

JOHN DAY AVIAN STUDIES FOR THE BIGLOW CANYON WIND FARM PROJECT

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1.0 INTRODUCTION

The Biglow Canyon Wind Farm Wildlife Monitoring Plan required a before/after avian behavior and monitoring study to determine whether operation of Biglow reduces bird use and abundance in the area (often referred to as displacement). The results of this study will aid in estimating indirect avian impacts of Biglow and guide potential mitigation.

The focus of the study is near turbine string locations nearest the John Day River. Four stations are located in the northeastern portion of the Biglow area near the John Day River canyon. The areas surrounding these survey stations were subject to numerous micro-siting decisions during facility layout. Primary micro-siting decisions included shortening and re-orientating turbine corridors to avoid native habitat, maintaining a minimum one-mile distance from the centerline of the John Day River, and avoiding locating turbines on steep slopes.

2.0 METHODS

2.1 Fixed-point Survey

The primary objective of the fixed-point surveys was to estimate spatial and temporal use of the site along the John Day River by birds, especially raptors and other large birds. Point counts (variable circular plots) were conducted on the Biglow development area using methods described by Reynolds et al. (1980) and Bibby et al. (1993). The points were selected to survey as much of the project area along the John Day River as possible while also providing relatively even coverage without overlap of surveyed area (Figure 1). The emphasis of these surveys was locating and counting raptors and other large birds (waterfowl, shorebirds, waterbirds, corvids, and upland gamebirds), however, all birds seen during the point counts were recorded.

2.1.1 Survey Plots

Results presented in this report are from 4 observation points (Figure 1). Points H and I were among 22 observation points established in March 2004 as part of pre-construction baseline avian use studies for the Biglow Canyon Wind Farm project. Points A5 and A6 were among 6 additional stations established in September 2005 to provide additional coverage of the Biglow Canyon project area. Each survey plot was a variable circular plot centered on an observation point marked in the field. The survey effort was concentrated within an approximate 800-m (0.5-mi) radius. Observations of birds beyond the 800-m radius were recorded, but were not included in the analysis so that results are standardized between survey plots at the site as well as with other similar wind project studies.

Survey periods at each point were 30 minutes long. All birds observed during the survey were recorded. All raptors and other large birds observed were assigned a unique observation number and plotted on a map of the survey plot. The date; start and end time of the observation 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, height

above ground, activity (behavior), and habitat(s) were recorded for each bird observed. Flight or movement paths were mapped for all raptors and large birds and given the corresponding unique observation number.

Four instantaneous counts were made during each 30-minute observation period. The first instantaneous count was made at the beginning of the observation period and the remaining counts occurred at 10-minute intervals. An instantaneous count consists of a summary of all birds present in and near the plot at a particular time. During the instantaneous count, the observer scanned the full survey plot recording all birds seen at that moment. For each raptor/large bird seen during an instantaneous count, the approximate height above ground and distance to the observer were recorded.

The behavior of each raptor/large bird observed and the habitat in or over which the bird occurred were recorded. Behavior categories recognized include perched, soaring, flapping, flushed, circle soaring, hunting, gliding, and other (noted in comments). Habitats were recorded as grassland-steppe, deciduous shrub, conifer forest, rock/rock outcrop, riparian, agriculture, CRP, and other (noted in comments). The initial flight patterns and habitats (first observation) were uniquely identified on the data sheet and subsequent patterns and habitats (if any) also recorded. The flight direction of observed birds was recorded on the data sheet map. Approximate flight height at first observation was recorded to the nearest meter or 5-meter increment and the approximate lowest and highest flight heights observed were also recorded. Any comments or unusual observations were noted in the comments section.

Raptors, other large birds, any species of concern, and species not previously seen on site that were observed between point counts were coded as in-transit observations and also recorded on field maps with unique observation numbers. Mapped information such as point of first observation and flight paths were digitized using a GIS for describing spatial use of the site.

Surveys were conducted during daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practicable, each station was surveyed about the same number of times each season; however, the schedule varied in response to adverse weather conditions (e.g., fog), which caused delays and/or missed surveys.

2.2 Data Compilation and Report Preparation

2.2.1 Data Compilation and Storage

A database was created to store, retrieve, and organize field observations. Data from field forms were keyed into electronic data files using a pre-defined format that made subsequent data analysis straightforward. All field data forms, field notebooks, and electronic data files have been retained for future reference.

2.2.2 Quality Assurance/Quality Control

QA/QC measures were implemented at various stages of the study, including in the field, during data entry, during data analysis, and report writing. Each observer was responsible for inspecting his or her data forms for completeness, accuracy, and legibility. The study team leader periodically reviewed data forms to ensure completeness and legibility. Problems

detected were corrected and changes made to the data forms were initialed and dated by the person making the change.

The electronic database was compared to the original data sheets by randomly choosing electronic records and verifying these with the field data sheet. Any errors detected were corrected by referencing the raw data forms and/or consulting the observer(s) who collected the data. Any irregular codes detected, or any data suspected as questionable, were discussed with the observer and study team leader. Any errors or suspect data identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

2.3 Statistical Analysis and Products

Statistics/data generated for the study include the following:

- Species lists and observations by season;
- Relative use by species, species group, season, and observation point (habitat);
- Mean frequency of occurrence and species composition;
- Mapped summary of raptor observations and flight paths by species or group;
- Mean flight characteristics by species and species group;
- Exposure indices by species and species group;
- Comparisons of avian use between the proposed project and other new or existing wind plants.

The number of raptors and other species seen during each point count survey was standardized to a unit area and unit time searched. Avian use by species was calculated as the mean number of observations per 30-minute survey within 800 m of the survey point. Standardizing the data to a unit area and unit time allows comparison of avian use within the site between survey plots (habitat) and seasons and from the site to other wind plants which have been studied with similar methods.

The frequency of occurrence by species was calculated as the percent of surveys in which a particular species was observed. Species composition was represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition. Frequency of occurrence and percent composition provide relative estimates of the avian diversity of the study area. For example, a particular species may have high use estimates of the site based on just a few observations of large flocks, however, the frequency of occurrence will indicate that it occurs during very few of the surveys and therefore, may be less likely affected by the project.

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

$$R = A * P_f * P_t$$

Where A = mean relative use for species i (observations within 800 m of observer) averaged across all surveys, P_f = 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_i = proportion of all flight height observations of species *i* within the rotor-swept area. This index does not account for differences in behavior other than flight characteristics (i.e., flight heights and percent of birds observed flying).

Maps of bird use (perches and flight paths) by observation point were developed to identify, to the extent possible, habitats or other topographic features that appeared related to bird use.

The intensity of use and changes in raptor flight path behavior will be compared between the pre-construction period and the post-construction period.

3.0 RESULTS

3.1 Species Abundance and Composition

Surveys were conducted at 4 fixed-point count stations located in the northeast part of the Biglow Canyon Wind Farm project area, along the John Day River (Figure 1) approximately once each week between April 1, 2004 and August 8, 2006. A total of 322 30-minute point count surveys were conducted during 51 visits.

A total of 59 avian species and an additional 6 unidentified bird types (best possible identifications, e.g., unidentified buteo) were observed during the fixed-point surveys (Table 1). In all, 6,086 total observations in 1,044 different groups¹ were recorded during the fixed-point surveys (Table 2). These are raw counts of observations that are not standardized by the number of hours of observation, but do provide an overall list of what was observed. These counts likely contain duplicate sightings of the same birds.

Avian richness (defined as number of species observed per survey) was highest in the spring (6.4) and lowest in the fall (3.4) (Table 2). The mean number of birds observed per survey of each plot was highest in the winter (19.9) and lowest in the summer (7.9), and averaged 15.3 over the entire year (Table 2).

For the whole study period, passerines (i.e., song birds) were the most numerous group; horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), common raven (*Corvus corax*), and black-billed magpie (*Pica pica*) were the most common passerines observed. Passerines composed 71% of all groups observed and 51% of the total number of birds observed. Raptors composed approximately 15% of all groups but only 3% of all birds observed. In contrast, waterfowl composed only 6% of all groups but 43% of all birds observed. Other birds (upland gamebirds, shorebirds, doves, and other non-passerine species) comprised approximately 9% of all groups and 3% of all birds observed (Table 3).

Spring. During the spring period, passerines were the most abundant avian group observed,

¹ Group is defined as an observation of a species of bird regardless of number seen together. For example, a flock of 8 American robins flying together is considered a group; as an individual robin observed by itself is also considered a group.

composing 88.1% of all birds observed (Table 4). Other avian groups commonly observed were upland gamebirds (7.0% of spring observations) and raptors (3.4% of spring observations). Species with the highest use of the project area, in order, were horned lark, western meadowlark, common raven, ring-necked pheasant, and American goldfinch (Table 5). The species of birds most frequently observed, regardless of the numbers observed, were horned lark, western meadowlark, ring-necked pheasant, common raven, and American kestrel (Table 6).

Seven species of raptors were observed during the spring surveys. The highest use of the study area was by red-tailed hawk, followed by American kestrel, northern harrier, and rough-legged hawk. There were only single observations of the other three species (Swainson's hawk, golden eagle, osprey) during the spring period. Overall, use of the area by raptors was lowest in spring, with only 27 raptors observed during the study period. Waterbirds, waterfowl, and shorebirds observed in the project area included gulls, Canada geese, mallards and other ducks, and a long-billed curlew. Upland gamebirds included California quail, chukars, gray partridge, and ring-necked pheasants. Other species observed were mourning dove and Vaux's swift (Table 3).

Summer. In the summer, passerines composed 78.4% of all birds observed, waterfowl composed 9.8%, and raptors composed 7.8% (Table 4). Species with the highest use of the project area during summer were horned lark, western meadowlark, unidentified swallows, and Canada goose (Table 5). The species of birds most frequently observed were the horned lark, western meadowlark, American kestrel, and red-tailed hawk (Table 6).

Five species of raptors were observed during the summer surveys. The highest use of the study area was by the American kestrel, followed by red-tailed hawk, northern harrier, turkey vulture, and Swainson's hawk. Waterbird, waterfowl, and shorebird species observed in the project area in summer were gulls, Caspian tern, great blue heron, Canada goose, and long-billed curlew. Upland gamebirds observed were California quail, chukars, and ring-necked pheasants. Other birds observed were mourning doves, black-chinned hummingbirds, and northern flickers (Table 3).

Fall. Passerines, waterfowl, and raptors were again the most abundant avian groups on the study area in fall (Table 4). Species with the highest use of the project area were horned lark, European starling, Canada goose, and western meadowlark (Table 5). The species of birds most frequently observed were the horned lark, western meadowlark, common raven, red-tailed hawk, and black-billed magpie (Table 6).

Eight raptor species and an unidentified raptor were observed during the fall surveys. The highest use of the study area was by the red-tailed hawk, followed by prairie falcon, sharp-shinned hawk, American kestrel, northern harrier, Cooper's hawk, turkey vulture, and golden eagle. There was only one observation of the unidentified raptor. The only waterfowl observed were Canada geese and canvasbacks. Upland gamebirds included California quail, chukars, gray partridge, and ring-necked pheasants. The only other bird species observed in the dove/pigeon group was the mourning dove.

Winter. During the winter, passerines were the most abundant avian group observed, composing 74.4% of all birds observed (Table 4). Other avian groups commonly observed were waterfowl (13.6% of winter observations), and upland gamebirds (8.3% of observations). Raptors

composed 2.9% of winter observations. Species with the highest use of the project area were horned lark, European starling, Canada goose, and California quail (Table 5), while those species most frequently observed were horned lark, common raven, western meadowlark, and black-billed magpie (Table 6).

Seven species of raptors were observed during the winter surveys. Those with the highest use of the study area were the red-tailed hawk, rough-legged hawk, golden eagle, prairie falcon, and bald eagle. There were single observations for American kestrel and northern harrier. Numerous Canada geese and some ducks were observed. Upland gamebirds included California quail, chukars, gray partridge, and ring-necked pheasants. The dove/pigeon group was represented by a flock of rock pigeons.

3.2 Flight Behavior

During the entire study, 602 flocks comprising 2,827 birds were observed flying during point count surveys (Table 7). For all species combined, 68.4% of all flying birds observed were below the assumed rotor-swept height (<25 m), 30.8% were within the rotor-swept height (25 – 136 m), and 0.8% were observed flying above the rotor-swept height (>136 m) (Table 7). The rotor-swept height of 25–136 m was used because this area encompasses the rotor-swept height of most turbines ranging in size from 1.5 to 2.7 MW. For groups with at least 10 observations of flying flocks, those most often observed flying within the turbine rotor-swept height were waterfowl (92.9%), buteos (53.0%), and eagles (40.0%). For all flying raptors/vultures combined, 42.4% were observed flying within the rotor-swept height. For species with at least 10 observations of flying flocks, those most often observed at rotor-swept heights were Canada goose (93.9%), rough-legged hawk (61.9%), red-tailed hawk (50.0%), common raven (47.1%), and house finch (41.7%) (Table 8).

Appendix A shows the flight paths of raptors observed at the four stations. These maps will be compared to the post construction maps to investigate avoidance.

3.3 Turbine Exposure Index

Based on the exposure index derived from abundance and flight behavior, the species most likely to collide with turbines are Canada goose (index = 0.29), European starling (0.26), common raven (0.21), swallows (unidentified spp.) (0.19), horned lark (0.17), and red-tailed hawk (0.11) (Table 9). This analysis may provide insight into what species might be the most likely turbine casualties. However, this index only considers relative probability of exposure based on abundance, proportion of daily activity budget spent flying, and flight height of each species. This analysis is based on observations of birds during the daylight period, including dawn and dusk observations when nocturnal migrants would be arriving at or leaving migratory stopover habitat. This index does not take into consideration varying ability among species to detect and avoid turbines, habitat selection, and other factors that may influence exposure to turbine collision; therefore, the actual risk may be lower or higher than indicated by these data. For example, in the Altamont Pass WRA in California, mortality among the five most common species was not related to their abundance. American kestrels, red-tailed hawks, and golden eagles had higher fatality rates, and turkey vultures and common ravens had lower fatality rates

than predicted based on abundance (Orloff and Flannery 1992). Similarly, at the nearby Tehachapi Pass WRA in California, common ravens were found to be the most common large bird in the WRA, yet no fatalities for this species have been documented during intensive studies (Anderson et al. 2004).

4.0 SUMMARY AND DISCUSSION

4.1 Avian Use and Species Diversity

Avian use varied by season, however, over all seasons, the four most common species based on the fixed-point surveys were horned lark, European starling, Canada goose, and western meadowlark. Passerines were by far the most numerous birds observed. The high use estimates for Canada goose were due primarily to large flocks observed in the fall and winter and, to a lesser degree in the summer. European starlings were also observed in large flocks that led to high use estimates for this species but were observed in few of the surveys. In contrast, horned larks were observed in more than three-quarters of the surveys but in smaller group sizes.

For avian species groups, passerines were by far the most common group, followed by waterfowl, upland gamebirds, and raptors. While the species vary, these results are similar to other existing and proposed wind projects that have been studied, where a few common passerines, and in some cases waterfowl, account for most of the avian use of a site and there is relatively low species diversity.

Over all seasons, the most abundant raptors observed in order were red-tailed hawk, rough-legged hawk, and American kestrel, although rough-legged hawks were observed primarily in the winter. On average approximately one red-tailed hawk was observed every 5 surveys, one rough-legged hawk every 14 surveys, and one kestrel every 14 surveys. Raptor use varied by season but was highest in the fall (0.75) and lowest in the spring (0.55) and winter (0.57).

Frequency of occurrence provides a relative estimate of the avian diversity of the study area. Species diversity was typical of other wind areas studied in Washington and Oregon with the majority of use scattered among only a few species. Horned lark was regularly observed in about three-quarters of surveys. Western meadowlark was observed in over 75% of surveys in spring, 40% of surveys in summer and fall, and over 25% of surveys in winter. Other species that were observed regularly included black-billed magpie, red-tailed hawk, common raven, American robin, killdeer, and vesper sparrow; European starling, horned lark, Brewer's blackbird, rough-legged hawk, American kestrel, northern harrier, American goldfinch, and California quail, but none of these species was observed in more than about a quarter of the observation periods (see Table 4 for percent of surveys). The rather low species diversity for the area is likely the result of the dominance of open agriculture and shrub-steppe habitat. These species most commonly seen are typical residents of such habitat.

4.2 Risk of Turbine Collision

4.2.1 Exposure Index

The species with the highest exposure indices for the site in order were Canada goose, European starling, and common raven. Horned lark was the most abundant species observed, had the highest use of the area, and was frequently observed flying; however, less than 4% of horned larks were observed flying in the zone of risk, resulting in a lower exposure index (fifth highest). In contrast, Canada geese were often observed in flocks, and only about 20% of Canada geese were observed flying, but the majority were flying within the zone of risk, leading to a high exposure index. European starlings also had high use in the project area, and about one-third were observed flying, but only about one-quarter of those were flying in the zone of risk. While common ravens used the site less, they were often observed flying at an altitude within the zone of risk. Mortality studies at other wind plants have found European starlings and common ravens but generally not in high numbers (see Erickson et al. 2001). European starling, a non-native species, is not protected and there is little or no concern over potential fatalities of this species. There has been some waterfowl mortality reported at wind plants, however, it does not appear to be substantial. The Klondike wind plant in Oregon had relatively high use by Canada goose and two fatalities were found in the first year of monitoring (Johnson et al. 2003). The Buffalo Ridge wind plant in Minnesota also had relatively high waterfowl use with few mortalities (Johnson et al. 2000a).

4.2.2 Raptors

Compared to other wind plants that have been studied, raptor use for the site is slightly below average, with raptors observed once about every two surveys or 0.51 raptors/survey. The majority of the raptor sightings were red-tailed hawks during all seasons and rough-legged hawks during the winter. For comparison, raptor use at several wind plants studied with the same methods² was generally lower. For example, raptor use (per 30-minute survey) at the Vansycle Wind Plant (OR) was approximately 0.55 raptors; Condon Wind Plant (OR) was approximately 0.49 raptors; at the Stateline Wind Plant (WA/OR) approximately 0.90; at the Klondike Wind Plant (OR) approximately 0.70; at the Buffalo Ridge Wind Plant (MN) approximately 0.74; and at the Foote Creek Rim Wind Plant (WY) raptor use was approximately 1.10 raptors.

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² Fixed-point surveys were conducted following the same methods at all wind plants but had variable survey duration. The calculated use at these wind plants was standardized to 30-minute duration surveys under the assumption that raptor observations were uniform across time for each survey period.

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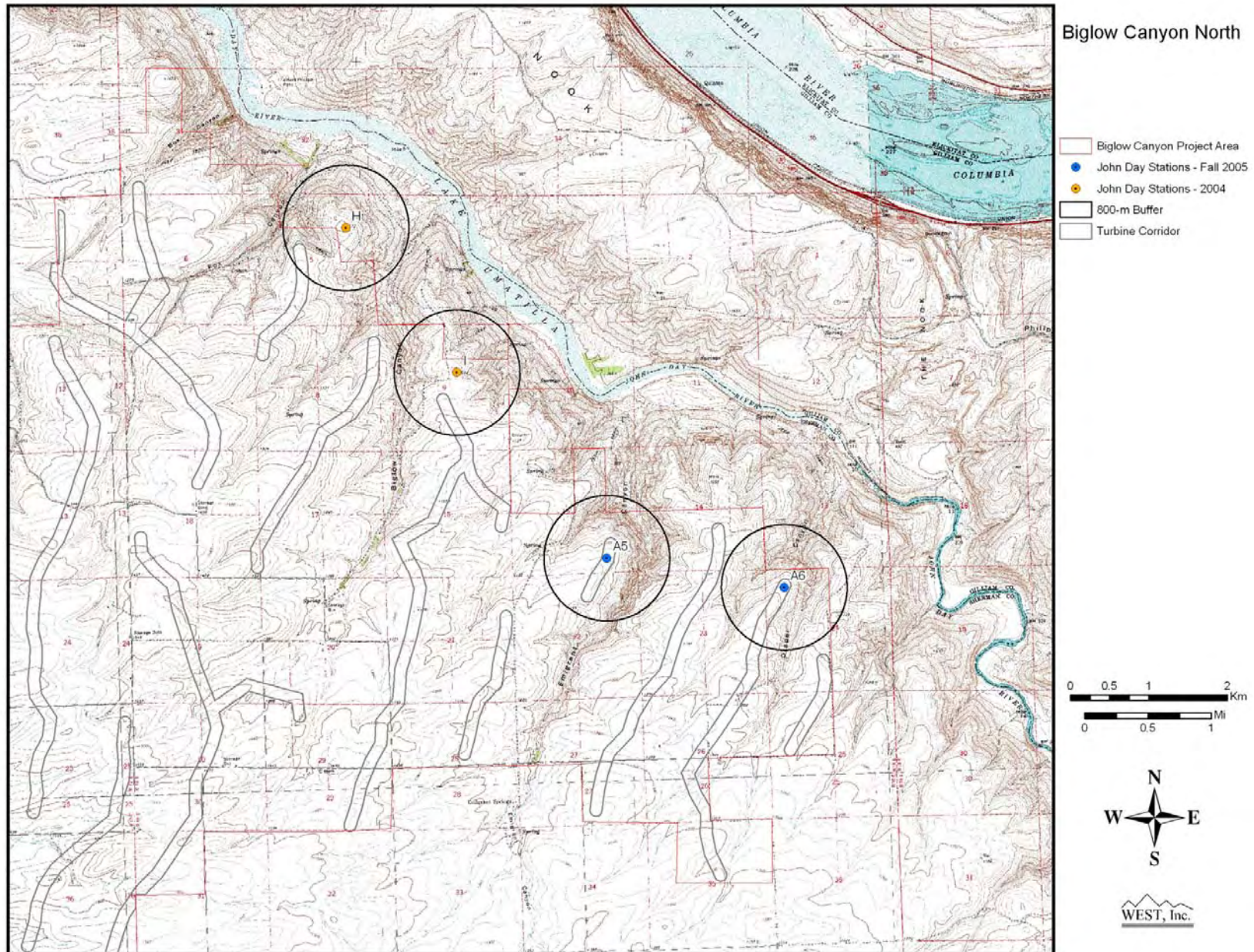


Figure 1. Fixed-point avian observation stations along the John Day River, in the northeast part of the Biglow Canyon Wind Farm project.

Table 1. List of avian species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Species/Group | Scientific Name | Species/Group | Scientific Name |
|---------------------|---------------------------------|-------------------------------|-----------------------------------|
| caspian tern | <i>Sterna caspia</i> | house finch | <i>Carpodacus mexicanus</i> |
| great blue heron | <i>Ardea herodias</i> | lark sparrow | <i>Chondestes grammacus</i> |
| ring-billed gull | <i>Larus delawarensis</i> | mountain bluebird | <i>Sialia currucoides</i> |
| Canada goose | <i>Branta canadensis</i> | northern rough-winged swallow | <i>Stelgidopteryx serripennis</i> |
| canvasback | <i>Aythya valisineria</i> | northern shrike | <i>Lanius excubitor</i> |
| mallard | <i>Anas platyrhynchos</i> | red-breasted nuthatch | <i>Sitta Canadensis</i> |
| long-billed curlew | <i>Numenius americanus</i> | red-winged blackbird | <i>Agelaius phoeniceus</i> |
| American kestrel | <i>Falco sparverius</i> | sage thrasher | <i>Oreoscoptes montanus</i> |
| bald eagle | <i>Haliaeetus leucocephalus</i> | savannah sparrow | <i>Passerculus sandwichensis</i> |
| Cooper's hawk | <i>Accipiter cooperii</i> | Say's phoebe | <i>Sayornis saya</i> |
| golden eagle | <i>Aquila chrysaetos</i> | vesper sparrow | <i>Pooecetes gramineus</i> |
| northern harrier | <i>Circus cyaneus</i> | violet-green swallow | <i>Tachycineta thalassina</i> |
| osprey | <i>Pandion haliaetus</i> | western bluebird | <i>Sialia mexicana</i> |
| prairie falcon | <i>Falco mexicanus</i> | western kingbird | <i>Tyrannus verticalis</i> |
| red-tailed hawk | <i>Buteo jamaicensis</i> | western meadowlark | <i>Sturnella neglecta</i> |
| rough-legged hawk | <i>Buteo lagopus</i> | white-crowned sparrow | <i>Zonotrichia leucophrys</i> |
| sharp-shinned hawk | <i>Accipiter striatus</i> | yellow-rumped warbler | <i>Dendroica coronata</i> |
| Swainson's hawk | <i>Buteo swainsoni</i> | California quail | <i>Callipepla californica</i> |
| turkey vulture | <i>Cathartes aura</i> | chukar | <i>Alectoris chukar</i> |
| American crow | <i>Corvus brachyrhynchos</i> | gray partridge | <i>Perdix perdix</i> |
| American goldfinch | <i>Carduelis tristis</i> | ring-necked pheasant | <i>Phasianus colchicus</i> |
| American pipit | <i>Anthus rubescens</i> | mourning dove | <i>Zenaida macroura</i> |
| American robin | <i>Turdus migratorius</i> | rock pigeon | <i>Columba livia</i> |
| barn swallow | <i>Hirundo rustica</i> | black-chinned hummingbird | <i>Archilochus alexandri</i> |
| black-billed magpie | <i>Pica pica</i> | northern flicker | <i>Colaptes auratus</i> |
| Brewer's blackbird | <i>Euphagus cyanocephalus</i> | Vaux's swift | <i>Chaetura vauxi</i> |
| chipping sparrow | <i>Spizella passerina</i> | unidentified gull | |
| cliff swallow | <i>Petrochelidon pyrrhonota</i> | unidentified duck | |
| common raven | <i>Corvus corax</i> | unidentified raptor | |

Table 1. List of avian species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Species/Group | Scientific Name | Species/Group | Scientific Name |
|---------------------|------------------------------|------------------------|-----------------|
| dark-eyed junco | <i>Junco hyemalis</i> | unidentified passerine | |
| European starling | <i>Sturnus vulgaris</i> | unidentified sparrow | |
| grasshopper sparrow | <i>Ammodramus savannarum</i> | unidentified swallow | |
| horned lark | <i>Eremophila alpestris</i> | | |

Table 2. Mean use, mean # species/survey, total number of species, and total number of fixed-point surveys conducted by season and overall for the Biglow Canyon Wind Farm site.

| Season | Number of Visits | Mean Use ^a | # Species/Survey | # Species | # Surveys Conducted |
|---------|------------------|-----------------------|------------------|-----------|---------------------|
| Spring | 9 | 16.125 | 6.389 | 37 | 46 |
| Summer | 12 | 7.875 | 4.854 | 34 | 102 |
| Fall | 17 | 16.711 | 3.387 | 31 | 78 |
| Winter | 13 | 19.920 | 5.904 | 27 | 96 |
| Overall | 51 | 15.346 | 4.904 | 59 | 322 |

^a # observations per 30-minute survey

Table 3. Avian species observed while conducting fixed-point surveys (April 1, 2004 - August 8, 2006) for the Biglow Canyon Wind Farm site. ^a

| Species/Group | Spring | | Summer | | Fall | | Winter | | Grand Total | |
|--------------------------|-----------|-----------|-----------|-----------|------------|-----------|-------------|-----------|-------------|------------|
| | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups |
| Waterbirds | 11 | 3 | 8 | 7 | 0 | 0 | 0 | 0 | 19 | 10 |
| caspian tern | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 2 |
| great blue heron | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 2 |
| ring-billed gull | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 |
| unidentified gull | 9 | 2 | 4 | 3 | 0 | 0 | 0 | 0 | 13 | 5 |
| Waterfowl | 46 | 7 | 69 | 4 | 938 | 23 | 1581 | 33 | 2634 | 67 |
| Canada goose | 11 | 4 | 69 | 4 | 924 | 22 | 1574 | 32 | 2578 | 62 |
| canvasback | 0 | 0 | 0 | 0 | 14 | 1 | 0 | 0 | 14 | 1 |
| mallard | 30 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 2 |
| unidentified duck | 5 | 1 | 0 | 0 | 0 | 0 | 7 | 1 | 12 | 2 |
| Shorebirds | | | | | | | | | | |
| long-billed curlew | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 3 |
| Raptors | 27 | 24 | 44 | 38 | 42 | 41 | 52 | 52 | 165 | 155 |
| <i>Accipiters</i> | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 6 | 6 |
| Cooper's hawk | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| sharp-shinned hawk | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 4 | 4 |
| <i>Buteos</i> | 17 | 14 | 19 | 17 | 20 | 20 | 36 | 36 | 92 | 87 |
| Swainson's hawk | 1 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 4 | 3 |
| red-tailed hawk | 14 | 11 | 16 | 15 | 20 | 20 | 15 | 15 | 65 | 61 |
| rough-legged hawk | 2 | 2 | 0 | 0 | 0 | 0 | 21 | 21 | 23 | 23 |
| <i>Northern Harriers</i> | | | | | | | | | | |
| northern harrier | 4 | 4 | 7 | 7 | 2 | 2 | 1 | 1 | 14 | 14 |

Table 3. Avian species observed while conducting fixed-point surveys (April 1, 2004 - August 8, 2006) for the Biglow Canyon Wind Farm site. ^a

| Species/Group | Spring | | Summer | | Fall | | Winter | | Grand Total | |
|----------------------|------------|------------|------------|------------|------------|------------|-------------|------------|-------------|------------|
| | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups |
| <i>Eagles</i> | 1 | 1 | 0 | 0 | 2 | 2 | 9 | 9 | 12 | 12 |
| bald eagle | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| golden eagle | 1 | 1 | 0 | 0 | 2 | 2 | 7 | 7 | 10 | 10 |
| <i>Falcons</i> | 4 | 4 | 13 | 10 | 10 | 9 | 6 | 6 | 33 | 29 |
| American kestrel | 4 | 4 | 13 | 10 | 5 | 4 | 1 | 1 | 23 | 19 |
| prairie falcon | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 10 | 10 |
| <i>Other Raptors</i> | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 |
| osprey | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| unidentified raptor | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| <i>Vultures</i> | | | | | | | | | | |
| turkey vulture | 0 | 0 | 5 | 4 | 1 | 1 | 0 | 0 | 6 | 5 |
| Passerines | 540 | 155 | 465 | 197 | 981 | 171 | 1116 | 213 | 3102 | 736 |
| American crow | 6 | 1 | 0 | 0 | 105 | 2 | 6 | 2 | 117 | 5 |
| American goldfinch | 14 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 3 |
| American pipit | 19 | 3 | 0 | 0 | 0 | 0 | 2 | 2 | 21 | 5 |
| American robin | 1 | 1 | 0 | 0 | 1 | 1 | 18 | 7 | 20 | 9 |
| barn swallow | 0 | 0 | 6 | 5 | 2 | 1 | 0 | 0 | 8 | 6 |
| black-billed magpie | 5 | 3 | 12 | 7 | 15 | 12 | 43 | 14 | 75 | 36 |
| Brewer's blackbird | 14 | 5 | 19 | 7 | 13 | 3 | 0 | 0 | 46 | 15 |
| chipping sparrow | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| cliff swallow | 0 | 0 | 26 | 4 | 0 | 0 | 0 | 0 | 26 | 4 |
| common raven | 26 | 16 | 18 | 10 | 24 | 17 | 54 | 34 | 122 | 77 |
| dark-eyed junco | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 7 | 1 |
| European starling | 9 | 2 | 12 | 3 | 404 | 8 | 123 | 6 | 548 | 19 |
| grasshopper sparrow | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 2 |

Table 3. Avian species observed while conducting fixed-point surveys (April 1, 2004 - August 8, 2006) for the Biglow Canyon Wind Farm site. ^a

| Species/Group | Spring | | Summer | | Fall | | Winter | | Grand Total | |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-------------|-----------|
| | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups |
| horned lark | 246 | 55 | 184 | 86 | 305 | 80 | 696 | 95 | 1431 | 316 |
| house finch | 2 | 1 | 0 | 0 | 6 | 2 | 95 | 12 | 103 | 15 |
| lark sparrow | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 2 |
| mountain bluebird | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 3 | 2 |
| northern rough-winged swallow | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 4 | 2 |
| northern shrike | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| red-breasted nuthatch | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| red-winged blackbird | 4 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 5 | 3 |
| sage thrasher | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 2 |
| savannah sparrow | 12 | 5 | 4 | 4 | 0 | 0 | 0 | 0 | 16 | 9 |
| Say's phoebe | 4 | 4 | 3 | 2 | 1 | 1 | 0 | 0 | 8 | 7 |
| unidentified passerine | 1 | 1 | 0 | 0 | 1 | 1 | 6 | 1 | 8 | 3 |
| unidentified sparrow | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 3 |
| unidentified swallow | 0 | 0 | 38 | 1 | 0 | 0 | 0 | 0 | 38 | 1 |
| vesper sparrow | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 3 | 1 |
| violet-green swallow | 11 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 3 |
| western bluebird | 0 | 0 | 0 | 0 | 19 | 4 | 0 | 0 | 19 | 4 |
| western kingbird | 2 | 2 | 8 | 8 | 0 | 0 | 0 | 0 | 10 | 10 |
| western meadowlark | 147 | 42 | 122 | 51 | 77 | 34 | 47 | 34 | 393 | 161 |
| white-crowned sparrow | 7 | 1 | 0 | 0 | 0 | 0 | 7 | 1 | 14 | 2 |
| yellow-rumped warbler | 3 | 1 | 0 | 0 | 5 | 2 | 9 | 2 | 17 | 5 |
| Upland Gamebirds | 45 | 34 | 14 | 14 | 11 | 4 | 59 | 13 | 129 | 65 |
| California quail | 4 | 3 | 2 | 2 | 1 | 1 | 37 | 3 | 44 | 9 |
| chukar | 5 | 4 | 1 | 1 | 4 | 1 | 17 | 6 | 27 | 12 |
| gray partridge | 4 | 2 | 0 | 0 | 3 | 1 | 2 | 1 | 9 | 4 |

Table 3. Avian species observed while conducting fixed-point surveys (April 1, 2004 - August 8, 2006) for the Biglow Canyon Wind Farm site. ^a

| Species/Group | Spring | | Summer | | Fall | | Winter | | Grand Total | |
|---------------------------|------------|------------|------------|------------|-------------|------------|-------------|------------|-------------|-------------|
| | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups | # obs. | # groups |
| ring-necked pheasant | 32 | 25 | 11 | 11 | 3 | 1 | 3 | 3 | 49 | 40 |
| Doves/Pigeons | 6 | 1 | 7 | 5 | 1 | 1 | 17 | 1 | 31 | 8 |
| mourning dove | 6 | 1 | 7 | 5 | 1 | 1 | 0 | 0 | 14 | 7 |
| rock pigeon | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 1 | 17 | 1 |
| Other Birds | 4 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 6 | 3 |
| black-chinned hummingbird | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| northern flicker | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Vaux's swift | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 |
| Overall Total | 679 | 225 | 609 | 267 | 1973 | 240 | 2825 | 312 | 6086 | 1044 |

^a All individuals included even those outside the 800-m view shed.

Table 4. Mean use, percent composition and percent frequency of occurrence for avian groups by season for the Biglow Canyon Wind Farm site.

| Species/Group | Mean Use (#/30 min. survey) | | | | Group Composition (%) | | | | % Frequency | | | |
|--------------------------|-----------------------------|--------|--------|--------|-----------------------|--------|--------|--------|-------------|--------|-------|--------|
| | Spring | Summer | Fall | Winter | Spring | Summer | Fall | Winter | Spring | Summer | Fall | Winter |
| Waterbirds | 0.111 | 0.000 | 0.000 | 0.000 | 0.69 | 0.00 | 0.00 | 0.00 | 5.56 | 0.00 | 0.00 | 0.00 |
| Waterfowl | 0.000 | 0.771 | 1.971 | 2.760 | 0.00 | 9.79 | 11.79 | 13.85 | 0.00 | 2.08 | 3.68 | 9.62 |
| Shorebirds | 0.009 | 0.021 | 0.000 | 0.000 | 0.06 | 0.26 | 0.00 | 0.00 | 0.93 | 2.08 | 0.00 | 0.00 |
| Raptors | 0.551 | 0.611 | 0.750 | 0.574 | 3.42 | 7.76 | 4.49 | 2.88 | 38.89 | 43.06 | 36.76 | 48.72 |
| <i>Accipiters</i> | 0.000 | 0.000 | 0.140 | 0.000 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 10.29 | 0.00 |
| <i>Buteos</i> | 0.282 | 0.240 | 0.328 | 0.442 | 1.75 | 3.04 | 1.97 | 2.22 | 18.98 | 16.67 | 17.16 | 41.03 |
| <i>Eagles</i> | 0.000 | 0.000 | 0.022 | 0.083 | 0.00 | 0.00 | 0.13 | 0.42 | 0.00 | 0.00 | 0.74 | 6.41 |
| <i>Northern Harriers</i> | 0.088 | 0.063 | 0.044 | 0.006 | 0.55 | 0.79 | 0.26 | 0.03 | 8.80 | 6.25 | 2.21 | 0.64 |
| <i>Falcons</i> | 0.181 | 0.271 | 0.186 | 0.042 | 1.12 | 3.44 | 1.11 | 0.21 | 18.06 | 20.83 | 8.58 | 3.53 |
| <i>Vultures</i> | 0.000 | 0.038 | 0.029 | 0.000 | 0.00 | 0.49 | 0.18 | 0.00 | 0.00 | 3.13 | 1.47 | 0.00 |
| Passerines | 14.213 | 6.174 | 13.806 | 14.824 | 88.14 | 78.40 | 82.62 | 74.42 | 93.52 | 84.72 | 94.12 | 90.38 |
| Upland Gamebirds | 1.120 | 0.153 | 0.154 | 1.654 | 6.95 | 1.94 | 0.92 | 8.30 | 53.70 | 13.19 | 3.68 | 17.63 |
| Doves/Pigeons | 0.083 | 0.118 | 0.029 | 0.109 | 0.52 | 1.50 | 0.18 | 0.55 | 1.39 | 6.94 | 1.47 | 0.64 |
| Other Birds | 0.037 | 0.028 | 0.000 | 0.000 | 0.23 | 0.35 | 0.00 | 0.00 | 0.93 | 2.78 | 0.00 | 0.00 |
| Overall | 16.125 | 7.875 | 16.711 | 19.920 | 100.00 | 100.00 | 100.00 | 100.00 | | | | |

Table 5. Avian species observed within 800m of the observer and estimated mean use (#/30-minute survey) for large and small birds for the Biglow Canyon Wind Farm site (April 1, 2004 - August 8, 2006).

| <u>Large Birds</u> | | | | | | | |
|---------------------------|-------|----------------------|-------|----------------------|-------|----------------------|-------|
| Spring | | Summer | | Fall | | Winter | |
| Species/Group | Use | Species/Group | Use | Species/Group | Use | Species/Group | Use |
| common raven | 0.995 | Canada goose | 0.771 | Canada goose | 1.868 | Canada goose | 2.715 |
| ring-necked pheasant | 0.593 | American kestrel | 0.271 | American crow | 0.794 | California quail | 1.423 |
| American crow | 0.333 | common raven | 0.222 | common raven | 0.471 | black-billed magpie | 0.772 |
| gray partridge | 0.222 | red-tailed hawk | 0.212 | black-billed magpie | 0.346 | common raven | 0.599 |
| red-tailed hawk | 0.204 | ring-necked pheasant | 0.132 | red-tailed hawk | 0.328 | red-tailed hawk | 0.234 |
| American kestrel | 0.181 | black-billed magpie | 0.083 | prairie falcon | 0.105 | rough-legged hawk | 0.208 |
| California quail | 0.181 | northern harrier | 0.063 | canvasback | 0.103 | chukar | 0.199 |
| chukar | 0.125 | turkey vulture | 0.038 | sharp-shinned hawk | 0.103 | golden eagle | 0.071 |
| ring-billed gull | 0.111 | Swainson's hawk | 0.028 | chukar | 0.088 | unidentified duck | 0.045 |
| black-billed magpie | 0.097 | long-billed curlew | 0.021 | American kestrel | 0.081 | American crow | 0.038 |
| northern harrier | 0.088 | California quail | 0.014 | northern harrier | 0.044 | prairie falcon | 0.035 |
| rough-legged hawk | 0.069 | chukar | 0.007 | Cooper's hawk | 0.037 | ring-necked pheasant | 0.019 |
| long-billed curlew | 0.009 | | | turkey vulture | 0.029 | bald eagle | 0.013 |
| Swainson's hawk | 0.009 | | | gray partridge | 0.029 | gray partridge | 0.013 |
| | | | | ring-necked pheasant | 0.029 | American kestrel | 0.006 |
| | | | | golden eagle | 0.022 | northern harrier | 0.006 |
| | | | | California quail | 0.007 | | |

Table 5 (continued). Avian species observed within 800m of the observer and estimated mean use (#/30-minute survey) for large and small birds for the Biglow Canyon Wind Farm site (April 1, 2004 - August 8, 2006).

| <u>Small Birds</u> | | | | | | | |
|---------------------------|-------|---------------------------|-------|------------------------|-------|-------------------------|-------|
| Spring Species/Group | Use | Summer Species/Group | Use | Fall Species/Group | Use | Winter Species/Group | Use |
| horned lark | 6.778 | horned lark | 2.535 | horned lark | 5.730 | horned lark | 6.109 |
| western meadowlark | 3.102 | western meadowlark | 1.465 | European starling | 4.279 | European starling | 4.526 |
| American goldfinch | 0.500 | unidentified swallow | 0.792 | western meadowlark | 1.319 | house finch | 0.933 |
| American pipit | 0.398 | cliff swallow | 0.250 | western bluebird | 0.257 | western meadowlark | 0.519 |
| white-crowned sparrow | 0.389 | Brewer's blackbird | 0.146 | Brewer's blackbird | 0.162 | yellow-rumped warbler | 0.346 |
| European starling | 0.333 | vesper sparrow | 0.125 | yellow-rumped warbler | 0.147 | dark-eyed junco | 0.269 |
| Brewer's blackbird | 0.315 | mourning dove | 0.118 | house finch | 0.110 | white-crowned sparrow | 0.269 |
| violet-green swallow | 0.269 | Say's phoebe | 0.090 | barn swallow | 0.059 | unidentified passerine | 0.231 |
| Say's phoebe | 0.134 | European starling | 0.083 | American robin | 0.029 | American robin | 0.179 |
| savannah sparrow | 0.125 | barn swallow | 0.083 | Say's phoebe | 0.029 | rock pigeon | 0.109 |
| unidentified sparrow | 0.120 | grasshopper sparrow | 0.063 | red-breasted nuthatch | 0.029 | mountain bluebird | 0.019 |
| lark sparrow | 0.111 | western kingbird | 0.056 | unidentified passerine | 0.029 | American pipit | 0.013 |
| | | northern rough-winged | | | | | |
| mourning dove | 0.083 | swallow | 0.042 | mourning dove | 0.029 | | |
| American robin | 0.056 | savannah sparrow | 0.042 | northern shrike | 0.007 | | |
| red-winged blackbird | 0.046 | unidentified sparrow | 0.042 | sage thrasher | 0.007 | | |
| Vaux's swift | 0.037 | chipping sparrow | 0.021 | | | | |
| house finch | 0.028 | red-winged blackbird | 0.021 | | | | |
| yellow-rumped warbler | 0.028 | northern flicker | 0.021 | | | | |
| western kingbird | 0.023 | lark sparrow | 0.007 | | | | |
| northern rough-winged | | | | | | | |
| swallow | 0.019 | sage thrasher | 0.007 | | | | |
| unidentified passerine | 0.014 | black-chinned hummingbird | 0.007 | | | | |

Table 6. Avian species observed within 800m of observer and estimated frequency of occurrence for large and small birds for the Biglow Canyon Wind Farm site (April 1, 2004 - August 8, 2006).

| Large Birds | | | | | | | |
|----------------------|--------|----------------------|--------|----------------------|--------|----------------------|--------|
| Spring | | Summer | | Fall | | Winter | |
| Species/Group | % freq | Species/Group | % freq | Species/Group | % freq | Species/Group | % freq |
| ring-necked pheasant | 42.59 | American kestrel | 20.83 | common raven | 23.53 | common raven | 38.78 |
| common raven | 37.50 | red-tailed hawk | 14.93 | red-tailed hawk | 17.16 | black-billed magpie | 25.96 |
| American kestrel | 18.06 | common raven | 12.85 | black-billed magpie | 16.91 | red-tailed hawk | 22.76 |
| California quail | 12.50 | ring-necked pheasant | 12.50 | sharp-shinned hawk | 6.62 | rough-legged hawk | 19.55 |
| red-tailed hawk | 11.11 | northern harrier | 6.25 | prairie falcon | 4.90 | California quail | 11.54 |
| gray partridge | 11.11 | black-billed magpie | 4.86 | Canada goose | 3.68 | Canada goose | 8.97 |
| chukar | 9.72 | turkey vulture | 3.13 | American kestrel | 3.68 | chukar | 7.37 |
| northern harrier | 8.80 | Canada goose | 2.08 | Cooper's hawk | 3.68 | golden eagle | 5.13 |
| rough-legged hawk | 6.94 | long-billed curlew | 2.08 | American crow | 3.68 | prairie falcon | 2.88 |
| ring-billed gull | 5.56 | Swainson's hawk | 1.74 | northern harrier | 2.21 | ring-necked pheasant | 1.92 |
| American crow | 5.56 | California quail | 1.39 | turkey vulture | 1.47 | bald eagle | 1.28 |
| black-billed magpie | 4.17 | chukar | 0.69 | chukar | 1.47 | American crow | 1.28 |
| long-billed curlew | 0.93 | | | canvasback | 0.74 | unidentified duck | 0.64 |
| Swainson's hawk | 0.93 | | | golden eagle | 0.74 | American kestrel | 0.64 |
| | | | | California quail | 0.74 | northern harrier | 0.64 |
| | | | | gray partridge | 0.74 | gray partridge | 0.64 |
| | | | | ring-necked pheasant | 0.74 | | |

Table 6 (continued). Avian species observed within 800m of observer and estimated frequency of occurrence for large and small birds for the Biglow Canyon Wind Farm site (April 1, 2004 - August 8, 2006).

| Small Birds | | | | | | | |
|------------------------|--------|---------------------------|--------|------------------------|--------|------------------------|--------|
| Spring | | Summer | | Fall | | Winter | |
| Species/Group | % freq | Species/Group | % freq | Species/Group | % freq | Species/Group | % freq |
| horned lark | 88.89 | horned lark | 70.83 | horned lark | 86.76 | horned lark | 72.44 |
| western meadowlark | 75.46 | western meadowlark | 44.79 | western meadowlark | 40.44 | western meadowlark | 28.21 |
| Say's phoebe | 13.43 | mourning dove | 6.94 | European starling | 9.56 | house finch | 14.42 |
| Brewer's blackbird | 12.96 | western kingbird | 5.56 | yellow-rumped warbler | 5.88 | European starling | 10.90 |
| American pipit | 7.87 | Brewer's blackbird | 4.86 | western bluebird | 4.41 | American robin | 7.69 |
| violet-green swallow | 7.87 | Say's phoebe | 4.86 | American robin | 2.94 | yellow-rumped | 7.69 |
| American goldfinch | 7.41 | barn swallow | 4.17 | barn swallow | 2.94 | dark-eyed junco | 3.85 |
| European starling | 6.94 | grasshopper sparrow | 4.17 | Brewer's blackbird | 2.94 | unidentified passerine | 3.85 |
| unidentified sparrow | 6.48 | savannah sparrow | 4.17 | red-breasted nuthatch | 2.94 | white-crowned | 3.85 |
| American robin | 5.56 | unidentified sparrow | 4.17 | Say's phoebe | 2.94 | American pipit | 1.28 |
| lark sparrow | 5.56 | vesper sparrow | 4.17 | unidentified passerine | 2.94 | Mountain bluebird | 1.28 |
| savannah sparrow | 5.56 | cliff swallow | 3.47 | house finch | 2.21 | rock pigeon | 0.64 |
| white-crowned sparrow | 5.56 | chipping sparrow | 2.08 | mourning dove | 1.47 | | |
| red-winged blackbird | 2.31 | northern rough-winged | 2.08 | northern shrike | 0.74 | | |
| western kingbird | 2.31 | red-winged blackbird | 2.08 | sage thrasher | 0.74 | | |
| house finch | 1.39 | unidentified swallow | 2.08 | | | | |
| unidentified passerine | 1.39 | northern flicker | 2.08 | | | | |
| mourning dove | 1.39 | European starling | 1.39 | | | | |
| northern rough-winged | 0.93 | lark sparrow | 0.69 | | | | |
| yellow-rumped warbler | 0.93 | sage thrasher | 0.69 | | | | |
| Vaux's swift | 0.93 | black-chinned hummingbird | 0.69 | | | | |

Table 7. Flight height characteristics by avian group during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Group | # Birds Flying | # Groups Flying | % Birds Flying | Collision Risk Height (25-136m AGL) | | |
|--------------------------|----------------------|-----------------------|----------------------|--|--------|-------|
| | | | | below | within | above |
| Waterbirds | 12 | 6 | 63.16 | 66.67 | 8.33 | 25.00 |
| Waterfowl | 566 | 27 | 21.49 | 7.07 | 92.93 | 0.00 |
| Shorebirds | 0 | 0 | 0.00 | N/A | N/A | N/A |
| Raptors | 144 | 135 | 87.27 | 50.00 | 42.36 | 7.64 |
| <i>Accipiters</i> | 6 | 6 | 100.00 | 100.00 | 0.00 | 0.00 |
| <i>Buteos</i> | 83 | 78 | 90.22 | 37.35 | 53.01 | 9.64 |
| <i>Eagles</i> | 10 | 10 | 83.33 | 50.00 | 40.00 | 10.00 |
| <i>Northern Harriers</i> | 13 | 13 | 92.86 | 76.92 | 23.08 | 0.00 |
| <i>Falcons</i> | 25 | 22 | 75.76 | 76.00 | 24.00 | 0.00 |
| <i>Other Raptors</i> | 1 | 1 | 50.00 | 0.00 | 100.00 | 0.00 |
| <i>Vultures</i> | 6 | 5 | 100.00 | 16.67 | 50.00 | 33.33 |
| Passerines | 2032 | 423 | 65.51 | 85.68 | 13.88 | 0.44 |
| Upland Gamebirds | 41 | 4 | 31.78 | 100.00 | 0.00 | 0.00 |
| Doves/Pigeons | 27 | 5 | 87.10 | 100.00 | 0.00 | 0.00 |
| Other Birds | 5 | 2 | 83.33 | 100.00 | 0.00 | 0.00 |
| Overall | 2827 | 602 | 46.43 | 68.41 | 30.77 | 0.81 |

Table 8. Flight height characteristics by species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Species/Group | # Birds Flying | # Groups Flying | % Birds Flying | Collision Risk Height (25-136 m AGL) | | |
|------------------------|----------------------|-----------------------|----------------------|---|--------|-------|
| | | | | Below | Within | Above |
| unidentified swallow | 38 | 1 | 100.00 | 0.00 | 100.00 | 0.00 |
| canvasback | 14 | 1 | 100.00 | 0.00 | 100.00 | 0.00 |
| American goldfinch | 12 | 2 | 85.71 | 0.00 | 100.00 | 0.00 |
| unidentified duck | 7 | 1 | 58.33 | 0.00 | 100.00 | 0.00 |
| osprey | 1 | 1 | 100.00 | 0.00 | 100.00 | 0.00 |
| Canada goose | 538 | 24 | 20.87 | 6.13 | 93.87 | 0.00 |
| rough-legged hawk | 21 | 21 | 91.30 | 33.33 | 61.90 | 4.76 |
| cliff swallow | 26 | 4 | 100.00 | 42.31 | 57.69 | 0.00 |
| yellow-rumped warbler | 14 | 4 | 82.35 | 42.86 | 57.14 | 0.00 |
| red-tailed hawk | 58 | 54 | 89.23 | 39.66 | 50.00 | 10.34 |
| golden eagle | 8 | 8 | 80.00 | 37.50 | 50.00 | 12.50 |
| turkey vulture | 6 | 5 | 100.00 | 16.67 | 50.00 | 33.33 |
| Swainson's hawk | 4 | 3 | 100.00 | 25.00 | 50.00 | 25.00 |
| common raven | 102 | 61 | 83.61 | 44.12 | 47.06 | 8.82 |
| house finch | 84 | 12 | 81.55 | 58.33 | 41.67 | 0.00 |
| American pipit | 19 | 3 | 90.48 | 63.16 | 36.84 | 0.00 |
| American kestrel | 19 | 16 | 82.61 | 73.68 | 26.32 | 0.00 |
| European starling | 202 | 16 | 36.86 | 73.76 | 26.24 | 0.00 |
| unidentified sparrow | 4 | 3 | 100.00 | 75.00 | 25.00 | 0.00 |
| western kingbird | 4 | 4 | 40.00 | 75.00 | 25.00 | 0.00 |
| northern harrier | 13 | 13 | 92.86 | 76.92 | 23.08 | 0.00 |
| prairie falcon | 6 | 6 | 60.00 | 83.33 | 16.67 | 0.00 |
| unidentified passerine | 7 | 2 | 87.50 | 85.71 | 14.29 | 0.00 |
| Brewer's blackbird | 45 | 14 | 97.83 | 86.67 | 13.33 | 0.00 |
| barn swallow | 8 | 6 | 100.00 | 87.50 | 12.50 | 0.00 |
| unidentified gull | 8 | 3 | 61.54 | 75.00 | 12.50 | 12.50 |
| black-billed magpie | 61 | 25 | 81.33 | 88.52 | 11.48 | 0.00 |
| horned lark | 1148 | 215 | 80.22 | 96.08 | 3.92 | 0.00 |
| western meadowlark | 72 | 25 | 18.32 | 97.22 | 2.78 | 0.00 |
| American crow | 110 | 3 | 94.02 | 98.18 | 1.82 | 0.00 |
| California quail | 34 | 1 | 77.27 | 100.00 | 0.00 | 0.00 |
| western bluebird | 18 | 3 | 94.74 | 100.00 | 0.00 | 0.00 |
| rock pigeon | 17 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |
| white-crowned sparrow | 14 | 2 | 100.00 | 100.00 | 0.00 | 0.00 |
| violet-green swallow | 11 | 3 | 100.00 | 100.00 | 0.00 | 0.00 |
| mourning dove | 10 | 4 | 71.43 | 100.00 | 0.00 | 0.00 |
| American robin | 8 | 3 | 40.00 | 100.00 | 0.00 | 0.00 |
| dark-eyed junco | 7 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |

Table 8. Flight height characteristics by species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Species/Group | # | # | % | Collision Risk Height (25-136 m AGL) | | |
|-------------------------------|-----------------|------------------|-----------------|---|--------------|-------------|
| | Birds Flying | Groups Flying | Birds Flying | Below | Within | Above |
| mallard | 7 | 1 | 23.33 | 100.00 | 0.00 | 0.00 |
| Say's phoebe | 5 | 4 | 62.50 | 100.00 | 0.00 | 0.00 |
| chukar | 4 | 1 | 14.81 | 100.00 | 0.00 | 0.00 |
| northern rough-winged swallow | 4 | 2 | 100.00 | 100.00 | 0.00 | 0.00 |
| sharp-shinned hawk | 4 | 4 | 100.00 | 100.00 | 0.00 | 0.00 |
| Vaux's swift | 4 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |
| vesper sparrow | 3 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |
| bald eagle | 2 | 2 | 100.00 | 100.00 | 0.00 | 0.00 |
| caspian tern | 2 | 2 | 100.00 | 100.00 | 0.00 | 0.00 |
| Cooper's hawk | 2 | 2 | 100.00 | 100.00 | 0.00 | 0.00 |
| gray partridge | 2 | 1 | 22.22 | 100.00 | 0.00 | 0.00 |
| lark sparrow | 2 | 1 | 66.67 | 100.00 | 0.00 | 0.00 |
| mountain bluebird | 2 | 1 | 66.67 | 100.00 | 0.00 | 0.00 |
| ring-billed gull | 2 | 1 | 100.00 | 0.00 | 0.00 | 100.00 |
| black-chinned hummingbird | 1 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |
| northern shrike | 1 | 1 | 100.00 | 100.00 | 0.00 | 0.00 |
| ring-necked pheasant | 1 | 1 | 2.04 | 100.00 | 0.00 | 0.00 |
| savannah sparrow | 1 | 1 | 6.25 | 100.00 | 0.00 | 0.00 |
| chipping sparrow | 0 | 0 | 0.00 | N/A | N/A | N/A |
| grasshopper sparrow | 0 | 0 | 0.00 | N/A | N/A | N/A |
| great blue heron | 0 | 0 | 0.00 | N/A | N/A | N/A |
| long-billed curlew | 0 | 0 | 0.00 | N/A | N/A | N/A |
| northern flicker | 0 | 0 | 0.00 | N/A | N/A | N/A |
| red-breasted nuthatch | 0 | 0 | 0.00 | N/A | N/A | N/A |
| red-winged blackbird | 0 | 0 | 0.00 | N/A | N/A | N/A |
| sage thrasher | 0 | 0 | 0.00 | N/A | N/A | N/A |
| unidentified raptor | 0 | 0 | 0.00 | N/A | N/A | N/A |
| Overall | 2827 | 602 | 46.43 | 68.41 | 30.77 | 0.81 |

Table 9. Mean exposure indices calculated by species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

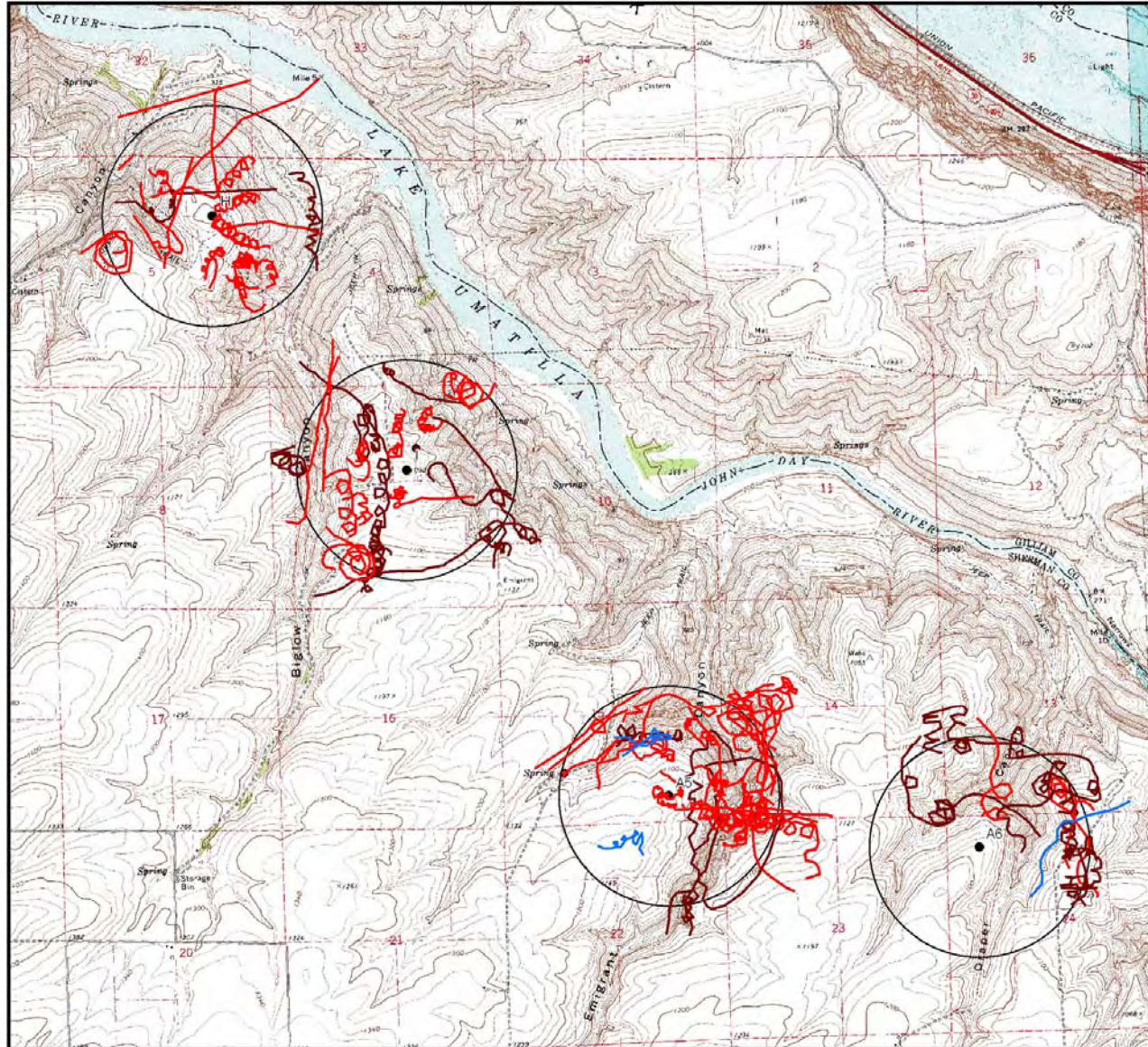
| Species/Group | Overall Mean Use | % Flying | % Flying within RSA | Exposure Index |
|------------------------|------------------|----------|---------------------|----------------|
| Canada goose | 1.496 | 20.87 | 93.87 | 0.293 |
| European starling | 2.658 | 36.86 | 26.24 | 0.257 |
| common raven | 0.538 | 83.61 | 47.06 | 0.212 |
| unidentified swallow | 0.186 | 100.00 | 100.00 | 0.186 |
| horned lark | 5.260 | 80.22 | 3.92 | 0.165 |
| red-tailed hawk | 0.255 | 89.23 | 50.00 | 0.114 |
| house finch | 0.279 | 81.55 | 41.67 | 0.095 |
| American goldfinch | 0.088 | 85.71 | 100.00 | 0.076 |
| yellow-rumped warbler | 0.142 | 82.35 | 57.14 | 0.067 |
| rough-legged hawk | 0.065 | 91.30 | 61.90 | 0.037 |
| canvasback | 0.034 | 100.00 | 100.00 | 0.034 |
| cliff swallow | 0.059 | 100.00 | 57.69 | 0.034 |
| black-billed magpie | 0.349 | 81.33 | 11.48 | 0.033 |
| American kestrel | 0.124 | 82.61 | 26.32 | 0.027 |
| American pipit | 0.074 | 90.48 | 36.84 | 0.025 |
| Brewer's blackbird | 0.144 | 97.83 | 13.33 | 0.019 |
| golden eagle | 0.025 | 80.00 | 50.00 | 0.010 |
| northern harrier | 0.047 | 92.86 | 23.08 | 0.010 |
| turkey vulture | 0.019 | 100.00 | 50.00 | 0.009 |
| unidentified passerine | 0.071 | 87.50 | 14.29 | 0.009 |
| unidentified sparrow | 0.031 | 100.00 | 25.00 | 0.008 |
| western meadowlark | 1.464 | 18.32 | 2.78 | 0.007 |
| unidentified duck | 0.011 | 58.33 | 100.00 | 0.007 |
| American crow | 0.333 | 94.02 | 1.82 | 0.006 |
| barn swallow | 0.039 | 100.00 | 12.50 | 0.005 |
| prairie falcon | 0.044 | 60.00 | 16.67 | 0.004 |
| Swainson's hawk | 0.008 | 100.00 | 50.00 | 0.004 |
| western kingbird | 0.017 | 40.00 | 25.00 | 0.002 |
| California quail | 0.400 | 77.27 | 0.00 | 0.000 |
| ring-necked pheasant | 0.150 | 2.04 | 0.00 | 0.000 |
| white-crowned sparrow | 0.137 | 100.00 | 0.00 | 0.000 |
| chukar | 0.104 | 14.81 | 0.00 | 0.000 |
| western bluebird | 0.086 | 94.74 | 0.00 | 0.000 |
| dark-eyed junco | 0.069 | 100.00 | 0.00 | 0.000 |
| American robin | 0.065 | 40.00 | 0.00 | 0.000 |
| Say's phoebe | 0.055 | 62.50 | 0.00 | 0.000 |
| mourning dove | 0.052 | 71.43 | 0.00 | 0.000 |
| gray partridge | 0.052 | 22.22 | 0.00 | 0.000 |
| violet-green swallow | 0.047 | 100.00 | 0.00 | 0.000 |

Table 9. Mean exposure indices calculated by species observed during fixed-point surveys for the Biglow Canyon Wind Farm site.

| Species/Group | Overall Mean Use | % Flying | % Flying within RSA | Exposure Index |
|-------------------------------|------------------|----------|---------------------|----------------|
| sharp-shinned hawk | 0.034 | 100.00 | 0.00 | 0.000 |
| savannah sparrow | 0.032 | 6.25 | 0.00 | 0.000 |
| vesper sparrow | 0.029 | 100.00 | 0.00 | 0.000 |
| rock pigeon | 0.028 | 100.00 | 0.00 | 0.000 |
| lark sparrow | 0.021 | 66.67 | 0.00 | 0.000 |
| ring-billed gull | 0.020 | 100.00 | 0.00 | 0.000 |
| northern rough-winged swallow | 0.013 | 100.00 | 0.00 | 0.000 |
| Cooper's hawk | 0.012 | 100.00 | 0.00 | 0.000 |
| Vaux's swift | 0.007 | 100.00 | 0.00 | 0.000 |
| mountain bluebird | 0.005 | 66.67 | 0.00 | 0.000 |
| bald eagle | 0.003 | 100.00 | 0.00 | 0.000 |
| northern shrike | 0.002 | 100.00 | 0.00 | 0.000 |
| black-chinned hummingbird | 0.002 | 100.00 | 0.00 | 0.000 |
| grasshopper sparrow | 0.015 | 0.00 | N/A | N/A |
| red-winged blackbird | 0.013 | 0.00 | N/A | N/A |
| red-breasted nuthatch | 0.010 | 0.00 | N/A | N/A |
| long-billed curlew | 0.007 | 0.00 | N/A | N/A |
| chipping sparrow | 0.005 | 0.00 | N/A | N/A |
| northern flicker | 0.005 | 0.00 | N/A | N/A |
| sage thrasher | 0.004 | 0.00 | N/A | N/A |
| caspian tern | N/A | 100.00 | 0.00 | N/A |
| osprey | N/A | 100.00 | 100.00 | N/A |
| unidentified gull | N/A | 61.54 | 12.50 | N/A |
| mallard | N/A | 23.33 | 0.00 | N/A |
| great blue heron | N/A | 0.00 | N/A | N/A |
| unidentified raptor | N/A | 0.00 | N/A | N/A |

APPENDIX A

Biglow Canyon



Buteos

- John Day Stations

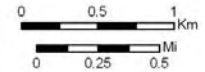
□ 800-m Buffer

Flight Paths

- Rough-legged hawk
- Red-tailed hawk
- Swainson's hawk

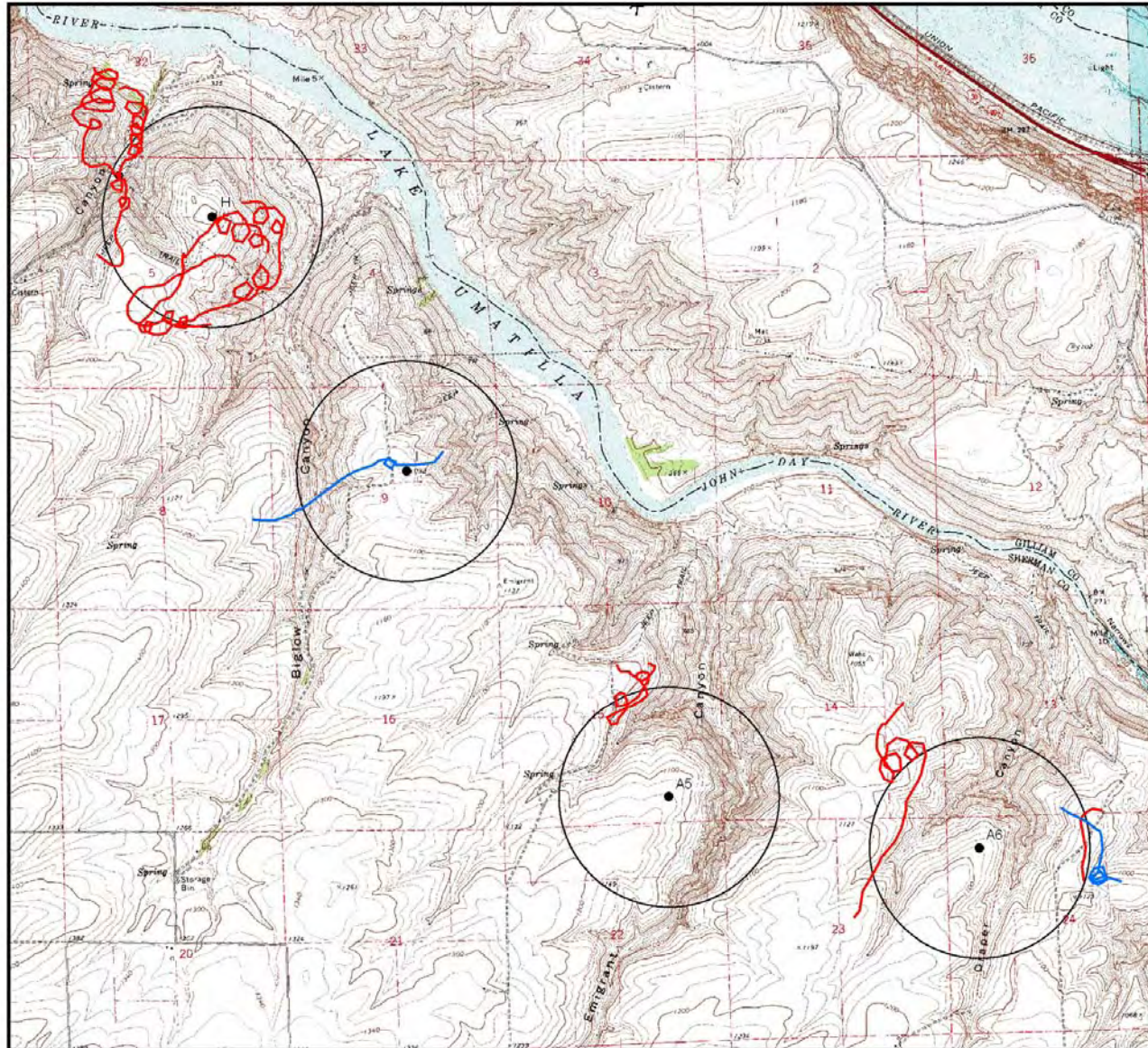
Perched

- RLHA
- RTHA



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Biglow Canyon



Eagles

- John Day Stations

□ 800-m Buffer

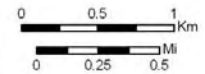
Flight Paths

— Bald Eagle

— Golden Eagle

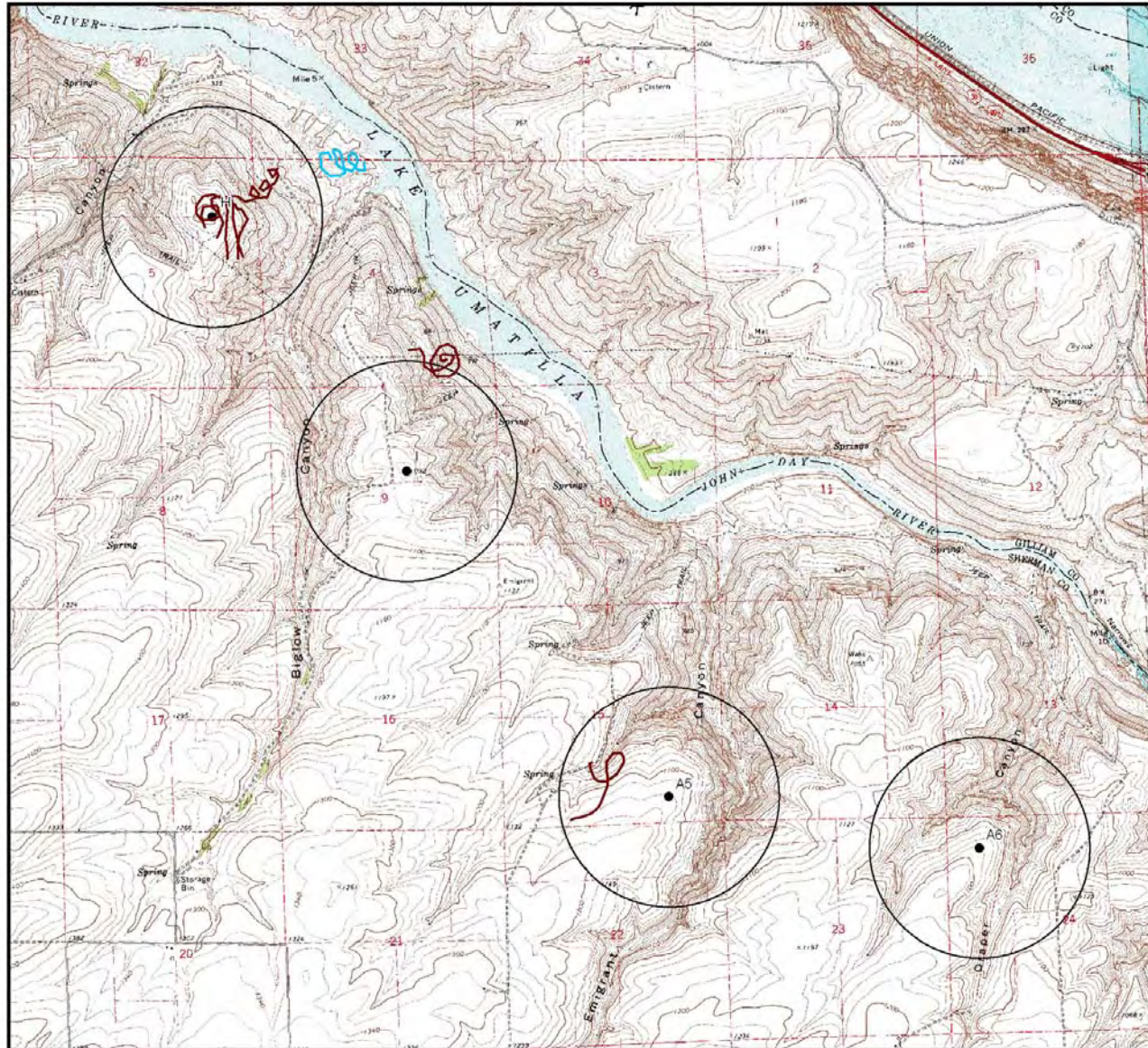
Perched

- Golden Eagle



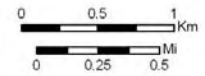
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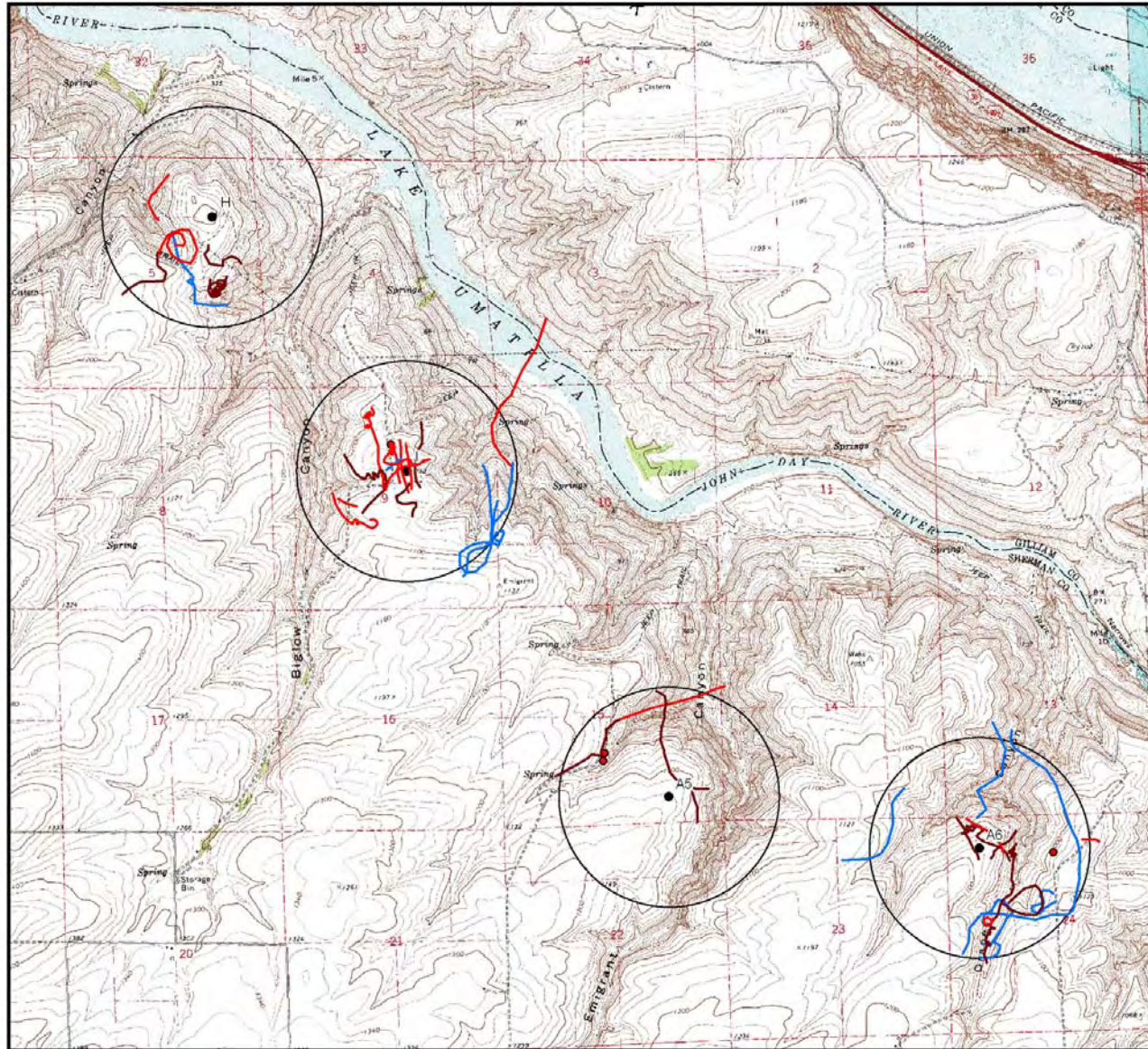


Turkey Vulture & Unk. Raptor

- John Day Stations
 - 800-m Buffer
- ### Flight Paths
- Turkey vulture
 - Unknown raptor



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Biglow Canyon

Falcons & No. Harrier

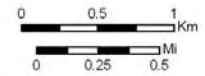
- John Day Stations
- 800-m Buffer

Flight Paths

- American kestrel
- Prairie falcon
- Northern harrier

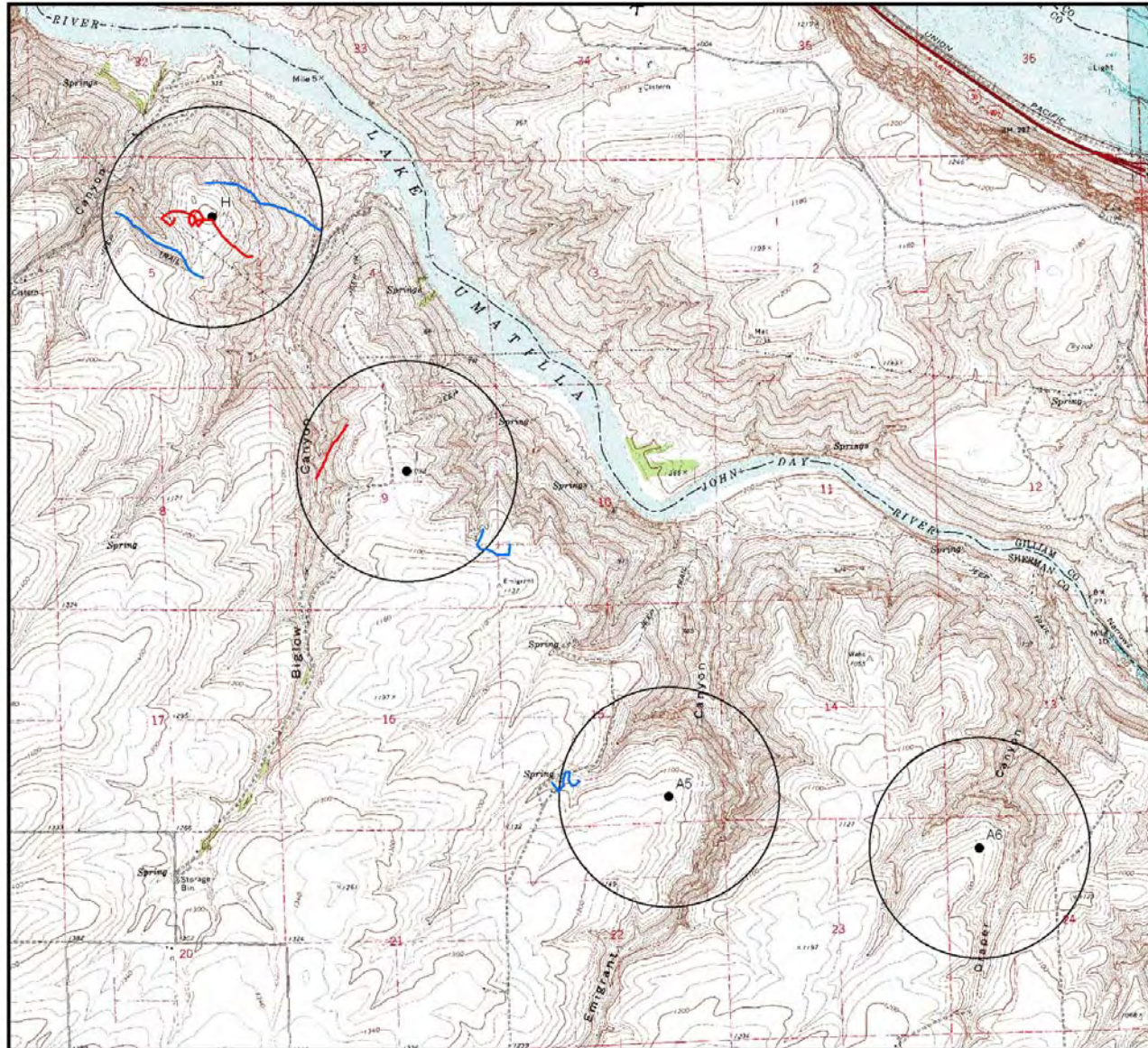
Perched

- American kestrel



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Biglow Canyon



Accipiters

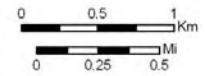
● John Day Stations

□ 800-m Buffer

Flight Paths

— Cooper's hawk

— Sharp-shinned hawk



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