliff face dominates the southern boundary of the WRA. The general land practice is cattle grazing.

The Sierra Madre WRA is dominated by sagebrush steppe with pockets of quaking aspen (*Populus tremuloides*). Topography in the WRA ranges from gently rolling plains in the northern portion to rolling hills in the southern portion. The escarpment of Miller Hill dominates the northern boundary of the WRA. Drainages in the southern portion are dominated by willow (*Salix* spp.). The general land practice is also cattle grazing.

METHODS

The goal of the nesting raptor survey was to gather information on nesting species visible from the air, locations of the nests, and timing of nesting by raptor species in the WRAs. The nest search area included each WRA and an approximate one-mile (1.6 km) buffer, which totaled approximately 183.2 square miles (mi^2; 474.5 square kilometers [km^2]) for the Chokecherry WRA and 86.2 mi^2 (223.3 km^2) for the Sierra Madre WRA. The survey was conducted by helicopter from May 14 to May 30, 2008.

Raptor nests were surveyed for by flying in a helicopter and searching suitable habitat (stands of trees, rocky areas and cliffs) for nests. Surveys were conducted while flying at a maximum altitude of 250 ft (76.2 meters [m]) and an approximate airspeed of 30 miles per hour (mph; 48.3 kilometers per hour [kph]). If a nest was observed, the helicopter was moved to a position where it could be determined if the nest was occupied and what species was using the nest. Efforts were made to minimize disturbance to breeding raptors, including keeping the helicopter at a maximum distance from the nest in which the species could be determined. Locations of inactive nests were also recorded as they may become occupied during subsequent years. All nests, whether active or inactive, were given a unique identification number and the Universal Transverse Mercator (UTM) location was recorded with a global positioning system (GPS). In addition to the aerial surveys, raptor nests observed while conducting other study activities at the WRAs (e.g., burrowing owl [*Athene cunicularia*]) were recorded and mapped.

To supplement data collected during the 2008 nesting season, all raptor nest records for the Chokecherry and Sierra Madre WRAs maintained by the BLM were obtained. These records include nests located since 1980 (a 28–year period) and therefore do not reflect expected raptor nesting activity for any given year. Prior to 1996, the BLM mapped raptor nest locations opportunistically. Since 1996, specific surveys have been conducted to map raptor nests in the Rawlins Field Office. These records have been supplemented with raptor nests located as part of the permitting process for development activities such as pipelines and oil and gas developments (Heath Cline, Wildlife Biologist, BLM Rawlins Field Office, personal communication 10-22-08).

RESULTS

Twenty-four active raptor nests, consisting of 11 nests of red-tailed hawk (*Buteo jamaicensis*), five of prairie falcon (*Falco mexicanus*), five of great horned owl (*Bubo virginianus*), and three of golden eagle were located during 2008 aerial surveys of the WRAs (Table 1). Two burrowing owls were also observed from the ground on the Chokecherry WRA, and it is assumed the burrowing owls were nesting in the area.

Twelve of the active raptor nests were found in or within one mile (1.6 km) of the Chokecherry WRA, and 12 were found in or within one mile of the Sierra Madre WRA (Figure 2). Fourteen (58%) of the active raptor nests were located in trees while the remaining 10 (42%) were located on cliffs (Table 1). Three of the four great horned owl and 10 of the 11 red-tailed hawk nests were in trees, whereas one great horned owl, one red-tailed hawk, and all golden eagle and prairie falcon nests were located on cliffs. Either eggs or chicks were observed in all active nests (Table 1).

A total of 110 inactive nests were also located, with 55 in or within one mile (1.6 km) of the Chokecherry WRA and 55 in or within one mile of the Sierra Madre WRA (Figure 3). Forty-eight percent of the inactive nests were on cliffs, 51% were in trees and 1% was on rock. All inactive nests were classified as being in good condition.

Most of the active and inactive raptor nests on the Chokecherry WRA were located along the extreme southern end of the WRA, although several also occurred along a ridgeline that runs east-west through the northern end of the project area (Figures 2 and 3). Very few active or inactive nests were located within the project boundary of the Sierra Madre WRA; the vast majority were located just outside the project boundary along steep, wooded slopes that lead away from the WRA (Figures 2 and 3).

In addition to raptors, seven active common raven (*Corvus corax*) nests and one active Canada goose (*Branta canadensis*) nest were located during aerial surveys (Table 2; Figure 2). Three of the common raven nests were in trees and four were on cliffs. The Canada goose nest was located in a tree along the North Platte River just east of the Chokecherry WRA.

Since 1980, the BLM has mapped 141 active raptor nests in or within one mile (1.6 km) of the WRAs, including 132 nests at the Chokecherry WRA, and nine at the Sierra Madre WRA (Figure 4). Over this 28-year period, golden eagle nests have been most common, with 42 active nests documented, followed by red-tailed hawk (31), ferruginous hawk (25), and prairie falcon (23). Other raptor nests located included three Cooper's hawks (*Accipiter cooperii*), three great horned owls, three American kestrels (*Falco americanus*), and one Swainson's hawk. The nest records also include two unidentified buteos and seven unidentified raptors. Most of the nests at the Chokecherry WRA occurred along the southern boundary of the WRA, although several nests were located throughout the WRA. Most of the nests found at the Sierra Madre WRA occur along the northern and eastern boundaries.

DISCUSSION

Active raptor nest density was 0.07 nests/mi^2 within the Chokecherry WRA and the one-mile (1.6-km) buffer, and 0.14 nests/mi^2 within the Sierra Madre WRA and the one-mile buffer. This is low to moderate in comparison to 16 other WRAs evaluated in the western U.S., where active raptor nest density ranged from 0.03 to 0.43 nests/mi^2 and averaged 0.22 nests/mi^2 (Table 3). The low active raptor nest density of the Chokecherry and Sierra Madre WRAs will minimize the potential impact on nesting raptors. Since few raptor species targeted during nest surveys have been observed as fatalities at newer wind-energy facilities, correlations are very low between the number of collision fatalities and raptor nest density within one-mile of the wind-energy facility. Raptors nesting closest to turbines likely have higher probabilities of being impacted from collision with turbines, but data on nests very close to turbines (e.g., within a half-mile [0.8 km]) are currently inadequate to determine the level of these impacts. The existing wind-energy facility with the highest reported nest density is the Foote Creek Rim wind-energy facility in Wyoming, which lies approximately 60 miles (96.6 km) east of Rawlins. Most of the nests within two miles (3.2 km) of the wind-energy facility are of red-tailed hawk (Johnson et al. 2000b), but no red-tailed hawk fatalities have been documented at this site (Young et al. 2003d, 2003e).

In addition to possible direct effects on raptors within the WRAs through collision mortality, indirect effects caused by disturbance-type impacts, such as construction activity near an active nest, also have a potential impact on raptors. Birds displaced from wind-energy facilities might move to areas with fewer disturbances, but with lower habitat quality, and therefore possibly reducing breeding success. Most studies on raptor displacement at wind-energy facilities, however, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, 2003; Madders and Whitfield 2006). At a wind-energy facility in eastern Washington, based on extensive monitoring using helicopter flights and ground observations, raptors still nested in the area at approximately the same levels after construction, and several nests were located within a half-mile (0.80 km) of turbines (Erickson et al. 2004). At the Foote Creek Rim wind-energy facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 miles (0.78 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl nest, and one golden eagle nest located within one mile (1.6 km) of the wind-energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested a half-mile from the wind-energy facility for three different years after it became operational. A Swainson's hawk also nested within a quarter-mile (0.4 km) of a turbine string at the Klondike I wind-energy facility in Oregon after the facility was operational (Johnson et al. 2003).

Notable exceptions to this include a study in Scotland that described territorial golden eagles avoiding the entire wind-energy facility area, except when intercepting non-territorial birds (Walker et al. 2005). The only published report of avoidance of wind turbines by nesting raptors occurred at Buffalo Ridge, Minnesota, where raptor nest density on 101 mi^2 (261.6 km^2) of land surrounding a wind-energy facility was 5.94 nests/39 mi^2 (5.94 nests/101.0 km^2), yet no nests were present in the 12 mi^2 (31.1 km^2) wind-energy facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumed that raptor nests are uniformly distributed across the landscape, an unlikely event, and even though no nests were found, only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. A subsequent study at the Buffalo Ridge wind-energy facility in Minnesota found evidence of northern harriers (*Circus cyaneus*) avoiding turbines on both a small scale (< 328 ft [100 m] from turbines) and a larger scale (344-17,958 ft [105–5,364 m] from the nearest turbine) in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected. These observations suggest that there will be limited nesting displacement of raptors at the Chokecherry and Sierra Madre WRAs, although the creation of a buffer surrounding known nests when siting turbines will further reduce any potential impact.

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Table 1. Composition and description of active raptor nests on the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming, Spring 2008.

			Nest Substrate
Chokecherry WRA			
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Cliff
red-tailed hawk	Active-eggs	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
Subtotal	12 nests		
Sierra Madre WRA			
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
Subtotal	12 nests		
Total	24 nests		

Table 2. Composition and description of active non-raptor nests on the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming, Spring 2008.

			Nest Substrate
Chokecherry WRA			
common raven	Active-chicks	Good	Cliff
common raven	Active-eggs	Good	Cliff
common raven	Active-chicks	Good	Cliff
common raven	Active-chicks	Good	Cliff
Canada goose	Active-eggs	Good	Tree
Sierra Madre WRA			
common raven	Active-chicks	Good	Tree
common raven	Active-eggs	Good	Tree
common raven	Active-chicks	Good	Tree
Total	**8 nests**		

Table 3. Estimated raptor nest densities from other proposed and existing wind-energy facilities located primarily in the western U.S.

Wind Resource Area	Density (# nests/mi^2)
Chokecherry, Wyoming	0.07
Sierra Madre, Wyoming	0.14
Biglow, Oregon	0.15
Klondike III,Oregon	0.16
Leaning Juniper, Oregon	0.41
Stateline, Oregon-Washington	0.21
Nine Canyon, Washington	0.03
Zintel Canyon, Washington	0.08
Buffalo Ridge, Minnesota	0.15
Klickitat County, Washington	0.12
Combine Hills, Oregon	0.24
Columbia Hills, Washington	0.30
Ponnequin, Colorado	0.06
Hopkins Ridge, Washington	0.43
Maiden, Washington	0.18
Wild Horse, Washington	0.16
Kittitas Valley, Washington	0.09
Desert Claim, Washington	0.34
Average	**0.19**

Biglow, OR	WEST 2005	Combine Hills, OR	Young et al. 2003c
Klondike III, OR	Mabee et al. 2005	Columbia Hills, WA	BPA 1995
Leaning Juniper, OR	NWC and WEST 2005	Ponnequin, CO	Kerlinger et al. 2000
Stateline, OR/WA	URS and WEST 2001	Hopkins Ridge, WA	Young et al. 2003a
Nine Canyon, WA	Erickson et al. 2005	Maiden, WA	WEST and NWC 2002a
Zintel Canyon, WA	WEST and NWC 2002b	Wild Horse, WA	Erickson et al. 2003b
Buffalo Ridge, MN	Johnson et al. 2000	Kittitas Valley, WA	Erickson et al. 2003a
Klickitat County, WA	Erickson et al. 1999	Desert Claim, WA	Young et al. 2003b

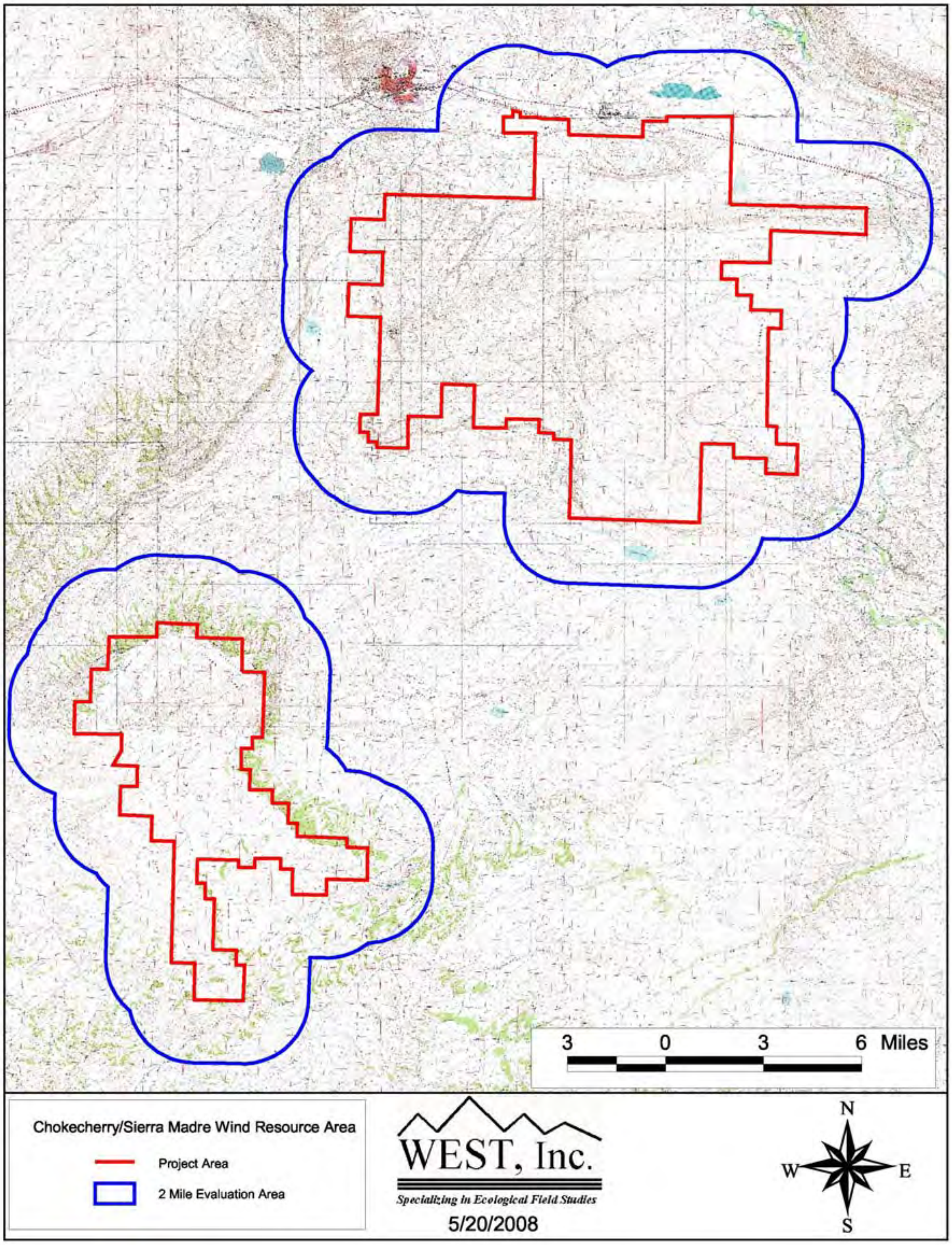

Figure 1. Location of the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming.

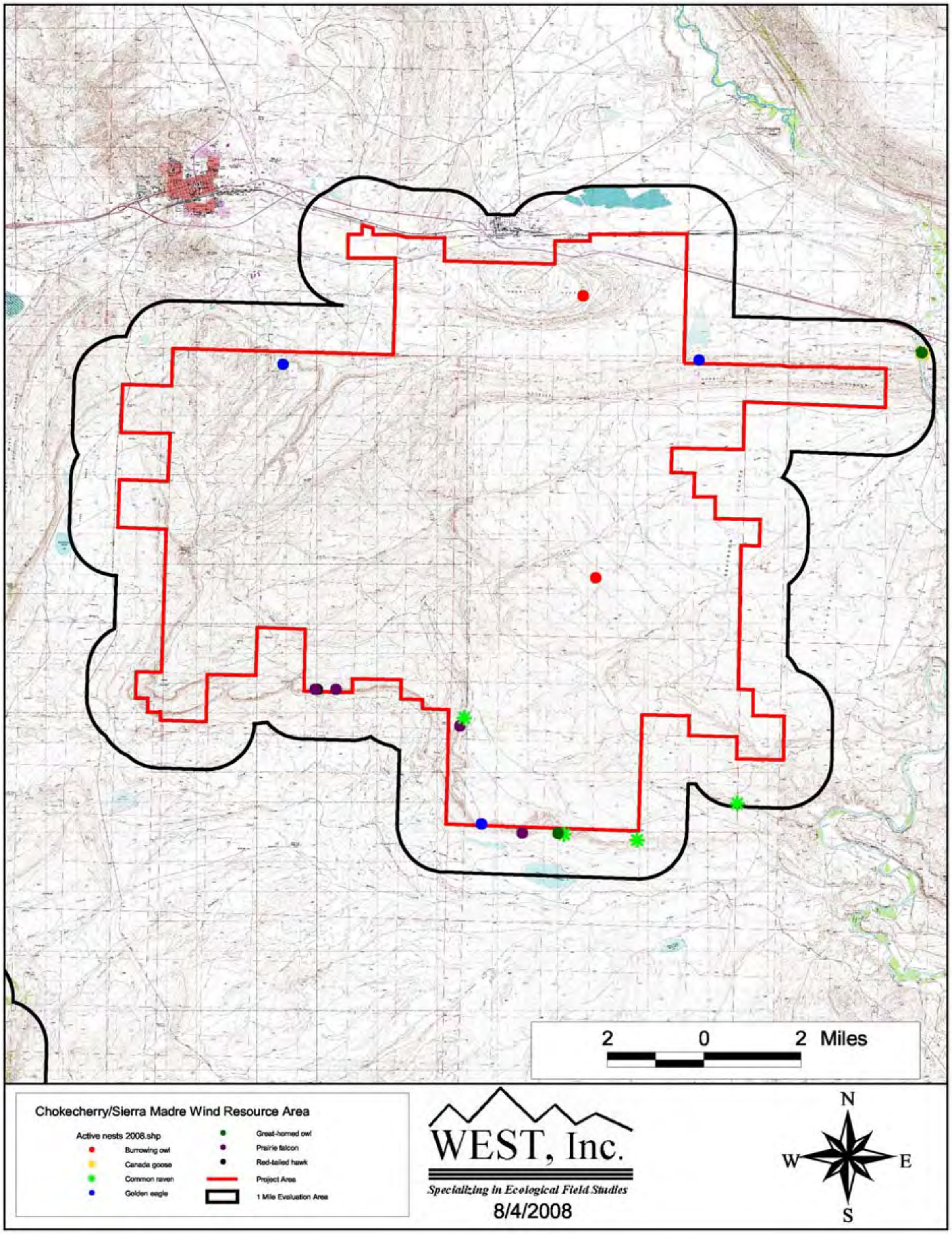

Figure 2a. Locations of active raptor nests at the Chokecherry WRA in Carbon County, Wyoming, April 2008.

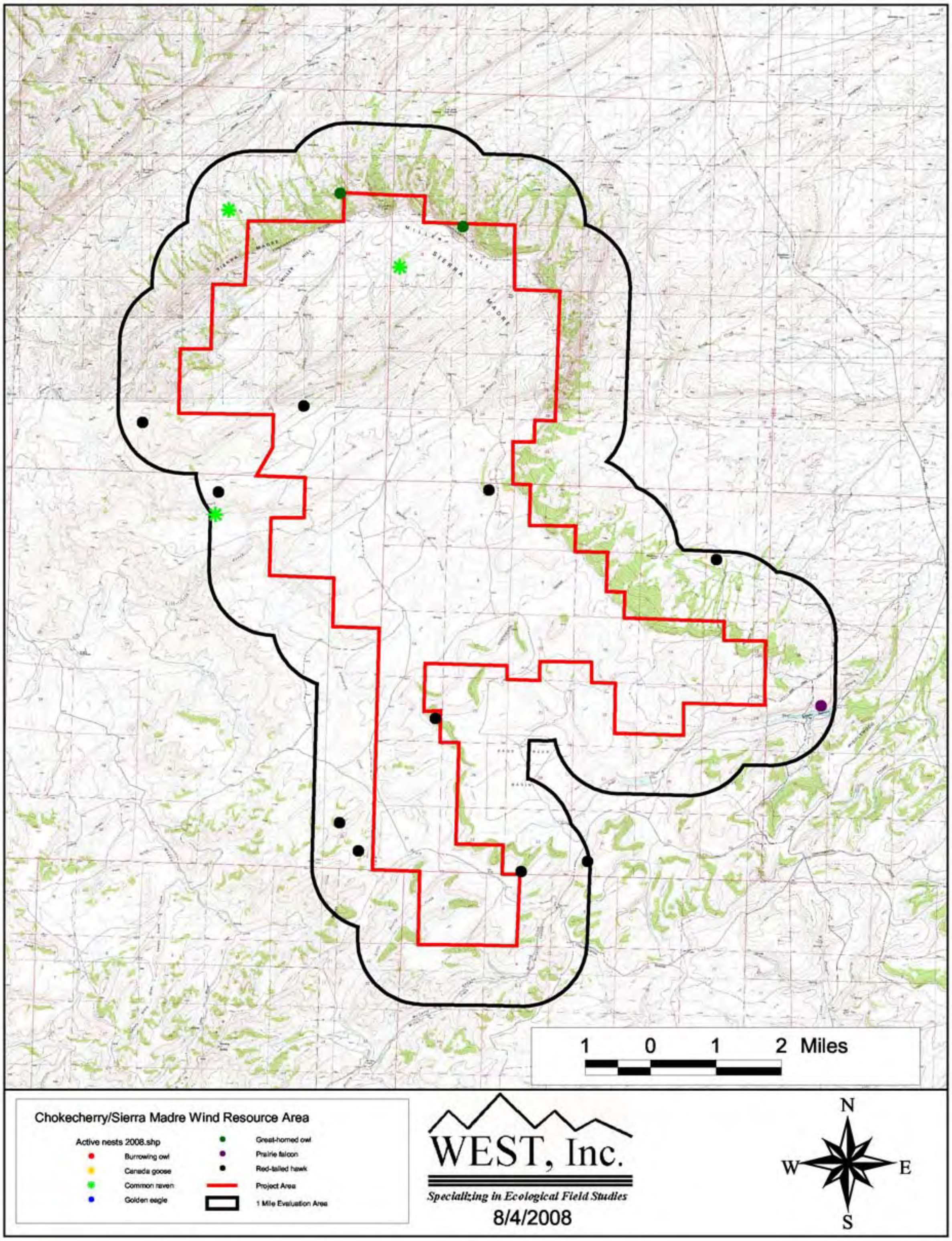

Figure 2b. Locations of active raptor nests at the Sierra Madre WRA in Carbon County, Wyoming, April 2008.

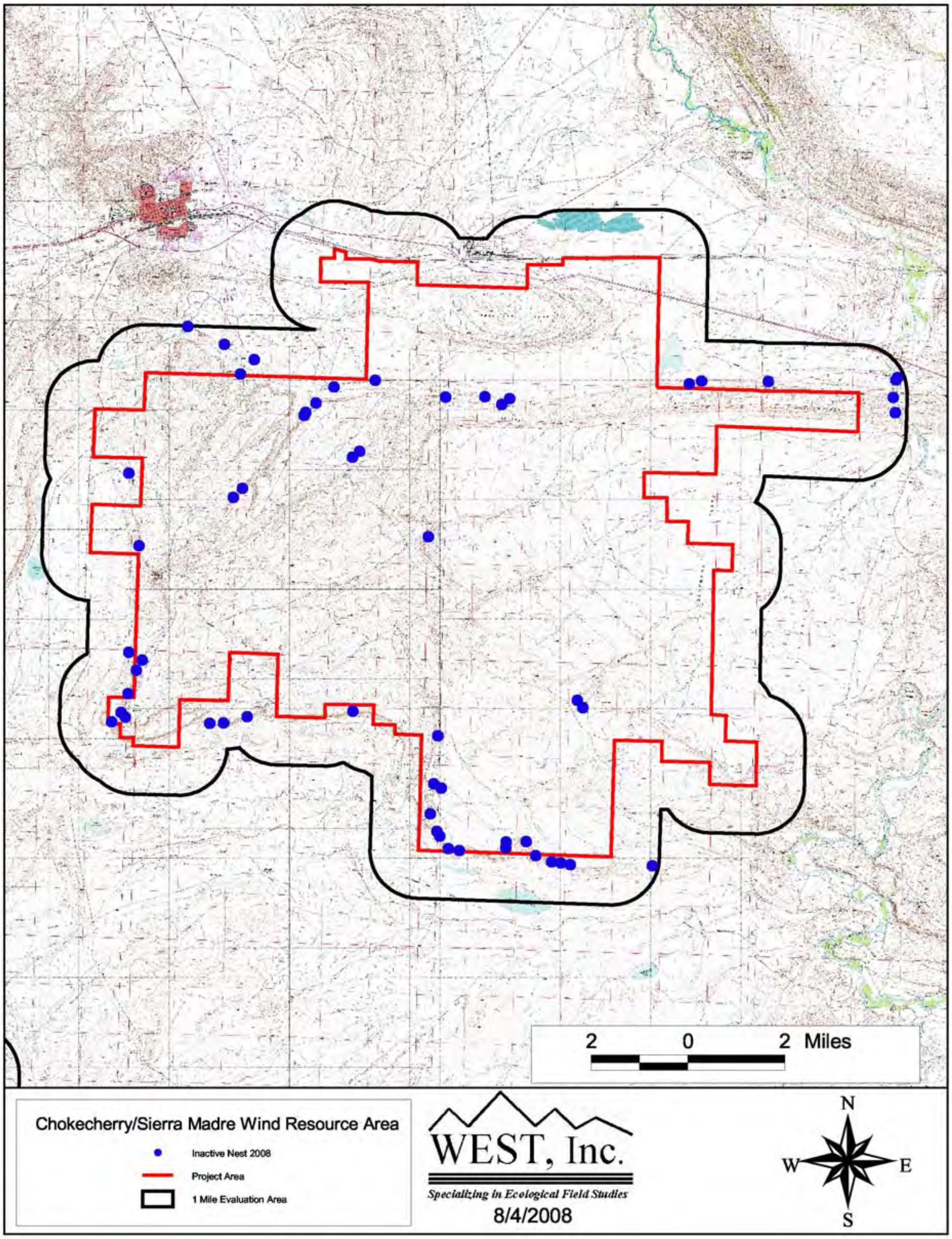

Figure 3a. Locations of inactive raptor nests at the Chokecherry WRA in Carbon County, Wyoming, April 2008.

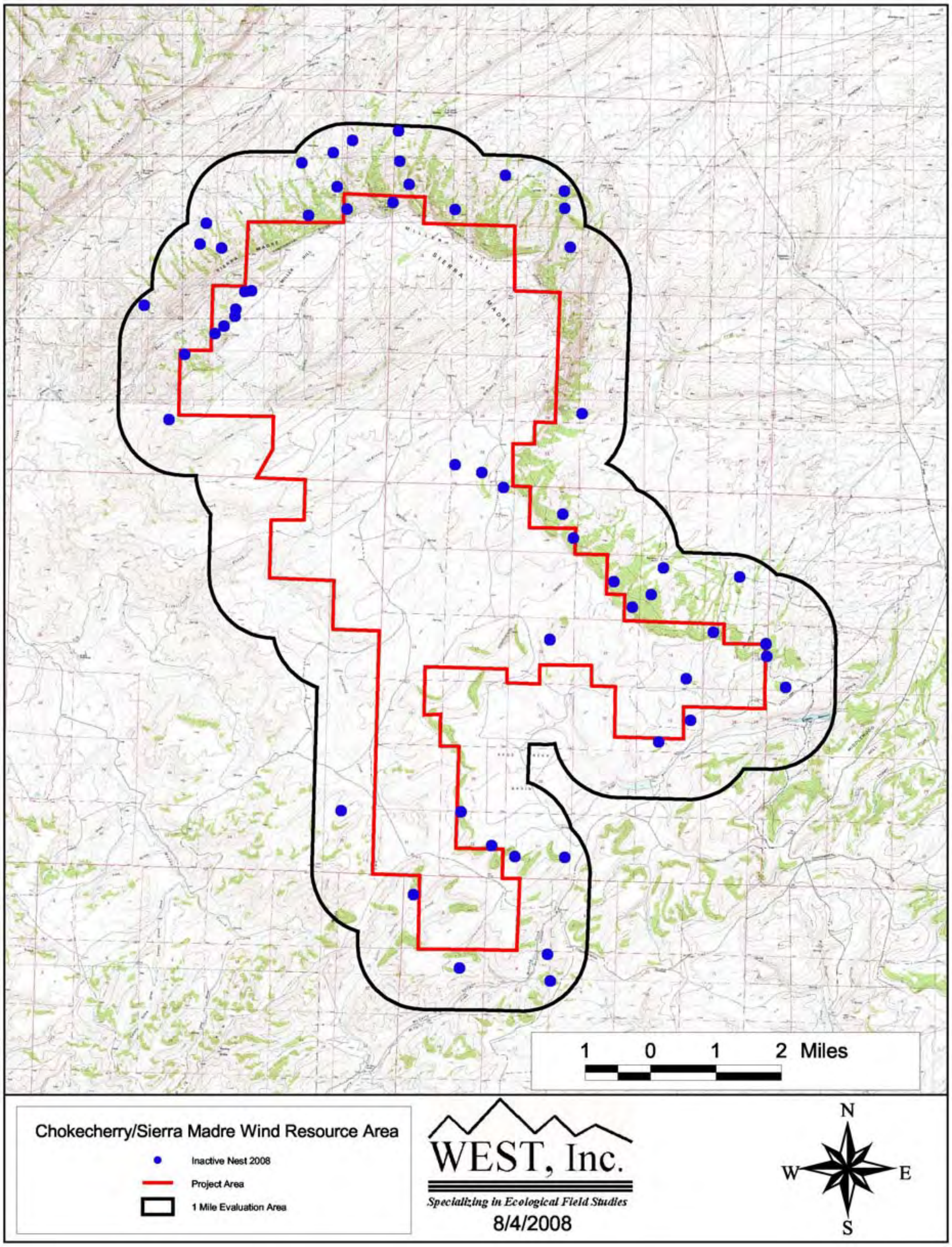

Figure 3b. Locations of inactive raptor nests at the Sierra Madre WRA in Carbon County, Wyoming, April 2008.

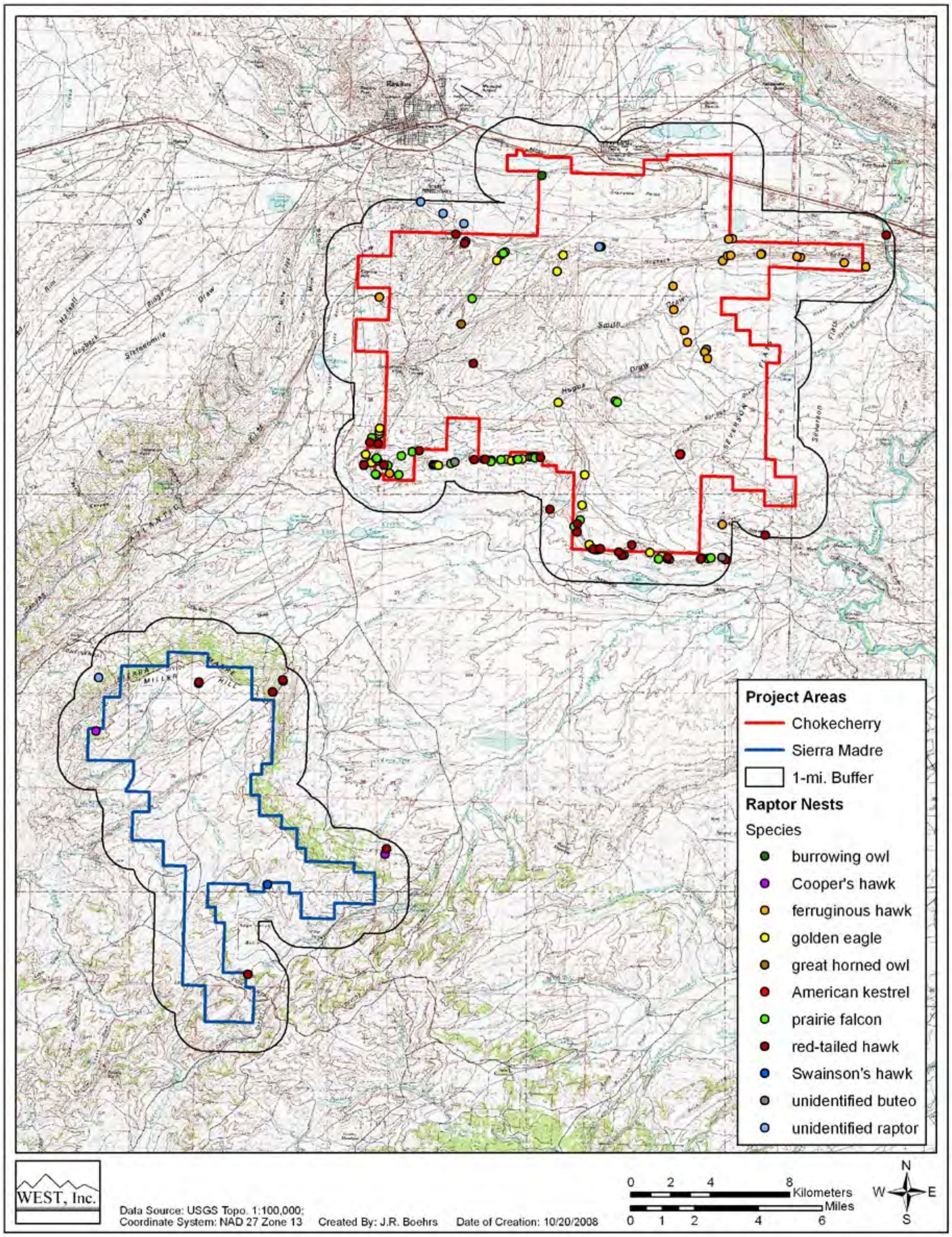

Figure 4. Locations of active raptor nests from BLM records at the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming.

Summary Report for 2011 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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October 6, 2011

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

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INTRODUCTION

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project area, which could also assist in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer. Data from those BLM monitoring efforts will be considered during development of the Avian Protection Plan and Eagle Conservation Plan.

Three types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter survey flight path. All ferruginous hawk (*Buteo regalis*) nests in the Project footprint were visited to assess current condition. Multiple nest monitoring visits were made to all active eagle nests and many of the active *Buteo* nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on May 25 and June 10. Surveys on May 25 were completed primarily for the Chokecherry portion of the Project and the North Platte River corridor. Surveys on June 10 were completed for the Sierra Madre portion of the Project area as well as the Atlantic Rim. During the June 10 flight, several of the active nests identified during the May 25 surveys were revisited to assess nest activity and the development stage of the chick(s) on the nest.

Nineteen hours were spent flying the Project area and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office (RFO) for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. While the focus of the nest flights was on the three previously mentioned species, any active raptor nest that was encountered during the course of the flights was documented. Additionally, all inactive or historic nests in poor condition that were observed during aerial surveying efforts were recorded. Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipter nests in the Project area. Ground surveys also identified a previously unknown bald eagle nest. Due to an abundance of late season snowpack, areas around the base of Miller Hill were inaccessible until late spring, at which time the groves of quaking aspen (*Populus tremuloides*) had fully leafed out. While locating nests in these groves proved mostly unsuccessful, any raptor activity occurring in these areas would be captured by the four raptor monitoring points located around Miller Hill. Ground surveys also included visits to all historic ferruginous hawk nests in the Project area to evaluate current nest condition and determine when the nest had last been active. All ferruginous hawk nests in the survey area were inactive in 2011 and many of the historic nests identified in the BLM datasets were no longer viable for nesting activities (Appendix A). All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

In total, 23 active raptor nests were located within the Project area and associated 5-mile buffer (Figure 1). The species composition of the active raptor nests were as follows: eight golden eagle, four bald eagle, six red-tailed hawk (*Buteo jamaicensis*), three prairie falcon (*Falco mexicanus*), one unknown *Buteo* (likely red-tailed hawk), and one American kestrel (*Falco sparverius*). An additional three active non-raptor nests were located during the flights and included one turkey vulture (*Cathartes aura*), one common raven (*Corvus corax*), and one unknown large species. The unknown large species nest was a medium-sized stick nest in a crevice of a cliff band, and was likely either a *Buteo* species or a common raven. All active golden eagle and bald eagle nests were located outside of the wind development footprint although three of the eagle nests (two golden eagle and one bald eagle) were located within 1 mile of potential turbine locations. Most active eagle nests were located east and southeast of the Chokecherry portion of the Project along cliff bands on the Bolten Rim and the North Platte River. One active eagle nest was located on the Sierra Madre portion of the Project. The remaining active eagle nests were located south of Middlewood Hill along Jack Creek and in the south Sage Creek Basin. All of the active golden eagle and bald eagle nests were observed to have one to two nestlings present, while the majority of the other active raptor nests appeared to be in the incubation or brooding stages. Appendix B contains representative photographs of the types of active and inactive nests that were observed during surveys.

NEST MONITORING

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project area between July 5 and August 2. By July 20, four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Additionally, three other *Buteo* and falcon nests were confirmed as fledged or inactive. As of August 2, the final four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Of the remaining active *Buteo* and falcon nests, four were confirmed as fledged or inactive. Two red-tailed hawk nests remained active as of August 2, and two falcon nests were unable to be relocated during ground surveys due to the nests being built into cavities and tight crevasses along cliff bands.

SUMMARY

In addition to the 23 active raptor nests, 158 inactive nests were also located and documented during the nest flights and other nest searching activities. These nests were located across the Project area and associated buffer; however, the vast majority were located along the Bolten Rim and around the perimeter of the Chokecherry plateau. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not able to be located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

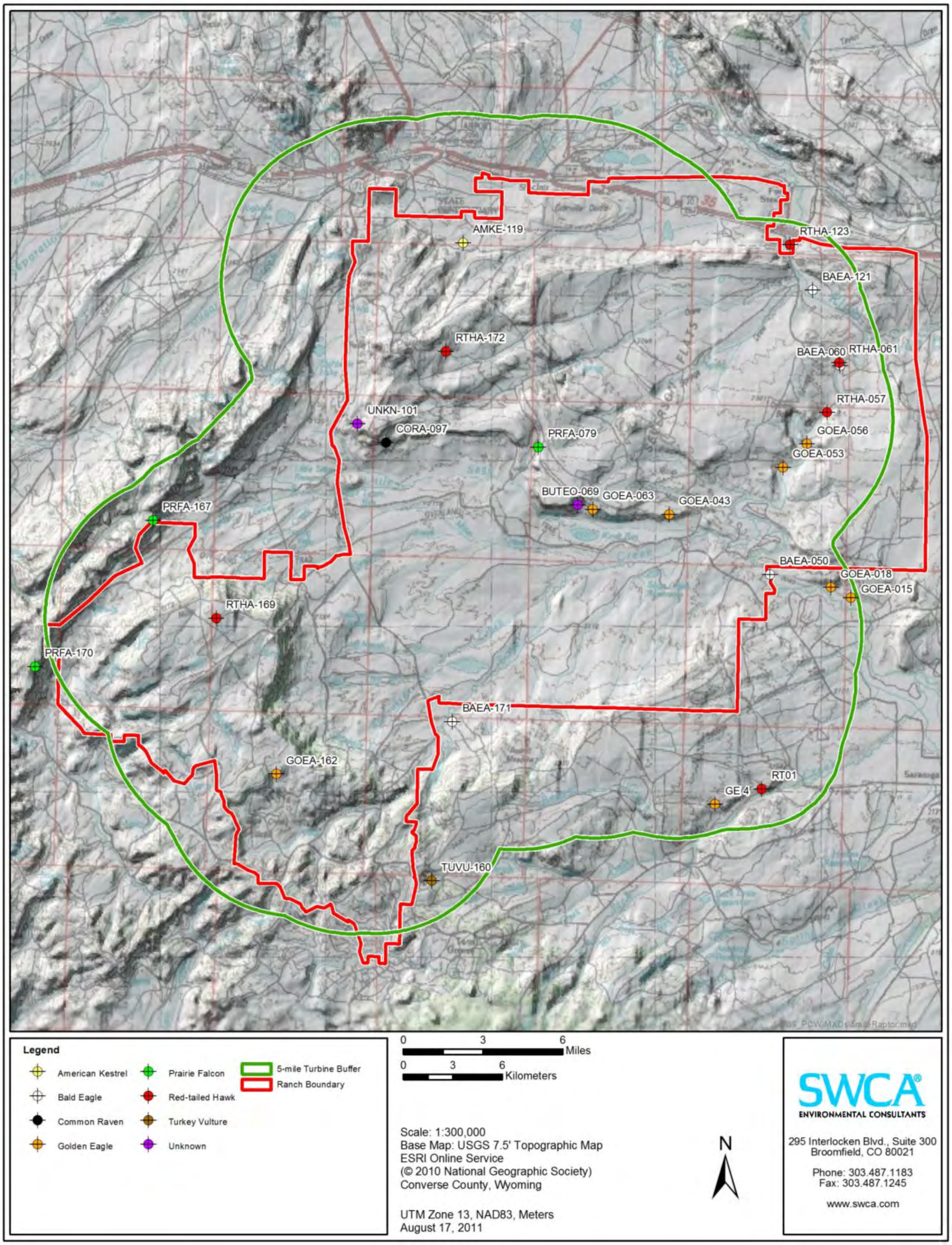

Figure 1. Project area boundary, 5-mile turbine buffer, and all active nests located within the 5-mile turbine buffer in 2011.

APPENDIX A
BLM Ferruginous Hawk Dataset

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BLM FERRUGINOUS HAWK DATASET

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. As part of SWCA's nest survey and monitoring effort, ground surveys were conducted to determine the status and condition of all ferruginous hawk (*Buteo regalis*) nests documented by the Bureau of Land Management (BLM) within the Project footprint. Forty ferruginous hawk nest sites were identified in the Project area from data shared by the BLM, and each of these nest sites was visited during 2011 ground surveys (Figure A-1). Data collected included presence/absence of a nest at each site; a description of the state of the nest (if a nest was detected); a description of the habitat surrounding the site; photographs of the nest and surrounding habitat (photographs are provided in Appendix B); and the presence of other features that could suggest recent ferruginous hawk activity (e.g., feathers, whitewash, fresh nesting materials, etc.). Of the 40 nest sites identified from the BLM data, 15 nest structures in various stages of condition and quality were located, some with almost no structure remaining. Additionally, seven historic sites were observed that may have once supported a nest; however, now only a few deteriorated sticks remain. Few of these nest structures were located at the BLM sites; however, SWCA surveyed at minimum 100 meters (m) around each of the BLM sites for nest structures as they were likely marked during aerial surveys, which can lead to some degree of inaccuracy in each location. Results for each BLM ferruginous hawk nest site are listed below.

FH18851701: No nest was detected at this site, which is located on a rocky hilltop (Appendix B, Photo 14). An historic nest site is located approximately 22 m northwest of the BLM site (Universal Transverse Mercator [UTM] 13T 0334724, 4599927). The nest is in extremely poor condition with only a few sticks on a small rock outcrop (Appendix B, Photo 15). There were no signs of recent ferruginous hawk activity.

FH18870101: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks and a small amount of old whitewash, but no remaining nest structure (Appendix B, Photo 16). No signs of recent ferruginous hawk activity were observed.

FH18870201: This site is located in a drainage with no evidence of active or historic nests within 100 m of the site (Appendix B, Photo 17). No signs of recent ferruginous hawk activity were observed.

FH18870202: No nest was detected at this site. The site is located on a hillslope, and no signs of recent ferruginous hawk activity were present (Appendix B, Photo 18). A nest is located approximately 64 m north of the BLM site (UTM 13T 0320037, 4603851). This nest is located on a hillslope and is in fair condition; however, there were no other signs of recent ferruginous hawk activity (Appendix B, Photo 19).

FH19860301: A nest is located approximately 15 m east of this site (UTM 13T 0327708, 4612200). The nest is in good condition, likely used in the recent past (Appendix B, Photo 20), with a small amount of whitewash observed around the nest. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-153).

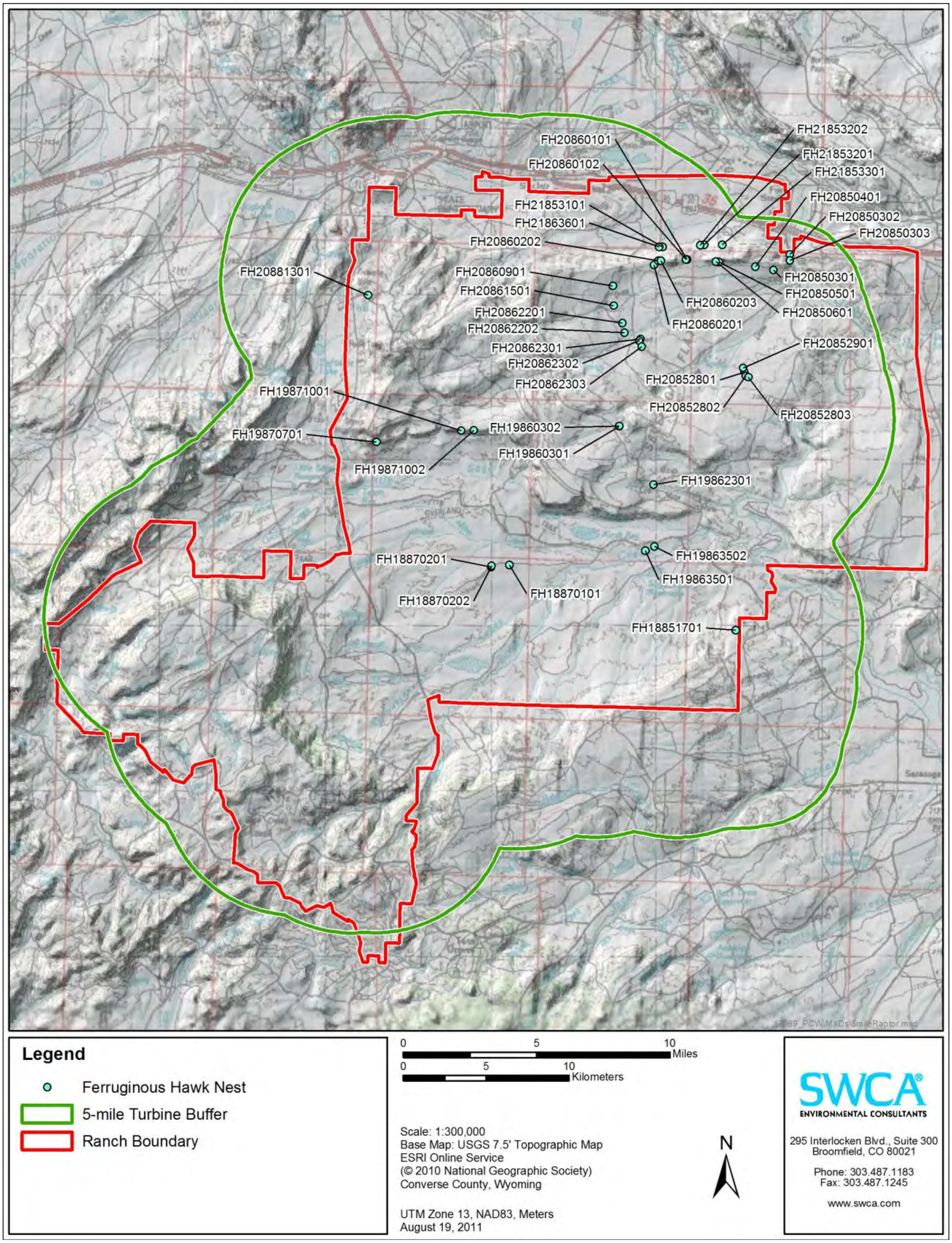

Figure A-1. Project area boundary, 5-mile turbine buffer, and all BLM ferruginous hawk nest sites within the Project area.

<u>FH19860302</u>: No nest was detected at this site. The site is on a rocky hilltop (Appendix B, Photo 21) and is located approximately 35 m north of FH1986031. The area surrounding both of these sites was searched, but no additional nests were detected. No signs of recent ferruginous hawk activity were observed.

<u>FH19862301</u>: No nest was detected at this site. This site is located in sagebrush and bare ground on a hillslope below a cliff band (Appendix B, Photo 22). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH19863501</u>: A nest was detected approximately 20 m north of the BLM site (UTM 13T 0329290, 4604725). The nest is located on a hilltop and is in fair condition, likely having been used in recent years (Appendix B, Photo 23). No other signs of recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-154).

<u>FH19863502</u>: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks, but no remaining nest structure (Appendix B, Photo 24). No signs of recent ferruginous hawk activity were observed.

<u>FH19870701</u>: No nest was detected at this site, which is located partway down a cliff band (Appendix B, Photo 25). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

<u>FH19871001</u>: No nest was detected at this site, which is located at the base of a cliff band above a rock outcrop (Appendix B, Photo 26). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

<u>FH19871002</u>: No nest was detected at this site. The site is located at the base of a cliff band (Appendix B, Photo 27) with signs of recent whitewash along the cliff band. A nest is located approximately 84 m northwest of the BLM site (UTM 13T 0318857, 4612023). The nest is located at the base of the cliff band on a rock outcrop and is in poor condition (Appendix B, Photo 28). No other signs of recent ferruginous hawk activity were observed.

<u>FH20850301</u>: No nest was detected at this site. The site is located in sagebrush and a bare ground drainage at the base of a small hillslope (Appendix B, Photo 29). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed on a perch 70 m to the north.

<u>FH20850302</u>: This site contains a large nest on a rock outcrop near the North Platte River (Appendix B, Photo 30). The nest is in good condition with relatively fresh grass woven into the inner bowl of the nest; the nest was likely used in the recent past. No feathers, whitewash, or other signs of recent ferruginous hawk activity were observed.

<u>FH20850303</u>: A nest was detected approximately 25 m south of the BLM site. The nest is located on a rock outcrop near the North Platte River. The nest is in poor condition and

appeared to be falling off the rock shelf on which it was originally built, which led to the structure being compromised (Appendix B, Photo 31). No signs of recent ferruginous hawk activity were observed.

FH20850401: No nest was detected at this site. The nest site is located on bare ground at the base of a hillslope (Appendix B, Photo 32). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850501: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 33). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850601: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 34). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20852801: The remnants of an historic nest are located approximately 16 m west of the BLM nest site at the base of a rock outcrop. The site mainly consists of a few deteriorated sticks, but there is no remaining nest structure (Appendix B, Photo 35). A small amount of old whitewash was observed on the rock outcrop, but there were no signs of recent ferruginous hawk activity.

FH20852802: A nest is located approximately 18 m north of the BLM site (UTM 13T 0335323, 4615247) on a rock outcrop. The nest is in fair to good condition with good structure, but is slightly collapsed (Appendix B, Photo 36). There were no signs of recent ferruginous hawk activity.

FH20852803: No nest was detected at this site, which is located on bare ground in a basin (Appendix B, Photo 37). The remnants of an historic nest are located approximately 95 m east of the BLM site (UTM 13T 0335585, 4615203) on a rock outcrop. The nest is in very poor condition and is mainly a pile of deteriorated sticks (Appendix B, Photo 38). No signs of recent ferruginous hawk activity were observed.

FH20852901: No nest was detected at this site. The site is located on bare ground near saltbush and next to a creek bed (Appendix B, Photo 39). A nest is located approximately 200 m north of the BLM site (UTM 13T 0335189, 4615940) on a rock outcrop. The nest is in fair condition and has potential for reuse in the future (Appendix B, Photo 40). Old whitewash is present at the site, but no other signs of recent ferruginous hawk activity.

FH20860101: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 41). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860102: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 42). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH20860201</u>: No nest was detected at this site, which is located on a rocky hillslope (Appendix B, Photo 43). A nest is located approximately 80 m northeast of the BLM site (UTM 13T 0329868, 4622032) on a small rock outcrop. The nest is in fair to good condition and has potential for reuse in the future (Appendix B, Photo 44). There were no signs of recent ferruginous hawk activity.

<u>FH20860202</u>: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 45). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH20860203</u>: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 46). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH20860901</u>: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 47). There are signs of an historic nest on a rock outcrop located approximately 45 m northeast of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-151). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

<u>FH20861501</u>: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 48). There are signs of an historic nest on a rock outcrop located approximately 110 m south of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-150). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

<u>FH20862201</u>: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 49). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH20862202</u>: No nest was detected at this site, which is located in sagebrush at the bottom of a small hillslope (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

<u>FH20862301</u>: No nest was detected at this site, which is located in sagebrush at the base of a small rock outcrop. There are signs of an historic nest on a rock outcrop located approximately 78 m northwest of the BLM site. The nest is in very poor condition and consists a pile of sticks with no cohesive structure (Appendix B, Photo 50). This site was also recorded during SWCA's flights across the Project area (nest FEHA-149). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

<u>FH20862302</u>: This site contains a large nest beside a rock outcrop. The nest is in good condition with a discernable inner bowl, and was likely used in the recent past (Appendix B, Photo 51). Newer whitewash was observed on the outcrop near the nest, but no other signs of

recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the project area (nest FEHA-148).

FH20862303: No nest was detected at this site, which is located at the bottom of a small hillslope/rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20881301: No nest was detected at this site, which is located in sagebrush at the bottom of a hillslope (Appendix B, Photo 52). A nest is located approximately 75 m southeast of the BLM site (UTM 13T 0312604, 4620081). The nest is in good condition and built on a small rock outcrop on a hillslope and has potential for reuse in the future (Appendix B, Photo 53). Old whitewash was observed around the nest; however, no other signs of recent ferruginous hawk activity were observed.

FH21853101: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 54). A nest is located approximately 329 m east of the BLM site (UTM 13T 0330639, 4623027). The nest is in good condition and built along the side of a rock outcrop, and likely has been used in the recent past (Appendix B, Photo 55). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853201: No nest was detected at this site, which is located on the side of a hillslope/rock outcrop. A nest is located approximately 115 m east of the BLM site (UTM 13T 0332949, 4623131). The nest is in fair condition and built along a rock outcrop and has potential for reuse in the future (Appendix B, Photo 56). This site was likely recorded during SWCA's flights across the Project area (nest GOEA-125). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853202: No nest was detected at this site, which is located along the side of a rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH21853301: No nest was detected at this site, which is located on the side of a hillslope. A nest is located approximately 100 m southwest of the BLM site (UTM 13T 0333852, 4623124). The nest is in poor condition, mostly deteriorated, and built on the top of a rock outcrop (Appendix B, Photo 57). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21863601: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 58). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

APPENDIX B

Photographs

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Photo 1. Active golden eagle nest GOEA-018. Adult and downy nestling are present.

Photo 2. Active golden eagle nest GOEA-043. One downy nestling is present.

Photo 3. Active golden eagle nest GOEA-053. One downy nestling is present.

Photo 4. Active golden eagle nest GOEA-056. One downy nestling is present and a smaller dummy nest is located just right of the active nest.

Photo 5. Active golden eagle nest GOEA-063. Adult is brooding a downy nestling.

Photo 6. Active golden eagle nest GOEA-162. One downy nestling is present.

Photo 7. Active bald eagle nest BAEA-171. One fully feathered nestling is present.

Photo 8. Inactive stick nest, classified as fair condition.

Photo 9. Inactive stick nest, classified as poor condition.

Photo 10. Inactive stick nest, classified as good condition.

Photo 11. Inactive stick nests. The upper nest is classified as fair to poor condition, the lower nest is classified as good condition.

Photo 12. Inactive stick nest, classified as good condition.

Photo 13. Inactive stick nest, classified as good condition.

Photo 14. BLM nest site FH18851701. No nest is located at this site.

Photo 15. Remnants of a nest located 22 meters northwest of FH18851701.

Photo 16. BLM nest site FH18870101. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 17. BLM nest site FH18870201. No nest is located at or near this site.

Photo 18. BLM nest site FH18870202. No nest is located at this site.

Photo 19. Nest located 64 meters north of FH18870202.

Photo 20. A nest located 15 meters east of BLM nest site FH19860301.

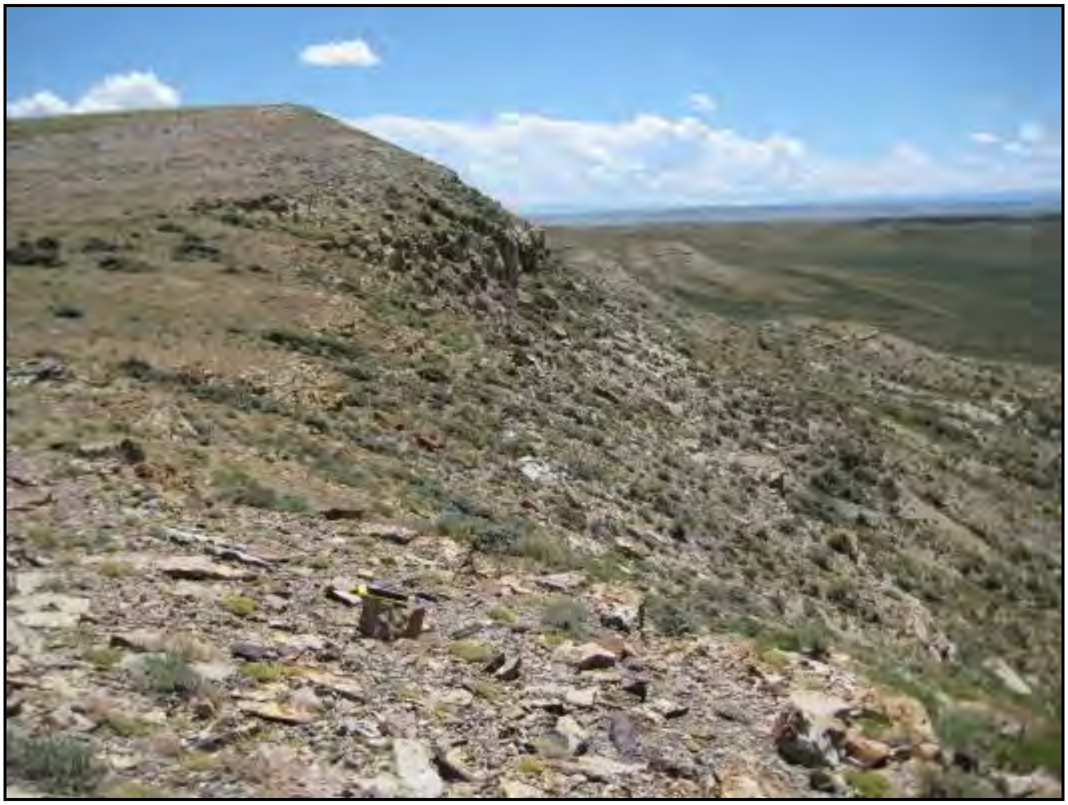

Photo 21. BLM nest site FH19860302. No nest is located at this site.

Photo 22. BLM nest site FH19862301. No nest is located at or near this site.

Photo 23. A nest located 20 meters north of BLM nest site FH19863501.

Photo 24. BLM nest site FH19863502. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 25. BLM nest site FH19870701. No nest is located at or near this site.

Photo 26. BLM nest site FH19871001. No nest is located at or near this site.

Photo 27. BLM nest site FH19871002. No nest is located at this site.

Photo 28. Nest located 84 meters northwest of FH19871002.

Photo 29. BLM nest site FH20850301. No nest is located at or near this site.

Photo 30. Nest located at BLM site FH20850302. Nest is in good condition and was likely used in the recent past.

Photo 31. Remnants of a nest located at BLM site FH20850303. Nest is in poor condition and falling off of the rock shelf on which it was built.

Photo 32. BLM nest site FH20850401. No nest is located at or near this site.

Photo 33. BLM nest site FH20850501. No nest is located at or near this site.

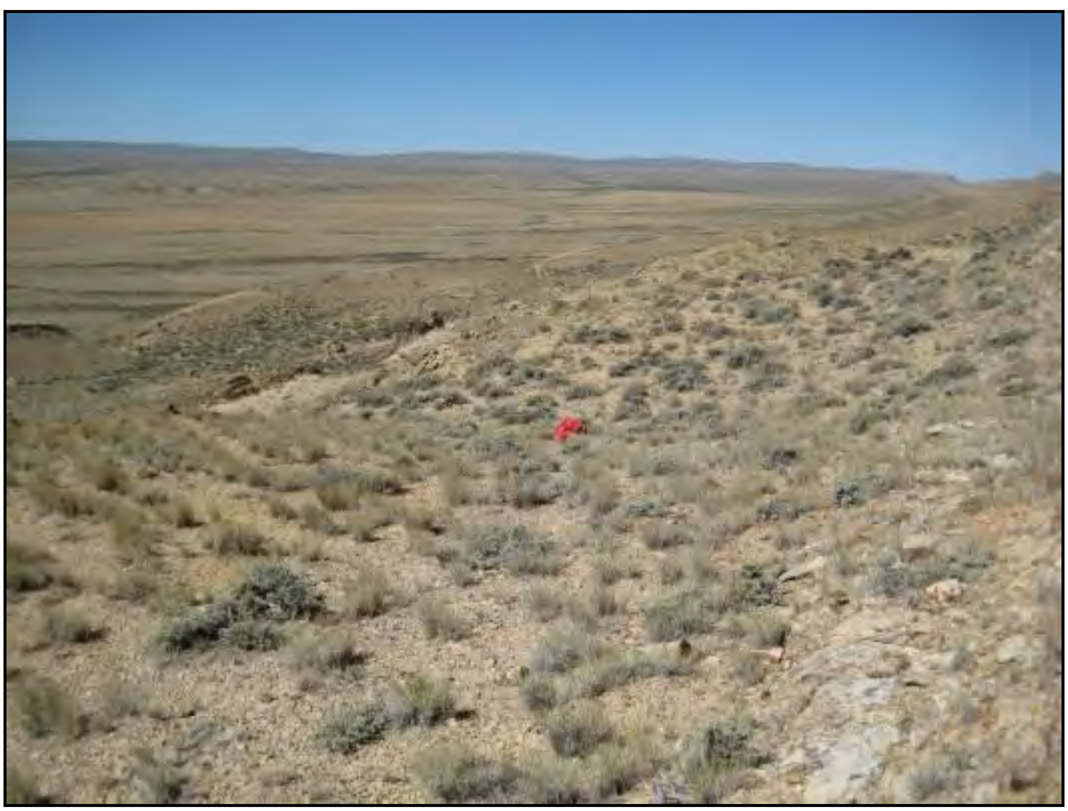

Photo 34. BLM nest site FH20850601. No nest is located at or near this site.

Photo 35. Remnants of a nest located 16 meters west of BLM site FH20852801. Site consists of some deteriorated sticks, but no remaining nest structure.

Photo 36. Nest located 18 meters north of FH20852802.

Photo 37. BLM nest site FH20852803. No nest is located at this site.

Photo 38. Remnants of a nest located 95 meters east of FH20852803.

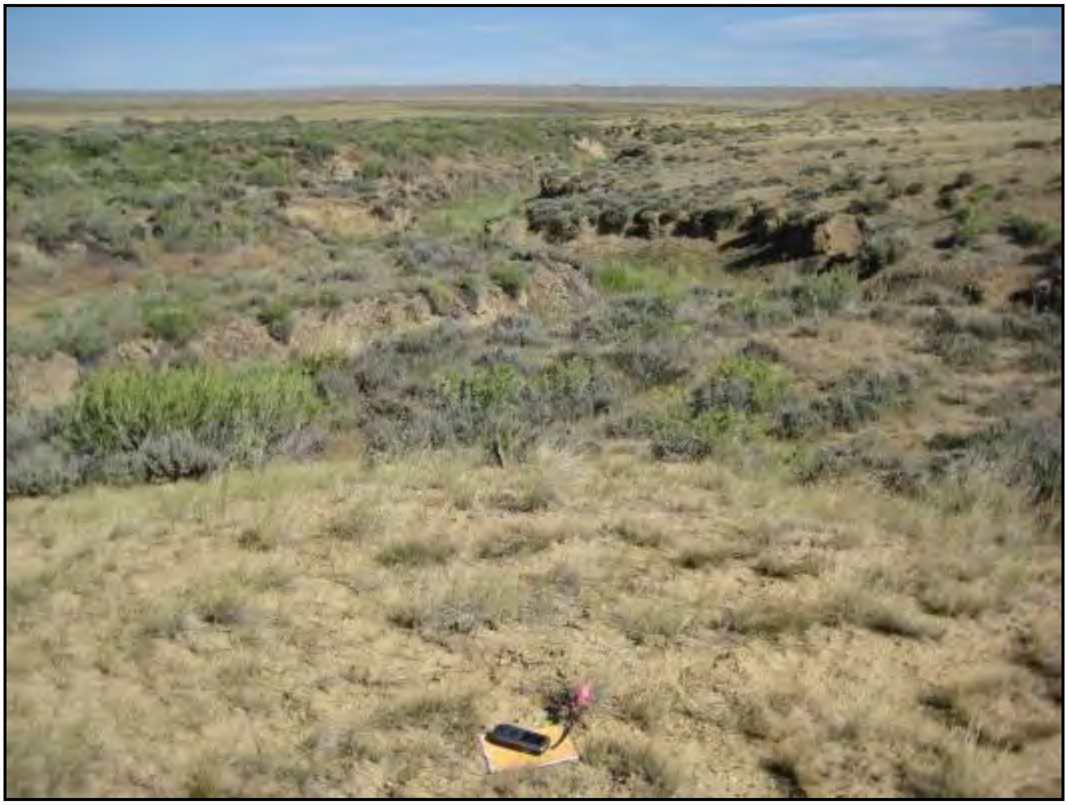

Photo 39. BLM nest site FH20852901. No nest is located at this site.

Photo 40. Nest located 200 meters north of FH20852901.

Photo 41. BLM nest site FH20860101. No nest is located at or near this site.

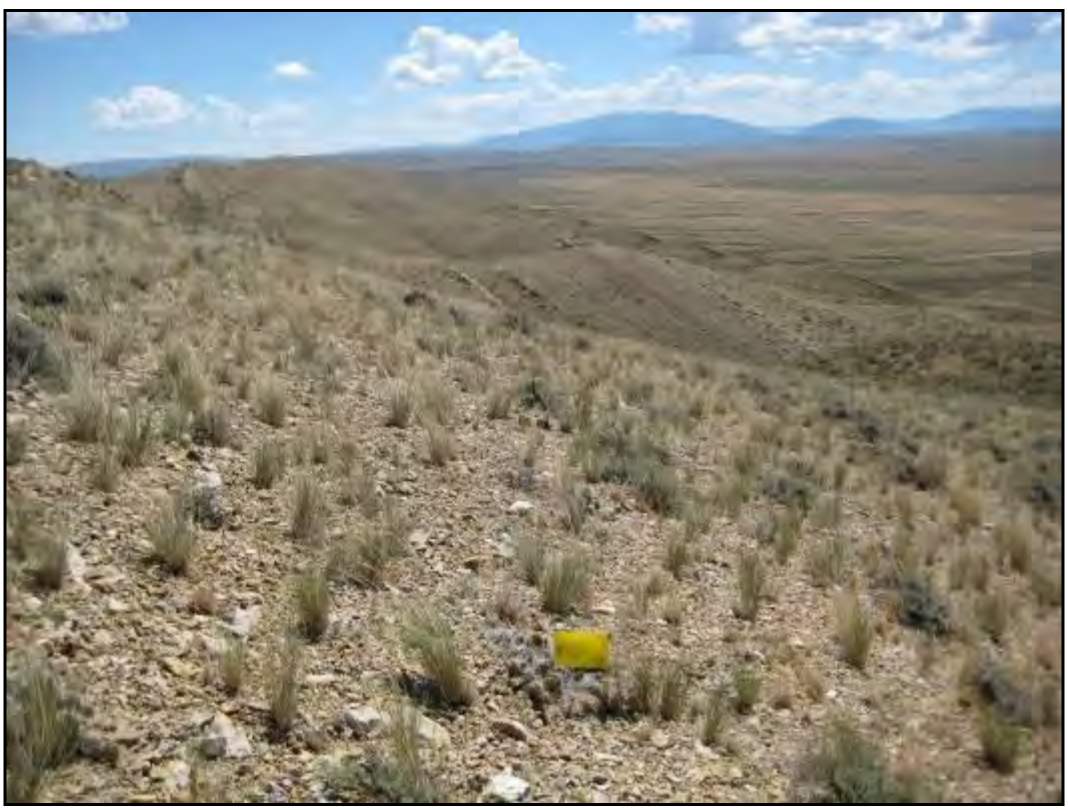

Photo 42. BLM nest site FH20860102. No nest is located at or near this site.

Photo 43. BLM nest site FH20860201. No nest was found at this site.

Photo 44. Nest located 80 meters northeast of FH20860201.

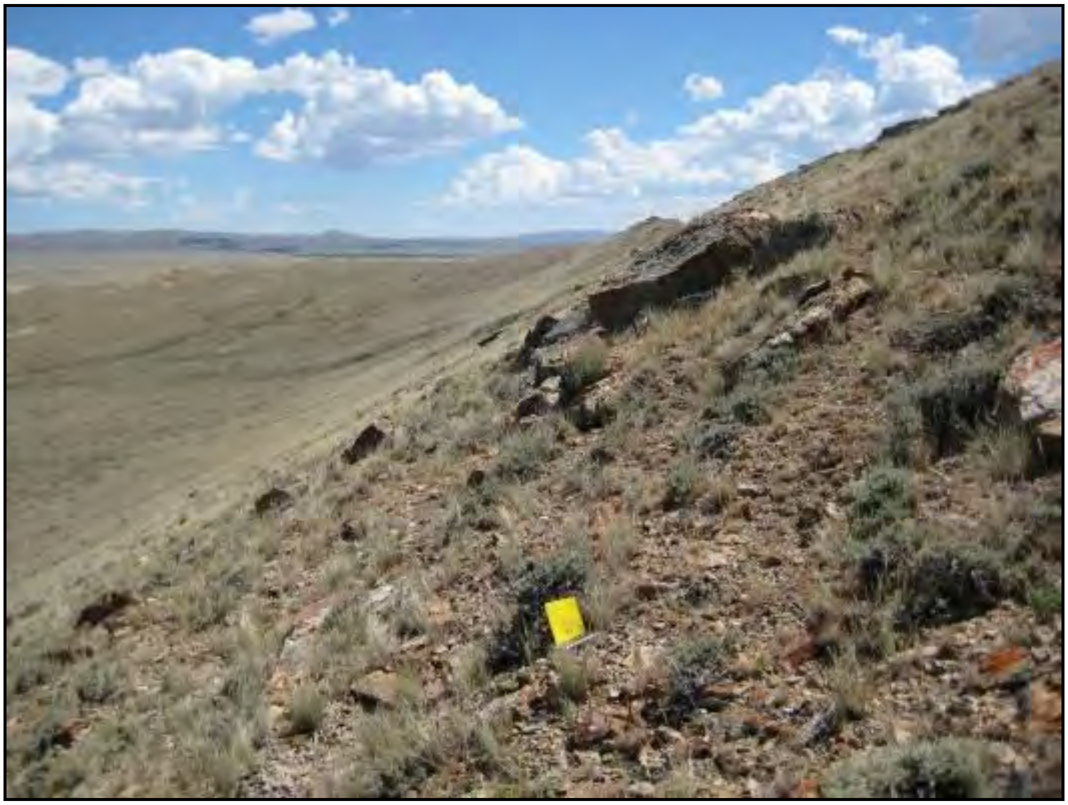

Photo 45. BLM nest site FH20860202. No nest is located at or near this site.

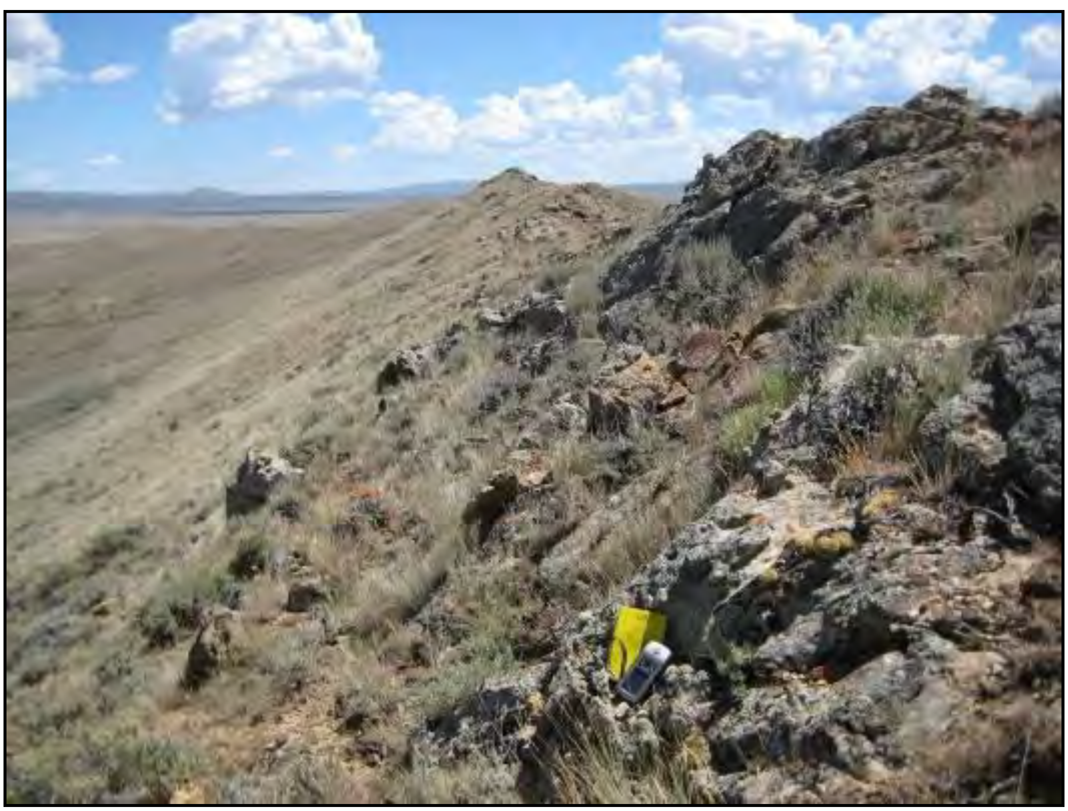

Photo 46. BLM nest site FH20860203. No nest is located at or near this site.

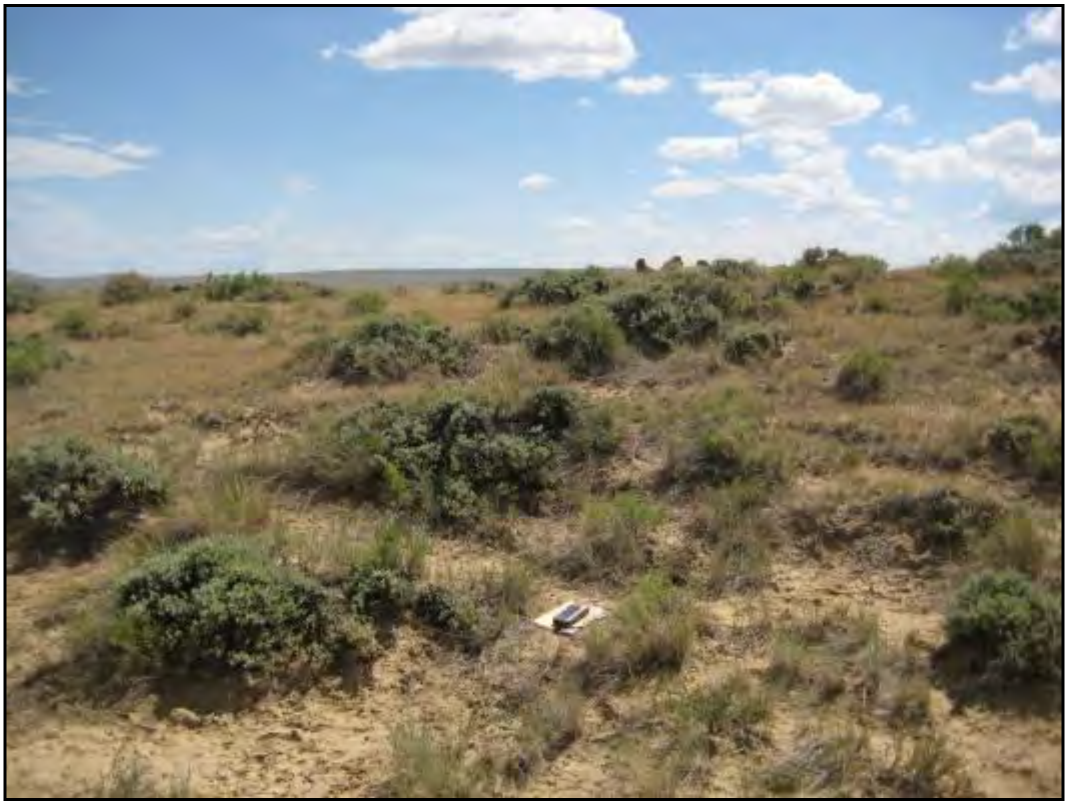

Photo 47. BLM nest site FH20860901. No nest is located at or near this site.

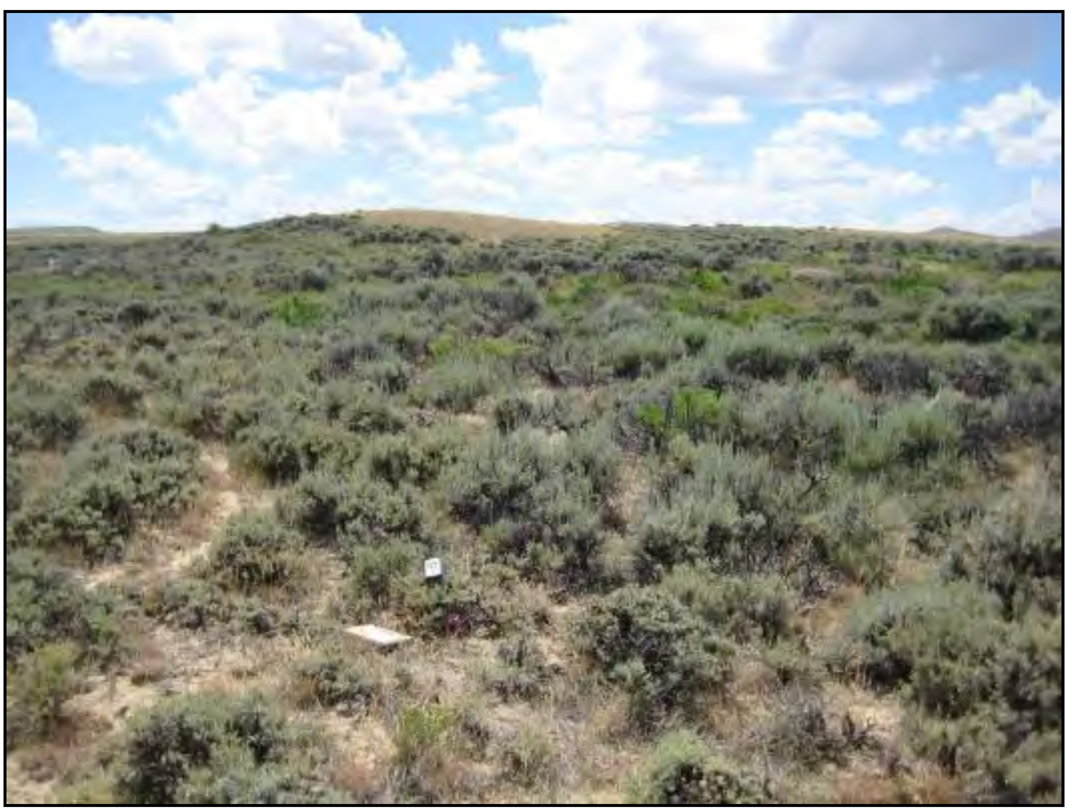

Photo 48. BLM nest site FH20861501. No nest is located at or near this site.

Photo 49. BLM nest site FH20862201. No nest is located at or near this site.

Photo 50. Remnants of a nest located 78 meters northwest of FH20862301. Photo taken during SWCA's nest flights.

Photo 51. Nest located at BLM site FH20862302.

Photo 52. BLM nest site FH20881301. No nest is located at this site.

Photo 53. Nest located 75 meters southeast of FH20881301.

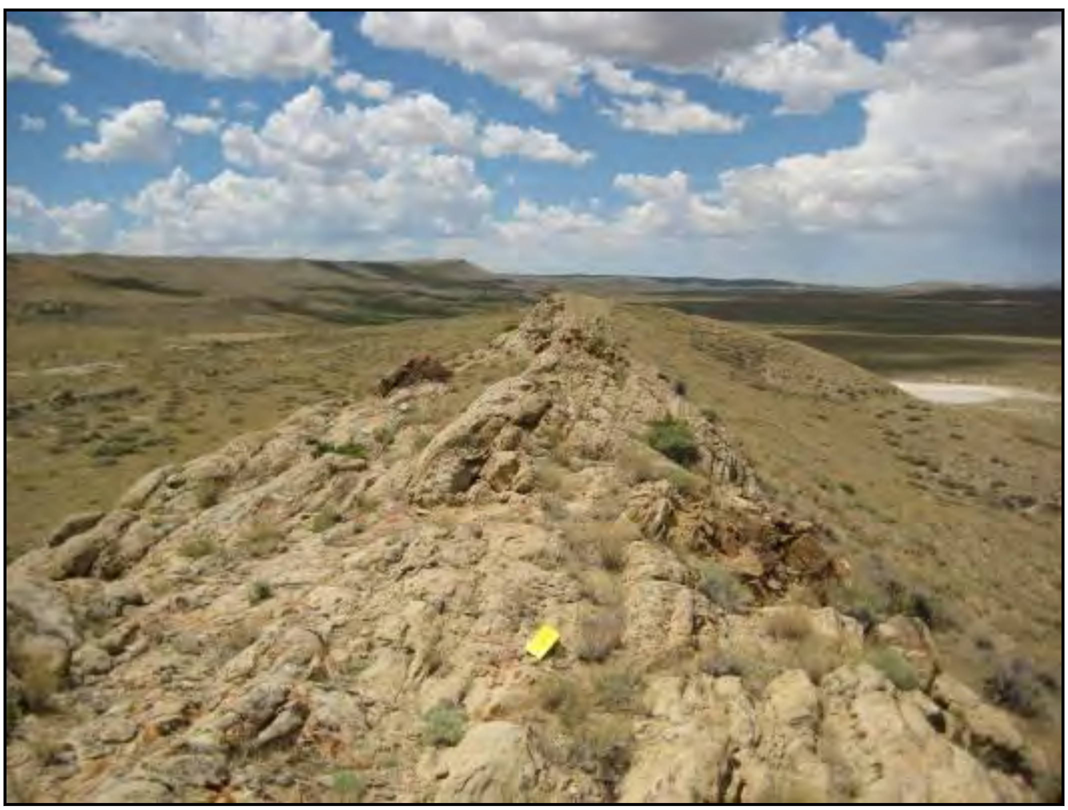

Photo 54. BLM nest site FH21853101. No nest was found at this site.

Photo 55. Nest located 329 meters east of FH21853101.

Photo 56. Nest located 115 meters east of FH21853201.

Photo 57. Remnants of a nest located 100 meters southwest of FH21853301.

Photo 58. BLM nest site FH21863601. No nest is located at or near this site.

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Summary Report for 2012 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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October 2012

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

In April and May 2012, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project Site, which could also assist in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Three types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All viable ferruginous hawk (*Buteo regalis*) nests in the Project Site were visited to assess nesting status. Multiple nest monitoring visits were made to all active eagle nests and most other active raptor nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on April 25 and 26, and May 8, 2012. Surveys on April 25 and 26 were completed for the area surrounding the Chokecherry Wind Development Area (WDA) and the North Platte River corridor. Surveys on May 8 were completed for the area surrounding the Sierra Madre WDA and the Atlantic Rim.

Approximately 20 hours were spent flying the Project Site and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office (RFO) and data collected during 2011 nest surveys for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. All inactive nests that were observed during aerial surveying efforts were recorded; however, historical nest sites with no remaining nest structure were not recorded due to the low likelihood those nests will be used again.

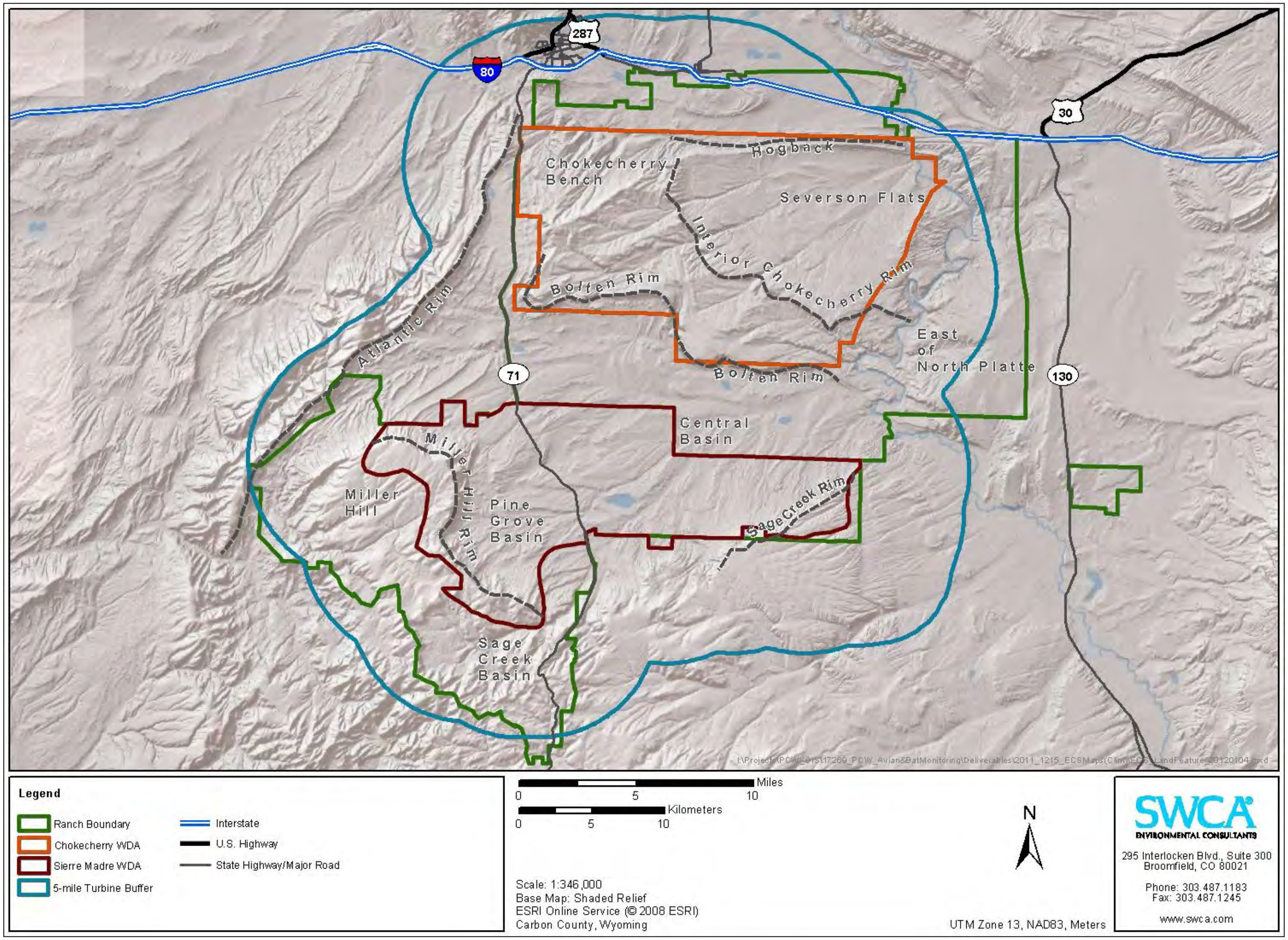

Figure 1. Project Site, 5-mile turbine buffer, and significant land features.

Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the Project Site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on the Project Site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on the Project Site were visited. During these surveys, the majority of the historical nest sites were either not located, or determined to be unviable as now only a few deteriorated sticks remain. All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
FH20850302	338031	4622605	Rock outcrop	Good	N/A
FH20852802	335323	4615247	Rock outcrop	Poor	N/A
FH20862302	328919	4617385	Rock outcrop	Good	N/A
FH-N1	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
FH-N2	330639	4623027	Rock outcrop	Good	Near BLM Nest FH21853101
FH-N3	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
FH-N4	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
FH-N18	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
FH-N21	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
FH-N22	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
FH-N23	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202
FH-N24	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201

RESULTS

In total, 34 active raptor nests were located within the Project Site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 10 red-tailed hawk (*Buteo jamaicensis*), nine prairie falcon (*Falco mexicanus*), seven golden eagle, six bald eagle, and two American kestrel (*Falco sparverius*). An additional five active non-raptor nests were located during the flights and included two common raven (*Corvus corax*), one Canada goose (*Branta canadensis*), one great blue heron (*Ardea herodias*), and one great horned owl (*Bubo virginianus*). No ferruginous hawks were found nesting in any of the 12 potential nest locations surveyed in 2012; however, two of the active golden eagle nests (both along the Hogback) were at nest sites previously identified through the 2011 ferruginous hawk nest surveys.

Only the two active golden eagle nests along the Hogback (both likely used by the same pair of eagles after the first nest failed) were located near or within the Chokecherry WDA. These nests are located on the northern boundary of the WDA (one inside and one outside the WDA) and outside the area of likely turbine development. Four active golden eagle nests and four active bald eagle nests were located along the North Platte River corridor outside of the WDAs. One active bald eagle nest was located along the North Platte River within the Chokecherry WDA but within the 1-mile turbine exclusion setback from the North Platte River established for the Project to protect nesting raptors and other wildlife. The nest is well outside the area of likely turbine development and therefore risk from Project development is minimal. The higher observance of active bald eagle nests along the North Platte River may be due to conducting aerial surveys earlier in the year in 2012 as compared to 2011, before trees had fully leafed out.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 1.5 miles south of the southern boundary of the WDA in the area of Sage Creek Rim; however, during a May 29 nest monitoring visit, it was discovered that this nest had been blown off of the cliff. One active bald eagle nest was located approximately 0.6 mile south of the WDA in a snag west of the base of Sage Creek Rim (the same location as observed in 2011).

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project Site between May 24 and July 27. By July 27, all seven golden eagle and six bald eagle nests were confirmed as fledged or inactive, and 15 other *Buteo* and falcon nests were confirmed as fledged or inactive (Table 2). The remaining nests were not included in the follow-up surveys due to being located on private land, or being located in cavities and tight crevasses along cliff bands where they could not be observed from the ground.

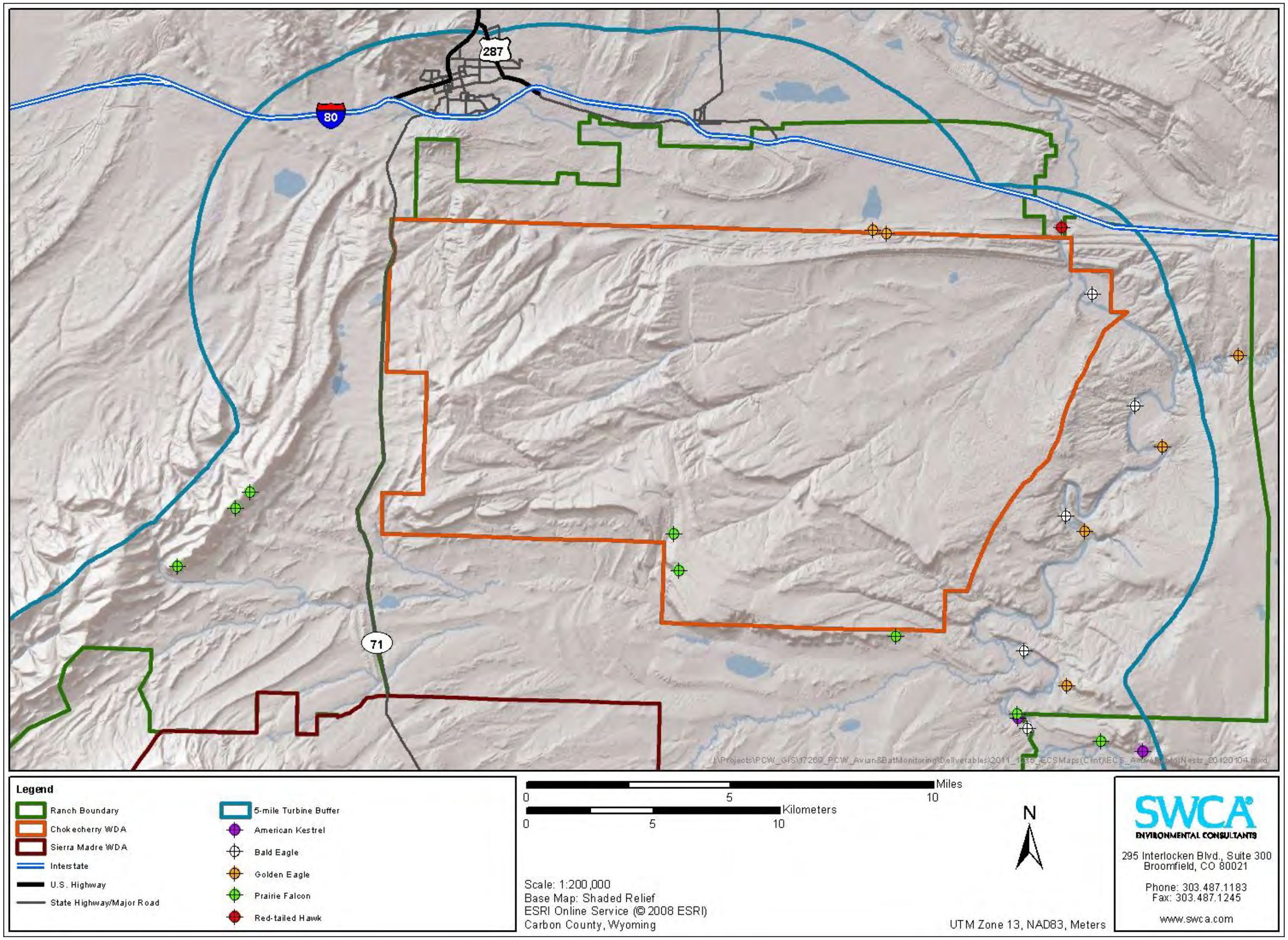

Figure 2. All active nests located in the vicinity of the Chokecherry WDA.

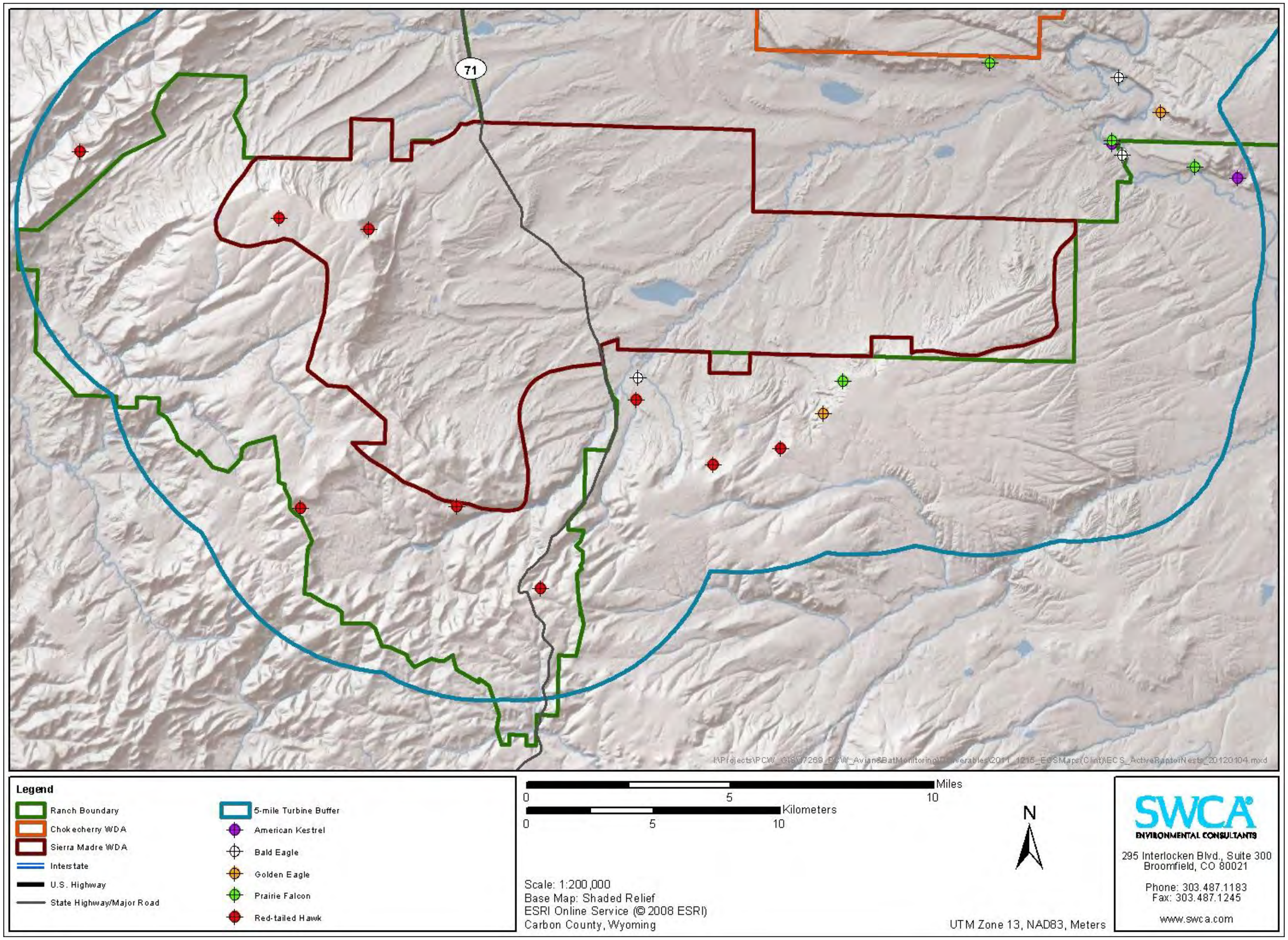

Figure 3. All active nests located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Checks for All Active Bald and Golden Eagle Nests and Most Other Raptor Nests within the Project Site and Associated Buffer.

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
American Kestrel	Cliff cavity	341388	4602365	6/1: adult flushed from eyrie	6/22: likely fledged	N/A	N/A
American Kestrel	Cottonwood cavity	336444	4603689	5/24: incubating	6/26: 1 fledgling	N/A	N/A
Bald Eagle	Cottonwood	336820	4603277	4/25: 1 nestling	5/31: active; unknown number of nestlings	6/26: active; unknown number of nestlings	7/27: unknown
Bald Eagle	Cottonwood	336682	4606344	4/25: incubating	5/25: active; adult flushed from nest tree	6/22: active; 2 adults observed	7/23: fledged
Bald Eagle	Cottonwood	338325	4611699	4/25: 2 adults perched on nest	5/30: failed	N/A	N/A
Bald Eagle	Cottonwood	341067	4616070	4/25: incubating	6/1: active; unknown number of nestlings	6/30: failed	N/A
Bald Eagle	Cottonwood	339381	4620512	4/25: incubating	6/19: failed	N/A	N/A
Bald Eagle	Snag	317657	4594433	4/25: 2 adults perched on nest	5/30: 1 nestling	6/18: 1 nestling	7/23: fledged
Golden Eagle	Cliff	338361	4604961	4/25: incubating	5/25: unknown	6/22: unknown; likely inactive	7/23: failed
Golden Eagle	Cliff	339071	4611096	4/25: incubating	5/30: unknown	6/21: 1 nestling	7/23: fledged
Golden Eagle	Cliff	342167	4614447	4/25: incubating	5/30: failed	N/A	N/A
Golden Eagle	Rock outcrop	330685	4623050	4/25: incubating	6/19: failed	N/A	N/A
Golden Eagle	Cliff	345176	4618079	4/26: incubating	6/1: 2 nestlings	6/19: 2 nestlings	7/23: likely fledged
Golden Eagle	Cliff	324997	4593017	5/9: incubating	5/29: failed; nest blown off cliff	N/A	N/A

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Golden Eagle	Rock outcrop	331228	4622914	6/27: failed	N/A	N/A	N/A
Prairie Falcon	Cliff cavity	322793	4611002	4/26: adult flushed from eyrie	5/31: unknown	6/30: 1 fledgling	N/A
Prairie Falcon	Cliff	323018	4609521	4/26: incubating	5/31: unknown	6:30: unknown; likely inactive	N/A
Prairie Falcon	Cliff	325753	4594280	5/8: 2 adults flushed from nest	5/29: active; adult perched near nest	6/20: active; 2 adults flushed	7/25: likely fledged
Prairie Falcon	Cliff	336428	4603842	5/25: adult flushed from nest	6/26: unknown; likely fledged	N/A	N/A
Red-tailed Hawk	Aspen	313788	4586085	5/8: incubating	5/31: active; adult observed	6/23: 2 nestlings	7/25: fledged
Red-tailed Hawk	Snag	304269	4589261	5/8: incubating	5/31: 1 nestling	6/23: 2 nestlings	7/24: fledged
Red-tailed Hawk	Aspen	320629	4590980	5/8: 2 adults flushed from area	5/29: unknown; 2 adults observed	6/20: unknown	7/25: unknown; 2 adults observed
Red-tailed Hawk	Aspen	323291	4591635	5/8: adult perched on nest	5/29: 2 nestlings	6/20: 3 nestlings	7/25: fledged
Red-tailed Hawk	Snag	306965	4600335	5/22: adult perched on nest	6/18: unknown; likely inactive	N/A	N/A
Red-tailed Hawk	Cottonwood	338160	4623133	6/1: incubating	6/19: 2 nestlings	7/23: likely fledged	N/A
Red-tailed Hawk	Snag	303433	4600759	6/29: 1 nestling	7/27: fledged	N/A	N/A
Red-tailed Hawk	Aspen	310451	4589317	6/23: 1 nestling	7/26: fledged	N/A	N/A
Red-tailed Hawk	Cottonwood	317580	4593539	5/8: adult perched in nest tree	5/30: unknown	6/18: 1 nestling	7/23: 1 nestling

SUMMARY

In addition to the 34 active raptor nests, 158 inactive nests were also located and documented during the nest flights and other nest searching activities. These nests were located across the Project Site and associated buffer; however, the vast majority were located around the perimeter of the Chokecherry WDA, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

The 2012 Year Three survey showed two active golden eagle nests located on the boundaries of the Chokecherry WDA (likely the same pair), but well outside the area of likely turbine development, and none were located within the Sierra Madre WDA. Five active golden eagle nests were located outside the Project Site but within the 5-mile buffer. There was one active bald eagle nest within the Chokecherry WDA but well outside the likely turbine development area. No other active bald eagle nests were within the Project Site. Five active bald eagle nests were outside the boundaries of the Project Site within the 5-mile buffer. Two active red-tailed hawk nests were located within the Sierra Madre WDA near the western boundary, while most others were located south of the Sierra Madre WDA and along the Atlantic Rim. Two prairie falcon nests were located along the Bolten Rim within the Chokecherry WDA, while most others were located along the North Platte River, the Sage Creek Rim, and Atlantic Rim. Multiple follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests within the Project site between May 24 and July 27, 2012, and the results of those surveys are summarized in Table 2.

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Summary Report for 2013 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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INTRODUCTION

In April 2013, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project site, which could also assist in identifying potential nesting raptors. Additionally, the BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Two types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All viable ferruginous hawk (*Buteo regalis*) nests in the Project site were visited to assess nesting status. Multiple nest monitoring visits were made to all active eagle nests and most other active raptor nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the U.S. Fish and Wildlife Service.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on April 24 and 25, 2013. Surveys on April 24 were completed for the area surrounding the North Platte River corridor and the Sierra Madre Wind Development Area (WDA). Surveys on April 25 were completed for the Chokecherry WDA and the area surrounding the Atlantic Rim.

Approximately 20 hours were spent flying the Project site and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office and data collected during 2011 and 2012 nest surveys for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. All inactive nests that were observed during aerial surveying efforts were recorded; however, historical nest sites with no remaining nest structure were not recorded due to the low likelihood those nests will be used again.

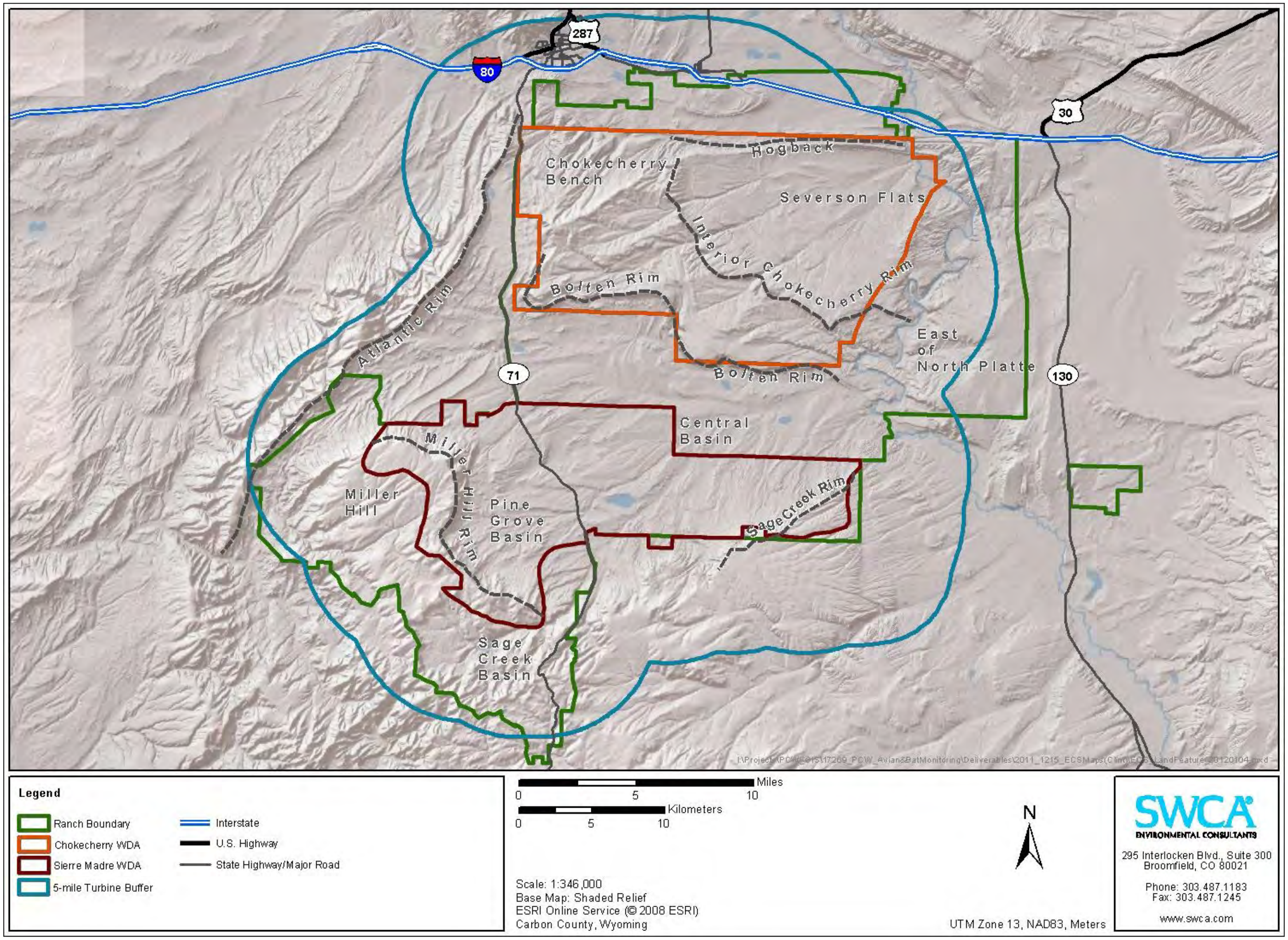

Figure 1. Project site, 5-mile turbine buffer, and significant land features.

Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the Project site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on the Project site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on the Project site were visited. During the 2013 surveys, the majority of the historical nest sites were either not located, or determined to be unviable as only a few deteriorated sticks remain. All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
59	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201
211	338031	4622605	Rock outcrop	Fair	FH20850302
212	335323	4615247	Rock outcrop	Fair	FH20852802
234	328919	4617385	Rock outcrop	Fair	FH20862302
238	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
239	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
241	309124	4608503	Hill slope	Fair	FH19882201
257	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
258	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
259	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
260	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
263	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202

RESULTS

In total, 25 active raptor nests were located within the Project site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 7 bald eagle, 7 golden eagle, 6 red-tailed hawk (*Buteo jamaicensis*), 4 prairie falcon (*Falco mexicanus*), and 1 American kestrel (*Falco sparverius*). One additional occupied golden eagle nesting territory was identified in the Central Basin during other Project survey efforts, but no nest initiation was detected during multiple visits to the site. Seven active non-raptor nests were also located during the flights and included 4 common raven (*Corvus corax*) and 3 great horned owl (*Bubo virginianus*). No evidence of ferruginous hawk nesting or nest maintenance was found at any of the 12 nest locations surveyed in 2013 (Table 1).

Only 1 active golden eagle nest located on Kindt Point was identified within the Chokecherry WDA. This nest was located just within the southern boundary of the WDA and falls within the Turbine No-Build area that encompasses the entirety of the Bolten Rim and Interior Chokecherry Rim. This nest also falls more than 5 miles outside the boundaries of the Phase I development area for the Chokecherry WDA. Four active golden eagle nests and 5 active bald eagle nests were located along the North Platte River corridor outside of the WDAs. These nests are all 10 to 15 miles outside the boundaries of the Phase I development area for the Chokecherry WDA. One active bald eagle nest was located along the North Platte River within the Chokecherry WDA but within the 1-mile turbine exclusion setback from the North Platte River established for the Project to protect nesting raptors and other wildlife. The nest is well outside the area of likely turbine development and therefore risk from Project development is minimal.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 0.50 mile south of the southern boundary of the WDA in the area of Sage Creek Rim, and another was located approximately 5.75 miles south of the southern boundary of the WDA, just inside the boundary of the survey buffer. These nests are both more than 5 miles outside the boundaries of the Phase I development area for the Sierra Madre WDA One active bald eagle nest was located approximately 0.6 mile south of the WDA in a snag at the base of Sage Creek Rim (the same location as observed in 2011 and 2012). This nest is approximately 1.5 miles outside the boundaries of the Phase I development area for the Sierra Madre WDA, and is located immediately south of a Turbine No-Build Area surrounding Rasmussen Reservoir that was created to protect foraging and use areas associated with this nest.

One additional occupied golden eagle nesting territory was identified in the Central Basin between the Chokecherry and Sierra Madre WDAs, approximately 0.75 mile west of Sage Creek Reservoir. This nest location is approximately 9 miles southeast of the Phase I development area for the Chokecherry WDA and 9 miles east of the Phase I development area for the Sierra Madre WDS. Individuals were observed perching and copulating on this nest; however, no signs of nest initiation were detected during multiple visits to the site. This nest falls within the Turbine No-Build area that encompasses much of the Central Basin between the Chokecherry and Sierra Madre WDAs.

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project site between May 21 and July 26. Of the 7 golden active eagle nests documented during 2013 nest surveys, 5 were determined to have failed by the end of June, and only one was determined to have fledged by the end of July. One was unable to be visited due to private land access issues. With regards to the 7 active bald eagle nests, 2 were confirmed as failed by the end of June, 2 were determined to have fledged and an additional 2 were about to fledge by the end of July. The status of one bald eagle nest was unable to be determined due to dense foliage surrounding the nest. Of the 6 active red-tailed hawk nests, 2 were confirmed to have fledged and 1 was confirmed to have failed by the end of June, and 2 were unable to be determined whether they had fledged or failed due to the timing of nest visits (Table 2). One red-tailed hawk nest was unable to be visited due to private land access issues. The remaining nests were not included in the follow-up surveys due to being located on private land, or being located in cavities and tight crevasses along cliff bands where they could not be observed from the ground.

In addition to the 25 active raptor nests, 196 inactive and historic nests were surveyed and assessed during the nest flights and other nest searching activities. These nests were located across the Project site and associated buffer; however, the vast majority were located around the perimeter of the Chokecherry WDA, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

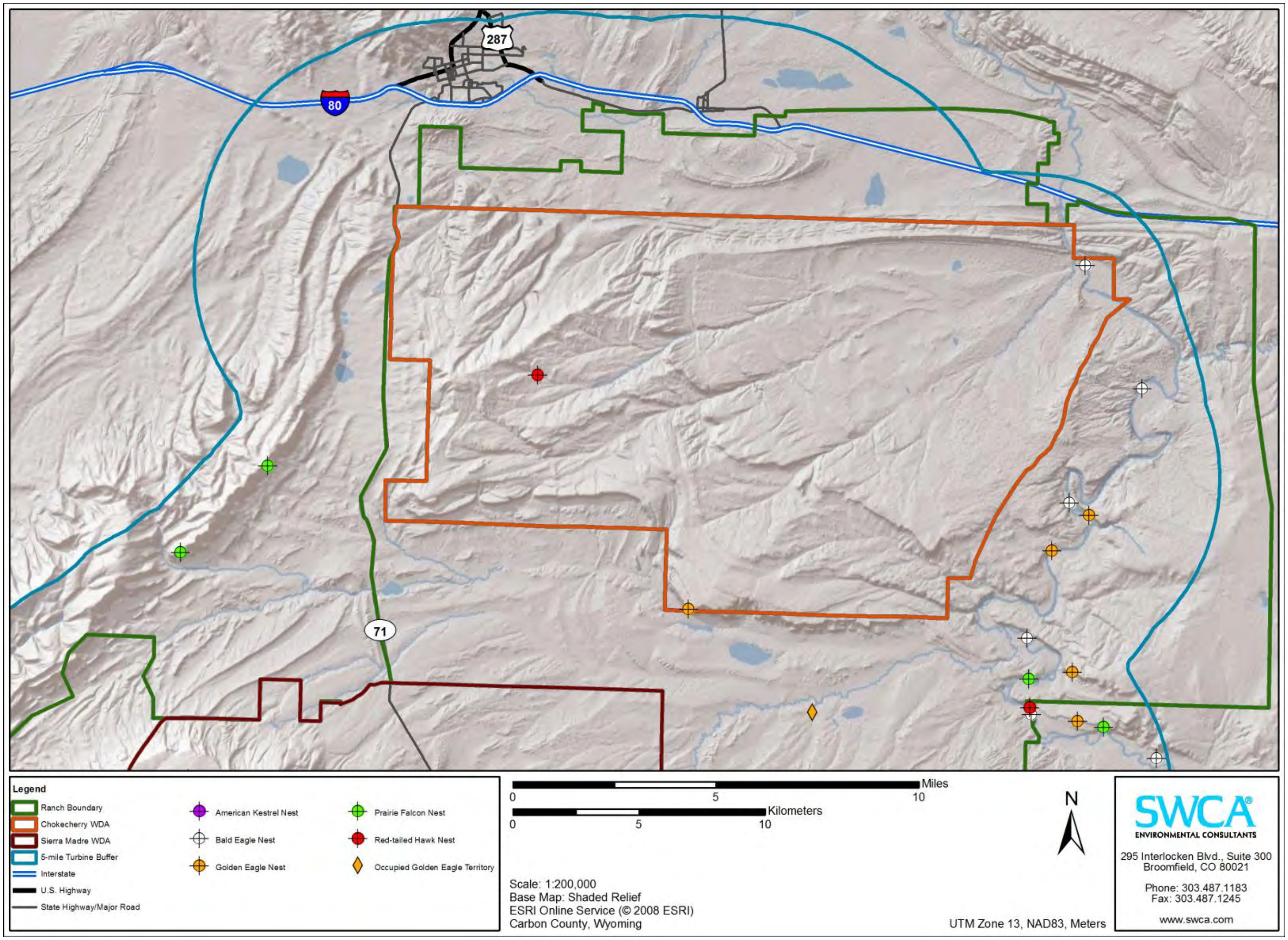

Figure 2. All active nests located in the vicinity of the Chokecherry WDA.

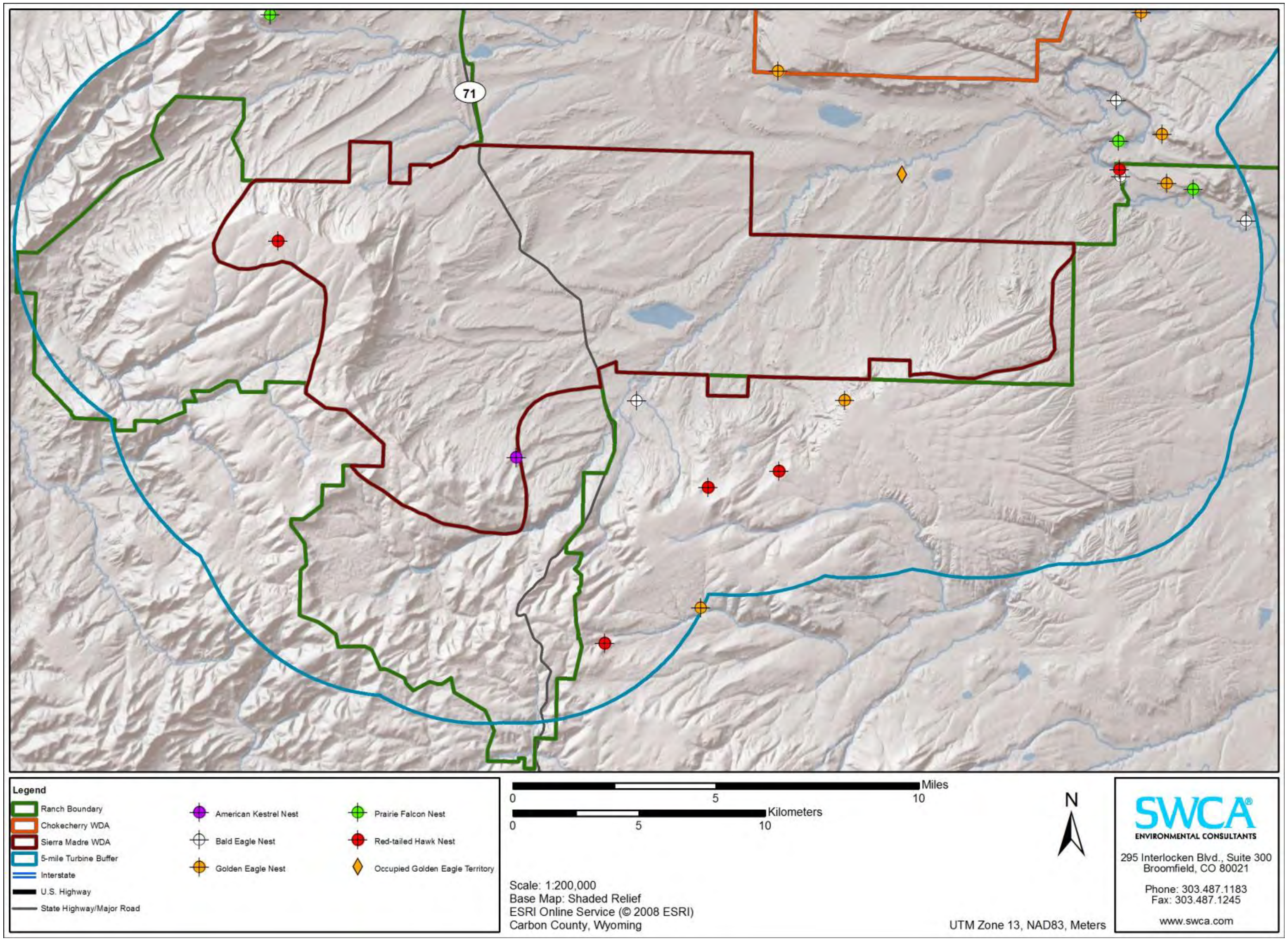

Figure 3. All active nests located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Checks for All Active Bald and Golden Eagle Nests and Most Other Raptor Nests within the Project Site and Associated Buffer.

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Bald eagle	Cottonwood	341820	4601564	4/24: 2 adults perched on nest	5/30: unable to check due to cattle in area (private land)	7/10: failed	N/A
Bald eagle	Cottonwood	336852	4603315	4/24: incubating	5/30: active; unknown number of nestlings	6/28: 1 nestling	7/24: fledged
Bald eagle	Cottonwood	336682	4606344	4/24: incubating	5/30: active; unknown number of nestlings	6/28: failed	N/A
Bald eagle	Cottonwood	338352	4611712	4/24: incubating	5/22: 1 nestling	6/27: 1 nestling	7/25: about to fledge
Bald eagle	Cottonwood	341240	4616259	4/24: 2 adults perched on nest	5/23: active; unknown number of nestlings	6/27: 1 nestling	7/25: fledged
Bald eagle	Cottonwood	338988	4621149	4/24: 2 adults perched on nest	5/23: active; unknown number of nestlings	6/26: active; unknown number of nestlings	7/23: unknown
Bald eagle	Snag	317657	4594433	4/24: incubating	6/4: active; unknown number of nestlings	7/1: 1 nestling	7/23: about to fledge
Golden eagle	Cliff	338676	4603051	4/25: incubating	5/30: unknown; likely inactive	6/28: failed	N/A
Golden eagle	Cliff	338483	4605000	4/25: incubating	5/30: unknown; likely inactive	6/29: failed	N/A
Golden eagle	Cliff	337660	4609823	4/25: incubating	5/21: active; unknown number of nestlings	6/27: failed	N/A
Golden eagle	Cliff	339131	4611220	4/25: incubating	5/22: unknown	6/27: failed	N/A

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Golden eagle	Cliff	323263	4607504	4/25: incubating	5/29: active; unknown number of nestlings	6/29: 1 nestling	7/24: fledged
Golden eagle	Cliff	325909	4594456	4/24: incubating	5/29: unknown	7/2: failed	N/A
Golden eagle	Conifer	320199	4586224	4/24: incubating	N/A: private land, unable to check status	N/A	N/A
Golden eagle	Cliff	328174	4603404	3/15: adults observed copulating on nest	5/2: no activity	5/16: no activity	N/A
Red-tailed hawk	Cottonwood	336791	4603594	4/24: incubating	5/30: active; unknown number of nestlings	N/A	N/A
Red-tailed hawk	Cottonwood snag	317278	4616802	5/15: incubating	5/31: incubating	7/3: failed	N/A
Red-tailed hawk	Aspen	323291	4591635	4/24: incubating	5/29: likely active	6/26: unknown	N/A
Red-tailed hawk	Conifer snag	303433	4600759	4/24: incubating	5/28: active; unknown number of nestlings	6/27: likely fledged	N/A
Red-tailed hawk	Aspen	320485	4590999	4/24: incubating	5/29: active; unknown number of nestlings	6/26: likely fledged	N/A

SUMMARY

The 2013 nest surveys showed one active golden eagle nest located on the southern boundary of the Chokecherry WDA within a Turbine No-Build area, and none were located within the Sierra Madre WDA. Six active golden eagle nests were located outside the Project site but within the 5-mile buffer. One occupied golden eagle nesting territory was identified in the Central Basin in a Turbine No-Build area, but nest initiation was never detected. There was one active bald eagle nest within the Chokecherry WDA but well outside the likely turbine development area. No other active bald eagle nests were within the Project site. Six active bald eagle nests were outside the boundaries of the Project site within the 5-mile buffer. One active red-tailed hawk nest was located in the western area of the Chokecherry WDA, and one was located on top of Miller Hill in the Sierra Madre WDA. Most other red-tailed hawk nests were located south of the Sierra Madre WDA and one was located along the North Platte River. Two prairie falcon nests were located along the North Platte River, and two were located along the Atlantic Rim. Multiple follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests within the Project site between May 21 and July 26, 2013, and the results of those surveys are summarized in Table 2.

ENVIRONMENTAL CONSULTANTS

Sound Science. Creative Solutions.®

Summary Report for 2014 Nest Surveys

Chokecherry and Sierra Madre Wind Energy Project

Prepared for

Power Company of Wyoming, LLC

Prepared by

SWCA Environmental Consultants

August 2014

Summary Report for 2014 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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August 2014

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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INTRODUCTION

This report documents SWCA Environmental Consultants (SWCA) raptor nest survey results for 2014 within the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project) Site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the CCSM Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). The USFWS and BLM concurred that the 5-mile buffer was appropriate because the existing raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts that have been underway within the CCSM Project Site since 2010, which also assists in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Two types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All known viable ferruginous hawk (*Buteo regalis*) nests in and immediately adjacent to the CCSM Project Site were visited to assess nesting status. SWCA biologists made multiple nest monitoring visits to all active eagle nests identified during helicopter and ground surveys. Nest monitoring visits are made until fledging is confirmed or until juveniles are no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in an Aerospatiale AS355 helicopter on May 1, 13, and 14, 2014. Surveys on May 1 and 13 were completed for the area surrounding the North Platte River corridor, Chokecherry Wind Development Area (WDA), and the Atlantic Rim. Surveys on May 14 were completed for areas in and adjacent to the Sierra Madre WDA. Data collected at each nest site included documentation of substrate and location, nest condition, nest status (e.g., active or inactive, number of adults, eggs, nestlings, etc.), activity, and global positioning system (GPS) location.

Approximately 18 hours were spent flying the CCSM Project Site and 5-mile turbine buffer. Historic nest locations provided by BLM Rawlins Field Office and data collected during 2011, 2012, and 2013 nest surveys were used for guidance in surveying existing and undocumented nest locations. Surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*) and bald eagle (*Haliaeetus leucocephalus*), as well as previously documented nest locations for other large *Buteos*, falcons, and accipiters. Habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting nest structures. All inactive nests observed during aerial surveys were recorded.

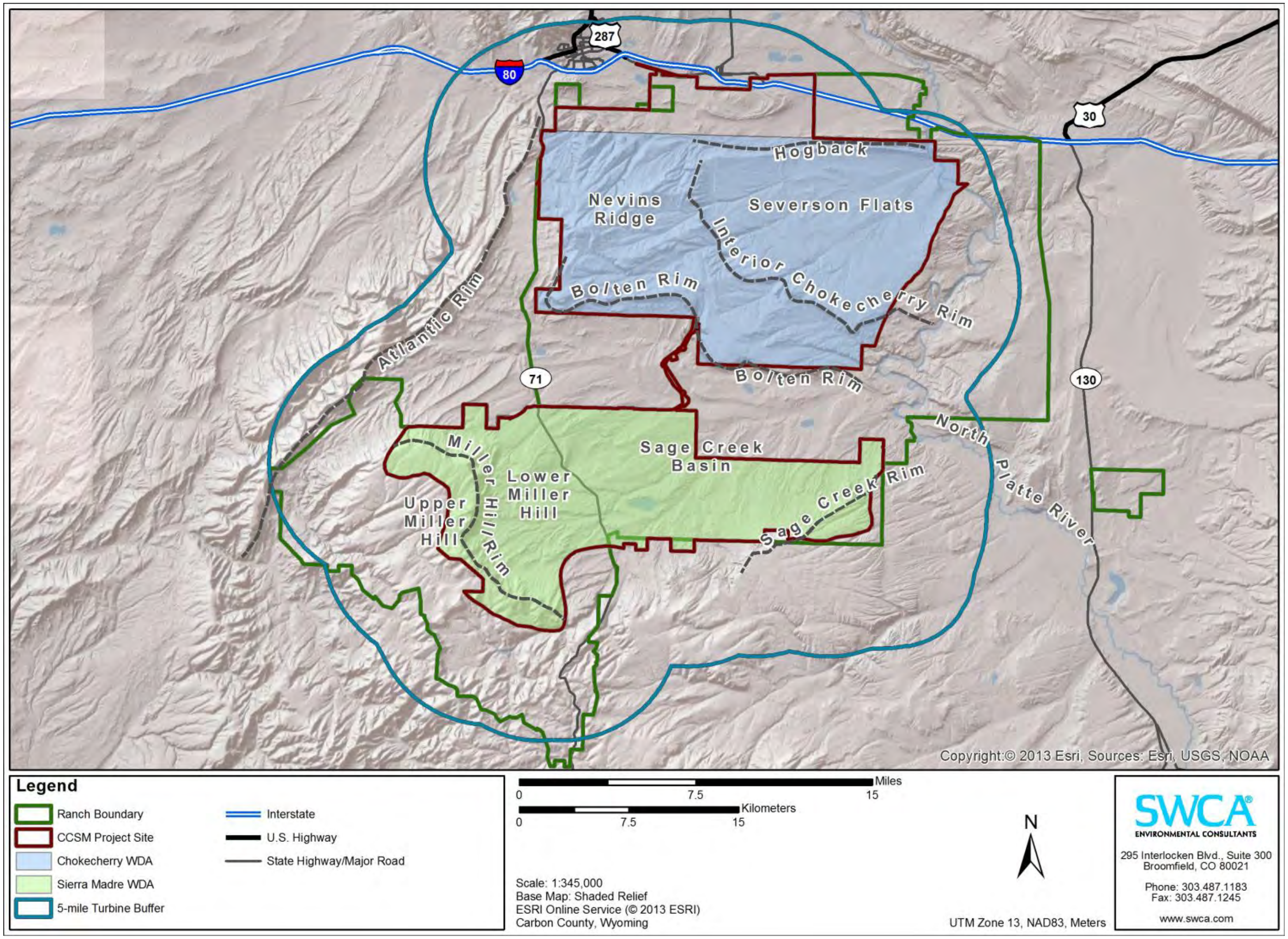

Figure 1. CCSM Project Site, Wind Development Areas, 5-mile turbine buffer, and notable land features.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the CCSM Project Site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on and adjacent to the CCSM Project Site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on or adjacent to the CCSM Project Site were visited. During the 2011 surveys, 28 of the historical nest sites were either not located or determined to be unviable as only a few deteriorated sticks remained. The 12 remaining historical ferruginous hawk nests have been accessed on foot or with trucks and all-terrain vehicles each subsequent year to survey for activity. Data collected during the 2014 ground surveys were identical to the data recorded during previous aerial and ground surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the CCSM Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
59	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201
211	338031	4622605	Rock outcrop	Fair	FH20850302
212	335323	4615247	Rock outcrop	Fair	FH20852802
234	328919	4617385	Rock outcrop	Fair	FH20862302
238	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
239	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
241	309124	4608503	Hill slope	Fair	FH19882201
257	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
258	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
259	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
260	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
263	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202

RESULTS

During 2014 survey efforts, 43 active raptor nests were located within the CCSM Project Site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 17 golden eagle, 12 red-tailed hawk (*Buteo jamaicensis*), 7 bald eagle, 4 prairie falcon (*Falco mexicanus*), 2 Swainson's hawk (*Buteo swainsoni*), and 1 unidentified *Buteo* nest that was likely a red-tailed hawk. Eighteen active non-raptor nests were also located during the flights and included 12 common raven (*Corvus corax*), 5 great horned owl (*Bubo virginianus*), and 1 Canada goose (*Branta canadensis*). No evidence of ferruginous hawk nesting or nest maintenance was found at any of the 12 nest locations surveyed in 2014 (Table 1).

Nesting patterns in 2014 were consistent with results from 2011, 2012, and 2013 surveys. As observed during previous raptor nest surveys, the highest density of nesting raptors in the 5-mile buffer surrounding the CCSM Project Site was along the North Platte River. Of the 43 active raptor nests identified during 2014 surveys, 16 (37%) were located along the North Platte River corridor. The 16 nests were comprised of 6 bald eagle nests (86% of all active bald eagle nests in the survey area), 6 golden eagle nests (35% of all active golden eagle nests in the survey area), 3 red-tailed hawk nests, and 1 prairie falcon nest. The nests along the North Platte River fall within an identified turbine no-build area and are more than 17 kilometers (11 miles) from the nearest Phase I turbine location.

Six of the 43 raptor nests identified during 2014 surveys were located on the Bolten Rim, which roughly corresponds to the southern boundary of the Chokecherry WDA, and one was located on a rock outcrop just north of the Bolten Rim. All 7 nests were located within identified turbine no-build areas or other associated setbacks from the Bolten Rim that were established in redesigning the CCSM Project to avoid and minimize risks to eagles and other avian species. Six of the 7 nests along the Bolten Rim were occupied by golden eagles with the remaining nest occupied by a prairie falcon. Of the 6 active golden eagle nests, 2 are on the eastern half of the Bolten Rim and are 8.5 and 12.9 kilometers (5.3 and 8.7 miles) from the nearest Phase I turbine location. The remaining 4 golden eagle nests are on the western half of the Bolten Rim and were specifically addressed in redesigning the Phase I Wind Turbine Development to avoid and minimize risks to eagles and other avian species (Figures 2 and 3). Of these 4 nests, the 2 westernmost golden eagle nests are located more than 3.4 kilometers (2 miles) from the nearest Phase I turbine location. The other two golden eagle nests are located between 2 and 3 kilometers (1.2 and 1.8 miles) from the nearest Phase I turbine location.

One active golden eagle nest was located on a small cliff in the Sage Creek Basin between the Chokecherry and Sierra Madre WDAs, approximately 1.2 kilometers (0.8 mile) west of Sage Creek Reservoir. This nest is located in a Turbine No-Build Area established in the Sage Creek Basin and is 14.7 kilometers (9.1 miles) from the nearest Phase I turbine location. This nest was occupied by golden eagles in 2013 and 2014, but failed early into the nesting season both years. This year the majority of the nest collapsed off the cliff and is no longer viable in its current form. This nest location falls within the Turbine No-Build Area that encompasses much of the Sage Creek Basin between the Chokecherry and Sierra Madre WDAs

Two active golden eagle nests were located along the Atlantic Rim west of the Chokecherry and Sierra Madre WDAs. The northernmost nest on Atlantic Rim is approximately 8.7 kilometers (5.41 miles) north of the nearest Phase I turbine location in the Sierra Madre WDA, and is located completely outside of the CCSM Project Site. The southernmost nest on Atlantic Rim is 6.8 kilometers (4.2 miles) west of the nearest Phase I turbine location in the Sierra Madre WDA, and is located completely outside of the CCSM Project Site.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 0.8 kilometer (0.5 mile) south of the southern boundary of the WDA in the area of Sage Creek Rim and is 11.4 kilometers (7.1 miles) from the nearest Phase I turbine location. One additional active golden eagle nest was located 8.4 milometers (5.2 miles) south of the southern boundary of the WDA, just inside the boundary of the survey buffer and 7.9 kilometers (4.9 miles) southeast of the nearest Phase I turbine location. One active bald eagle nest was located approximately 0.6 kilometers (0.4 miles) south of the WDA in a snag at the base of Sage Creek Rim (the same location as observed in 2011, 2012 and 2013). This nest is approximately 3.9 kilometers (2.4 miles) from the nearest Phase I turbine location, and is located immediately south of a Turbine No-Build Area surrounding Rasmussen Reservoir that was created to protect foraging and use areas associated with this nest.

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests in the CCSM Project Site and associated 5-mile buffer between May 22 and July 21 (Table 2). During this time, flight path mapping surveys were also initiated at 7 golden eagle nests located along the Bolten Rim, Interior Chokecherry Rim, and Sage Creek Rim in order to determine how eagles from those nests were using the surrounding habitat, and whether they were utilizing the Phase I Wind Turbine Development Site for their activities. These specific nests were selected due to their proximity to the Chokecherry and Sierra Madre WDAs, and results and analysis from these surveys may be found in Appendix A. Flight path mapping documented that patterns of use surrounding these 7 nests was consistent with observations made in previous years. The majority of use occurred south of the Bolten Rim over the Sage Creek Basin in a designated Turbine No-Build Area. The limited time spent north of the Bolten Rim occurred in designated Turbine No-Build Areas and associated setback and did not occur within the Phase I Wind Turbine Development Site.

Of the 17 active golden eagle nests documented during 2014 nest surveys, 7 were determined to have failed and 6 were determined to have fledged by the end of July. The statuses of the remaining nests were unable to be determined because of private land access issues or lack of evidence of fledging or failure. With regards to the 7 active bald eagle nests, 1 was confirmed to have failed, and 6 were determined to have fledged by the end of July 2014.

In addition to the 43 active raptor nests, 241 inactive and historic nests were surveyed and assessed during the helicopter nest flights and other nest searching activities. These nests were located across the CCSM Project Site and associated buffer; however, the highest concentrations were located along the Bolten Rim, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the helicopter nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests observed were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly which species built and/or used the nest in the past.

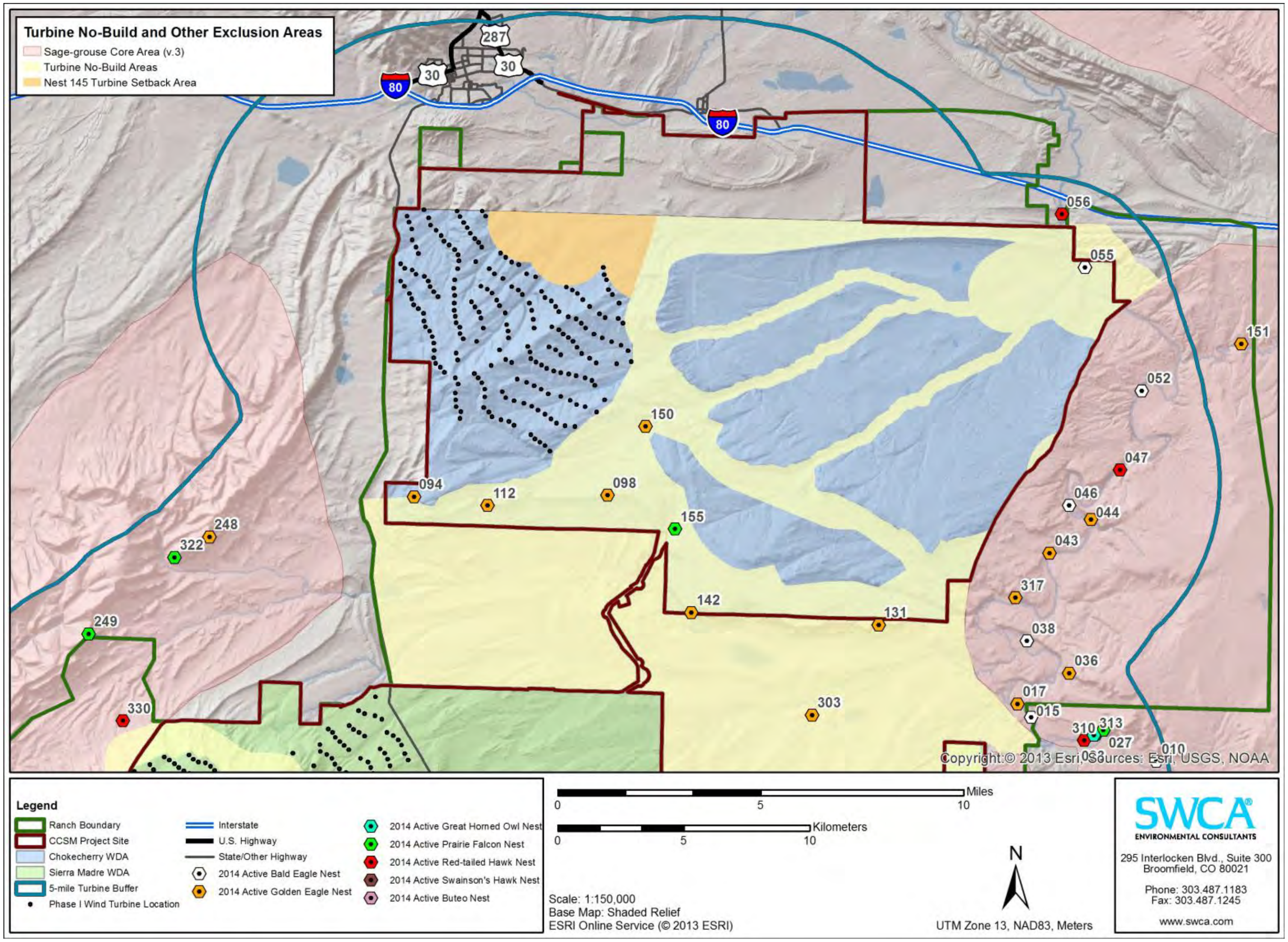

Figure 2. All active nests, Turbine No-Build Areas, and other avoidance and minimization areas located in the vicinity of the Chokecherry WDA.

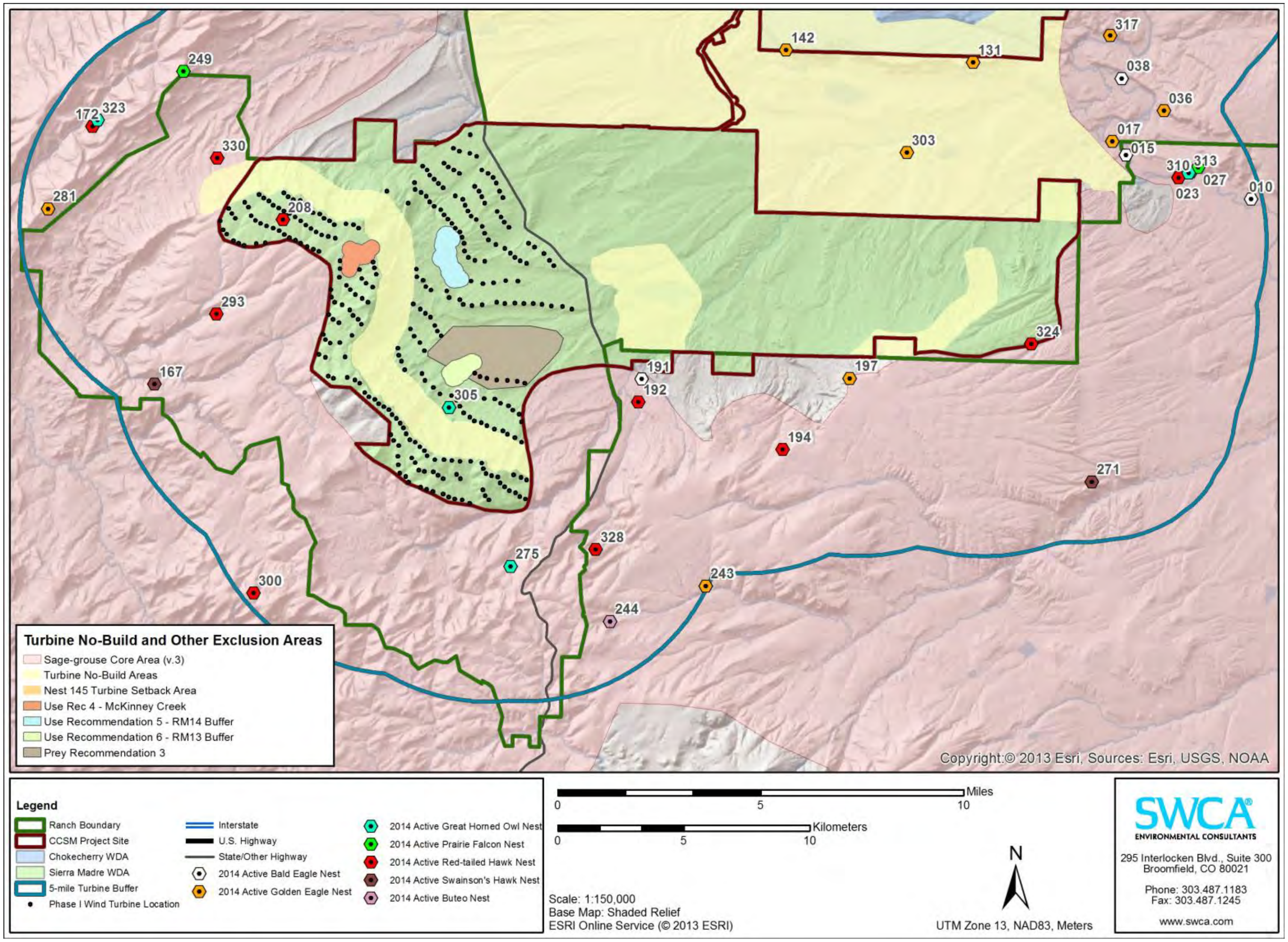

Figure 3. All active nests, Turbine No-Build Areas, and other avoidance and minimization areas located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Status Assessments for All Active Bald and Golden Eagle Nests within the CCSM Project Site and Associated Buffer.

Species	Nest ID	Substrate	Easting	Northing	Status at Flight	1st Check	2nd Check	3rd Check
Bald eagle	010	Cottonwood	341820	4601564	5/1: incubating	not checked	7/2: 1 adult perched on nest	7/20: fledged
Bald eagle	015	Cottonwood	336852	4603315	5/1: incubating	6/12: brooding	7/1: 2 adults perched on nest	7/24: 1 nestling fledged
Bald eagle	038	Cottonwood	336682	4606344	5/1: incubating	6/13: no activity detected	7/1: 1 nestling	7/20: 1 nestling fledged
Bald eagle	046	Cottonwood	338352	4611712	5/13: incubating	6/10: 1 nestling	6/30: 1 nestling	7/18: 1 nestling fledged
Bald eagle	052	Cottonwood	341240	4616259	5/13: 2 adults perched on nest	6/10: 1 adult perched on nest	6/30: 2 nestlings	7/18: 1 nestling fledged
Bald eagle	055	Cottonwood	338988	4621149	5/13: eggs in nest, adult perched nearby	6/10: no activity detected	6/30: no activity detected	7/23: failed
Bald eagle	191	Snag	317657	4594433	5/14: incubating	6/26: 1 nestling	7/3: 1 nestling	7/21: 1 nestling fledged
Golden eagle	017	Cliff	336319	4603846	5/13: incubating	6/12: no activity detected	7/1: no activity detected	7/20: failed
Golden eagle	036	Cliff	338361	4605066	5/13: 2 nestlings	6/13: no activity detected	7/2: 1 adult perched on nest	7/18: 1 nestling fledged
Golden eagle	043	Cliff	337586	4609820	5/13: 1-2 nestlings	6/10: 1 adult perched on nest	6/30: 2 eagles of perched on nest, unknown age	7/18: status unknown
Golden eagle	044	Cliff	339223	4611152	5/13: 1 nestling	6/10: no activity detected	6/30: 1 nestling	7/18: 1 nestling fledged
Golden eagle	094	Cliff	312378	4612056	5/1: incubating	6/11: 1 adult flying nearby	6/23: no activity detected	7/17: failed
Golden eagle	098	Cliff	320060	4612115	5/1: incubating	6/5: 1 adult flying nearby	7/15: no activity detected	7/17: failed
Golden eagle	112	Cliff	315305	4611707	5/1: incubating	6/4: 1 adult flying nearby	6/23: 1 adult flying nearby	7/16: fledged

Species	Nest ID	Substrate	Easting	Northing	Status at Flight	1st Check	2nd Check	3rd Check
Golden eagle	131	Cliff	330801	4606975	5/1: incubating	6/20: 1 adult sitting on nest	7/1: 1 nestling	7/15: 1 nestling fledged
Golden Eagle	142	Cliff	323377	4607473	5/1: incubating	6/3: 1 adult flying nearby	6/25: 1 adult flying nearby	7/15: unknown fledging status
Golden Eagle	150	Cliff	321562	4614839	5/1: incubating	5/28: no activity detected	6/11: failed	N/A
Golden Eagle	151	Rock Outcrop	345183	4618108	5/13: incubating	not checked	7/2: 1 nestling	7/18: 1 nestling fledged
Golden Eagle	197	Cliff	325910	4594457	5/14: incubating	6/2: no activity detected	6/24: 1 adult flying nearby	7/14: failed
Golden Eagle	303	Cliff	328174	4603405	4/18: incubating	4/30: failed, nest collapsed from cliff	N/A	N/A
Golden Eagle	317	Cliff	336235	4608056	5/13: 1-2 nestlings	not checked	6/30: 1 nestling	7/18: 1 nestling fledged
Golden Eagle	248	Cliff	304266	4610464	5/13: incubating	6/26: 1 nestling	7/3: 1 nestling	7/21: 1 nestling fledged
Golden Eagle	281	Cliff	294128	4601180	5/14: incubating	6/25: 1 adult perched on nest	7/3: failed	N/A
Golden Eagle	243	Conifer	294128	4601180	5/14: incubating	NA – Private land	NA – Private land	NA – Private land

Appendix A: Results of Flight Path Monitoring Surrounding Select Active Golden Eagle Nests

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INTRODUCTION

During May, June and July of 2013 and 2014, SWCA Environmental Consultants (SWCA) conducted flight path mapping surveys for the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project) Site at select active golden eagle nest locations. The active nests surveyed were located along the Bolten Rim and Sage Creek Rim, which generally follow the southern boundaries of the Chokecherry and Sierra Madre Wind Development Areas (WDAs), respectively. In 2013, 2 active golden eagle nests (nests 143 and 197) were located along these rims, and in 2014, 7 nests (nests 094, 098, 112, 131, 142, 150, and 197) were located along these rims. All of the active golden eagle nests surveyed were between 2 and 14 kilometers (1.2 and 8.7 miles) of Phase I turbine locations.

FLIGHT PATH SURVEYS

For flight path surveys, biologists selected survey locations on top of the Bolten and Sage Creek rims with views of the nests and surrounding landscape. Surveys locations were sites at least 400 meters from nest locations to reduce the likelihood of disturbing nesting activities. Surveys were generally conducted once per week for 2 to 4 hours at each nest, and survey start times were rotated each week to provide coverage of all daylight hours at each nest location. During surveys, biologists would scan the landscape around them with the assistance of binoculars to detect any golden eagles utilizing the airspace around the active nest locations. Once an eagle was detected, biologists would track the eagle and record its flight path to capture its use of the surrounding topographic features and habitat. Golden eagle flight paths were mapped out to approximately 4,000 meters from the observer, and data collected during these surveys focused primarily on accurate recording of golden eagle flight paths and identification of the active nest the flight path was associated with. Flight paths were georeferenced and digitized for analysis purposes.

In 2013, approximately 30 hours were spent mapping flight paths at the 2 active golden eagle nests located on the Bolten and Sage Creek Rims and in 2014, approximately 160 hours were spent mapping flight paths at the 7 active golden eagle nests located on the Bolten and Sage Creek Rims. Survey effort varied between the two years primarily due to changes in the number of active golden eagle nests.

RESULTS

Flight path patterns observed in 2013 and 2014 were consistent with observations made during raptor surveys conducted for the CCSM Project from 2011 through 2013. As was observed during past raptor surveys, the majority of all eagle flight paths mapped during 2013 and 2014 occurred along and south of the Bolten Rim and north of the Sage Creek Rim in the Sage Creek Basin located between these two topographic features (Figure A.1). Almost no flight paths were recorded north of the Bolten Rim and south of the Sage Creek Rim. The few flight paths that occurred north of the Bolten Rim were located within Turbine No-Build Areas and other areas specifically addressed in redesigning the Phase I Wind Turbine Development to avoid and minimize risks to eagles and other avian species. Several nests (nest numbers 094, 098, 150, and 197) failed early in the flight path survey effort; therefore, few or no flight paths were recorded for these nests.

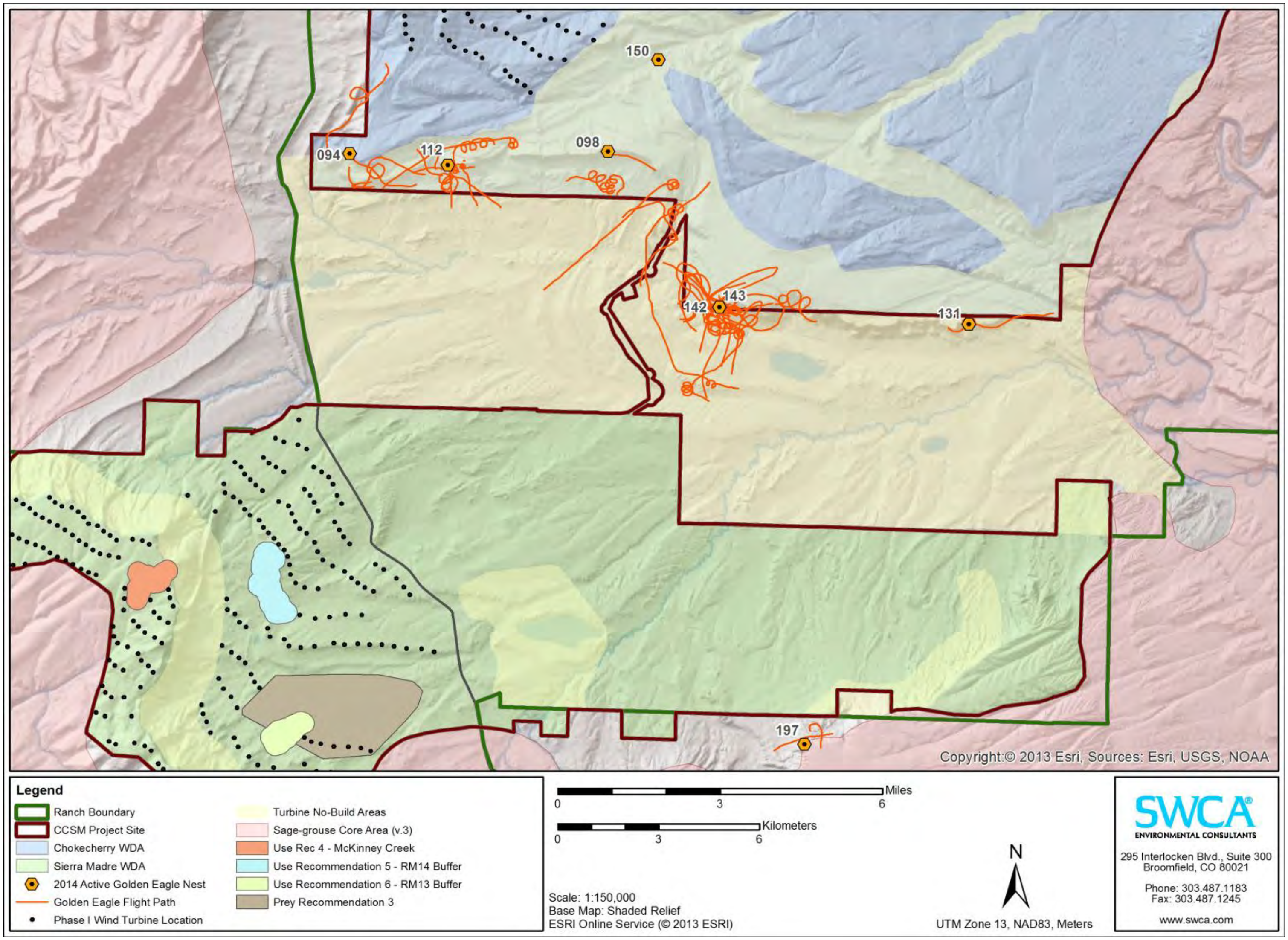

Figure A.1. Golden eagle nests and flight paths, Turbine No-Build Areas, and other avoidance and minimization areas located in the CCSM Project Site