Post-Construction Avian Monitoring Study
for the
Shiloh I Wind Power Project
Solano County, California

Two Year Report

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PPM Energy

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Shiloh I Wind Power Project Area is situated on roughly 6,800 acres of agricultural land in the Montezuma Hills, near Rio Vista in Solano County, California. The project consists of 100 wind turbines rated at 1.5 MW each for a total capacity of up to 150 MW. Seventy –six of the turbines are mounted on 80 meter towers and twenty-four are on 65 meter towers. These turbines are arrayed on similar landscape and habitat as that in which approximately 510 turbines of the older technology are deployed along with more than 200 turbines of the newer technology.

The Collinsville-Montezuma Hills Wind Resource Area (WRA) consists of approximately 40,300 acres of area. The current development area of the existing wind plants including Shiloh I, consists of approximately 17,300 acres. The landscape consists of rolling hills with elevations ranging between near sea level adjacent to the Sacramento River to about 250 - 300 feet (61-91 m) in elevation above sea level. Turbines are placed on the highest ground and do not run through low-lying valleys. Moving from south to north the terrain becomes more uniform with less elevation differential between the ridges and the valleys. On the west is the Suisun Marsh. The terrain is generally uniform along the east-west axis.

The land is privately owned and is largely agricultural. Where turbines and project roads are located the land use is rotating agricultural crops and grazed pastures. Crops include wheat, barley, hay, safflower and fallow fields. A multi-year rotation is the norm with wheat, fallow, and grazing alternating being the regime used most often. There are some isolated wetlands (mostly cattail marsh) and one small reservoir within the project boundaries, but these are not within the project footprint.

Treed areas within the project are limited to the areas close to homes and in a few valleys. No trees were removed to construct the project. Many of the trees are non-native eucalyptus, olive, and other species, although some native oaks and junipers are present near homes. There is a large olive grove to the east of the project area. These treed habitats provide havens and nesting substrate for birds that do not use farmland and other birds that forage in tilled fields.

This report details the results of the first two years of a three-year post-construction study of the Shiloh I wind power project. This is the third fatality study of the newer turbine technology installed in the Collinsville Montezuma Hills Wind Resource Area (CMHWRA).

During the first half (eighteen months) of this three-year study, carcass surveys were conducted once per week at every other wind turbine tower between April 10, 2006 and October 3, 2007, for a total of 78 near-complete rounds at fifty wind turbine towers. At the halfway point of this study, one and a half years into the project, carcass surveys were conducted at the second set of wind turbines which were not surveyed during the first half of the study. Presented in this report (alongside the first 18 months of data) are the first 6 months of surveys at these previously unsurveyed towers, conducted between October 15, 2007 and March 27, 2008, for a total of 24 complete rounds. Over the course of the 36 month study all turbines will have been searched for the same duration and at the same interval between searches of each turbine.

A total of 297 wind turbine related avian incidents were recorded by searchers during standardized surveys, representing 50 species and 17 unidentified birds (1 of these was a blackbird, 3 were sparrows, 1 a swallow, and 12 were not identified to species but classified as passerines; Table 2). Of the 50 avian species, 9 were raptor species including American Kestrel (22), Merlin (1), Peregrine Falcon (1), Red-tailed Hawk (13), Ferruginous Hawk (2), Northern Harrier (2), Golden Eagle (1), Barn Owl (2), and Great Horned Owl (3), comprising a total of 47 raptor incidents found during the 2 year period. The largest number of carcasses found were songbirds, this group comprised 196 incidents identified to 29 different species plus unidentified species. There were a total of 4 waterfowl incidents, (Mallards). Water bird species comprised 14 incidents, including 9 American Coots, 1 Sora, 2 Virginia Rails, 1 Killdeer, and 1 Black-crowned Night-Heron. Other avian species included a mixed group of Mourning Doves, Rock Pigeons, Turkey Vultures, Ring-necked Pheasants, a Chukar, and 2 Northern Flickers (Tables 2 and 3), comprising 6 species involved in 35 incidents. There was 1 unidentified bird, classified as a large non-passerine.

Ninety (90) bat carcasses were found by searchers, representing 4 different species including Hoary Bat (39), Mexican Free-tailed Bat (47), Silver-haired Bat (2), and Western Red Bat (2).

None of the carcasses or injured birds found is listed as federally or state threatened or endangered.

For comparison purposes, the number of incidents per turbine tower per year was calculated. The highest fatality rates (given in number of incidents/turbine/year) occurred in the Western Meadowlark (0.66), followed by Mexican Free-tailed Bat (0.47), Hoary Bat (0.39), Red-winged Blackbird (0.36), American Kestrel (0.22), and Mourning Dove (0.19). When looking at species groupings, the greatest rate of fatality occurred in passerines (1.87 incidents/turbine/year) followed by bats (0.90 incidents/turbine/year) and raptors (0.47 incidents/turbine/year). Approximately 3.0 birds and 0.9 bats per tower per year were found at wind turbine towers during this project to date.

Based on estimated month of death (or injury), the greatest number of incidents occurred during the month of January of 2007, with eleven percent of all incidents found during that month alone. The majority (~85%) of these were passerines. Sixty-seven percent (67%) of raptor incidents found in year one occurred during the fall migration and pre-breeding seasons, between October 2006 and January 2007. The number of raptor incidents found during those same months the following year only comprised 52% of the total raptors for that year. The greatest number of bat incidents occurred during the fall migration period, with 52% of all bat carcasses found between August and October 2006. There were nearly one and a half times as many bat incidents in August and September of 2006 (n=47) than in the same months in 2007 (n=32).

Raptor incidents were distributed widely throughout the project area with 4.9 times more incidents north of Birds Landing Road than south, slightly more than would be expected based on a random distribution. Based on the number of wind turbine towers searched in each of these areas, the expected number of incidents would reflect a 3.2:1 ratio, north to south, if incidents were distributed randomly. However, raptor incident numbers were low, and where tests were possible, we did not discern any statistically evident pattern of fatality (or injury) between north and south sites.

These two regions (north and south) differ in both topography and crop types. In comparison to the north, the southern area consists of steeper hills of higher elevations, which open up to a broad plain running south to the Sacramento River and Suisun Marsh. The south appears to have less variety of crops. Both of these factors may affect bird and bat use of these areas.

The distribution of passerine incidents appeared more concentrated in the north, with 5.5 times more incidents found north of Birds Landing Road than south. However, this difference was not significantly greater than that expected from the numbers of towers in each area. The numbers of incidents of all other non-raptor, non-passerine avian species groups also showed no significant difference from expected proportions.

Bat incidents were 5 times more numerous in the north than the south of Birds Landing Road. Looking at species individually, the Mexican Free-tailed Bat incidents were concentrated in the north (6.8:1), and showed no evidence of a significant difference in fatality distribution. The numbers of incidents of the other bat species with a large number of incidents, the Hoary Bat, were also distributed as would be expected based on wind turbine numbers in the north and south. Influences such as topographic features, availability of insect prey, presence of roosting trees or structures, or possibly light sources could have influenced the presence or absence of bats in different regions.

An examination of the numbers of night migrating bird and bat fatalities found during fall and spring migrations at turbines with FAA lights versus turbines without such lights did not reveal a significant difference from what would be expected based on a random distribution of incidents. If the red flashing lights attracted birds to turbines, a disproportionately greater number of these fatalities would have been found at turbines with lights, which was not the case.

Of the 387 incidents found during standardized surveys, 383 could be assigned distances from a wind turbine. Four were not able to be assigned a distance because they were injured birds with some degree of mobility. Avian carcasses of all size groups tended to be located somewhat evenly over a larger distance range than bat carcasses, which tended to be located closer to the towers. A greater percentage of bat carcasses (74%) were found within 60 meters as compared to small (36%), medium (33%) and large (64%) birds.

Analysis of incidents by species groups and the height of the tower (65 meters versus 80 meters) showed no difference from what would be expected based on distribution of towers of each height surveyed. Nearly twice as many bats were found at 80 meters towers than would be expected based on the number of 80 meter towers searched. However, this result was not statistically significant.

Potential prey species, such as rodents, rabbits, other larger mammals, reptiles and amphibians, were recorded incidentally when seen, however prey observations were recorded more systematically in the second year than in year one. Year two prey observations were distributed widely throughout the project area, with 4.2 times more prey individuals north of Birds Landing Road than south. This is not significantly different from what is expected based on the numbers of wind turbine towers surveyed in each of these two areas.

Preliminary analyses do not show a correlation between the locations of observed prey and raptor wind turbine strikes, though numbers may still be too low for patterns to be statistically detectable at this point in the study.

The vegetative cover of the wind farm consists entirely of agricultural land. It can roughly be sorted into two types of cover, pasture and crop land. In the first two years of this survey, fallow fields represented the ground cover around 30.32% of the surveyed towers, hay 7.68%, oat 1.04%, pasture 22.00%, rye 0.96, safflower 4.32%, tilled soil 11.20%, and wheat 22.48%.

Vegetation height was classified as short (<6"), medium (6"-12"), or tall (>12"). In the first 2 years of the survey, short vegetation accounted for 68.92% of the surveyed towers, medium for 18.50%, and high for 12.58%.

The percentage of incidents was higher in pasture, oat, and till, and lower in fallow, wheat, hay, and safflower than would be expected based on the percentage of ground cover. Pasture and till are either short vegetative cover or bare soil, so carcass visibility by the surveyor could be an explanation for this difference in incident distribution. A comparison of species group to cover height indicates that there seems to be a visibility factor involved, with over two-thirds of the incidents occurring in short vegetation, just under one fourth in medium vegetation, and only about one-sixteenth in high vegetation.

Comparing the species grouped by size to cover height further supports the idea that visibility might be an underlying factor influencing why carcasses were found more heavily in short and medium height vegetation than in tall (high) vegetation. The smallest percentage of incidents was found in tall vegetation, with the most noticeable differences between the numbers of incidents found in tall versus short vegetation occurring in the small and medium bird and bat groups.

Comparison of unadjusted fatality rates (number of incidents per tower per year) between species groups at the Shiloh I and High Winds project areas shows a significantly greater fatality rate for passerines at Shiloh I, with 5.5 times more passerine incidents reported at this site. However, raw data showed only 1.4 times more bat incidents and raptor incidents per tower per year at Shiloh I than at High Winds. Differences in unadjusted fatality rates of bats and all non-passerine avian species were not significant between sites.

The average bird fatality rate over both years at Shiloh I is 10.28 bird incidents/Mw/year, which is higher than the average bird fatality rate at the nearby High Winds WRA (1.36 bird incidents/Mw/year). Similarly, the average estimate of bat incidents per turbine at Shiloh I, 4.54 bat incidents/Mw/year is higher than the average bat fatality rate at High Winds (2.02 bat incidents/Mw/year).

When examining differences between species groups at the two projects, the situation becomes clearer. The adjusted number of raptors (consisting of large and medium sized birds) at Shiloh I (0.88 incidents/Mw/year) is only slightly higher than at High Winds (0.41 incidents/Mw/year). The major difference in fatality rates were derived from the smaller carcasses (i.e. bats, mentioned previously, as well as small birds). Passerine bird incidents at Shiloh (8.01

incidents/Mw/year) were much higher (~ 11 times) than at High Winds (0.71 incidents/Mw/year).

Differences in search protocol may be partly responsible for the greater observances of incidents per turbines searched and the per MW capacity of each turbine. There were fewer turbine searches (50 turbines) at Shiloh I compared to an average of 87.92 at the High Winds site. However, the 50 turbines at the Shiloh I project site were searched more frequently, every seven days, compared with the 15 day search interval between turbine searches at the High Winds project site. Further, the search radius at each tower in the High Winds project was 75m from the base of the tower, compared to 105m at the Shiloh I project. Thus, the area searched per tower (34,636 m^2) at Shiloh was nearly 2 times the amount searched per tower at High Winds (17,671 m^2).

For comparison purposes, we are reporting both unadjusted numbers of incidents which reflect the actual number of birds and bats found, as well as adjusted numbers which reflect a projection of potential incidents that could have occurred by taking into account those incidents which might have been missed by search methods. It is generally recognized that the number of carcasses found under the towers is lower than the total number of birds and bats likely to have been killed. There are at least two factors that need to be accounted for. The first is the possibility that the searchers will miss carcasses. A second possibility is that the carcasses are removed prior to the time the searchers arrive on location after the collision event occurred. Accounting for scavenging and searcher efficiency, an adjusted estimate of the total number of incidents at the Shiloh I project was calculated. The number of incidents/tower and incidents/megawatt (MW) were calculated using the estimated number of avian and bat incidents found during this two year study. These rates are readily comparable between wind farms of different sizes (different numbers of turbines and different generational capacities per turbine).

The adjusted numbers also show a substantial disparity between the adjacent wind projects. The tests of searcher efficiency differed between the two sites although it was essentially the same core of the search team that conducted surveys on both projects

The unanswered question is whether these projected numbers reflect a substantial increase of fatalities at the Shiloh I wind site and/or reflect a difference in execution of the studies on site. Several elements need to be examined. One area for review is the searcher efficiency rate. There is a substantial disparity of searcher efficiency between High Winds and Shiloh I. If the Shiloh I search efficiency rates were similar to those recorded at High Winds the adjusted per turbine and per Mw numbers of incidents comes closer to the differences reported in the unadjusted incidents. If the two standardized search areas were of equal size and only those birds on each project site that were found in the 75 meter search radius of the High Winds site the disparity is further reduced.

We will continue with analysis of the data gathered to date in order to firm up our understanding of the factors influencing the high adjusted rates at Shiloh I. In addition, we will examine whether adjustments can be made in the data gathering protocols for year three of the study that will not compromise the ability to continue to compare year three with the first two years of data collection. We also want to be assure that we will not jeopardize the ability to provide possible answers to the unanswered question of which variables are driving the adjusted rates.

1.0 INTRODUCTION

The Shiloh I Wind Power Project Area (hereafter, the "Project"), operated by Shiloh Wind Partners, LLC, encompasses approximately 6,800 acres of agricultural land in the Montezuma Hills, near Rio Vista in Solano County, California. The project is within the Collinsville Montezuma Hills Wind Resource Area (CMHWRA) and is west of the 90 turbine High Winds, LLC project which became operational in 2003. The wind turbines installed in that project are the Vestas V80 model capable of generating 1.8 megawatts.

The Shiloh I project utilizes 100 General Electric 1.5 MW wind turbines, for a total capacity of up to 150 MW. The hub height of twenty four (24) of the turbines is 65 meters (213 feet) and the rotor diameter is 77 meters (253 feet), for a total height of approximately 103.5 meters (339.5 feet) above ground level (AGL) when the rotors are in the 12 o'clock position. At the 6 o'clock position the tip of the rotors are approximately 26 meters (85 feet) AGL. Seventy-six (76) of the turbines are mounted on 80 meter towers . The hub height is 263 feet and using the same rotor diameter, the tip of the blade in the 12 O'clock position is 118.5 meters (390 feet) AGL and when the tip of the blade is in the 6 O'clock position, it is 51.5 meters (166 feet) AGL.

The Shiloh project is also adjacent to a 510 turbine wind farm originally constructed by Kenetech Windpower in the early 1990s and is currently operated by enXco. The turbines in this project are the Kenetech Model KCS-56, each one capable of generating 100 kilowatts. The Shiloh project is north and west of this project area. One hundred turbines went on-line in March, 2006.

The Collinsville-Montezuma Hills Wind Resource Area (WRA) consists of approximately 40,300 acres of area. The current development area of the existing wind plants including Shiloh I, consists of approximately 17,300 acres. The WRA in which the turbines are arrayed is situated about 3 miles west of Rio Vista in Solano County, California. The landscape consists of rolling hills with elevations ranging between near sea level adjacent to the Sacramento River to about 250 - 300 feet (61-91 m) in elevation above sea level. Turbines are placed on the highest ground and do not run through low-lying valleys. The northern boundary of the WRA for the present is California State Highway 12. The southern boundary is the Sacramento River Deep Water Ship Channel. The Sacramento River Deep Water Ship Channel is about 1.5 miles to the South of the southernmost location where turbines are located and most turbines are more than 4.5 miles from this waterway. Moving from south to north the terrain becomes more uniform with less elevation differential between the ridges and the valleys. On the west is the Suisun Marsh. The Suisun Marsh is a minimum of 1.25 miles from where the nearest turbine is located, with most turbines being located more than 1.5 miles from these wetlands. The terrain is generally uniform along the east-west axis.

The project is dissected by Shiloh Road, Birds Landing Road, Montezuma Hills Road and Talbert lane. These roads are bounded by narrow weedy (mostly grasses) strips and a few homesteads complete with houses, yards, barns, driveways, and other structures necessary for farming. The land is privately owned and is largely agricultural. Where turbines and project roads are located the land use is rotating agricultural crops and grazed pastures. Crops include wheat, barley, hay, safflower and fallow fields. A multi-year rotation is the norm with wheat, fallow, and grazing alternating being the regime used most often. There are some isolated

wetlands (mostly cattail marsh) and one small reservoir within the project boundaries, but they are not within the project footprint.

Treed areas within the project are limited to the areas close to homes and in a few valleys. No trees were removed to construct the project. Many of the trees are non-native eucalyptus, olive, and other species, although some native oaks and junipers are present near homes. There is a large olive grove to the east of the project area. These treed habitats provide havens and nesting substrate for birds that do not use farmland and other birds that forage in tilled fields.

2.0 METHODS

2.1 Clean Sweep Surveys

Prior to the start of the carcass surveys, a "clean sweep" was conducted at all newly installed and operational wind turbine towers to remove all carcasses and remains of carcasses from the survey area. Clean sweeps were conducted using the same protocol as used in the standardized carcass surveys (see below), except that virtually all (99 of 100) of the installed towers were searched during the clean sweeps while only every other tower (n=50) was searched during standardized surveys. The thoroughness of the sweep was adopted to increase the likelihood that all carcasses found during the subsequent surveys would be associated with incidents that occurred during the course of the systematic surveys, and remove the possibility that scavengers or wind could relocate remains between towers. The clean sweep for 99 of all 100 towers was executed March 28 through April 8, 2006. The one tower not surveyed (A16) during the clean sweeps was not part of the set of towers surveyed during subsequent standardized surveys, and was unable to be surveyed during clean sweeps due to road construction and the presence of heavy equipment surrounding the tower. Standardized surveys of every other tower started two days following the clean sweeps, on April 10, 2006.

In October, 2007 (the halfway point of the three year study cycle), we began to survey the set of 50 turbines which were not surveyed during the first 18 months, maintaining the same seven day interval cycle. Clean sweeps at these towers were conducted on three days between October 8 and 10th, 2007, and standardized surveys at these towers commenced on October 15, 2007.

2.2 Standardized Surveys

During the first 18 months of this on-going three-year project, carcass surveys were conducted approximately once per week at the same fifty (every other tower of the 100) wind turbine towers between April 10, 2006 and October 3, 2007, for a total of approximately 78 total rounds. During the second half of the study (the last 6 months of 24 months), the other set of 50 towers were surveyed once per week between October 15, 2007 and March 27, 2008, for a total of 24 total rounds. To date, a total of nearly 102 rounds (n=101.4) have been conducted (Figure 1).

There are towers of two different heights in the project area: 65 meter and 80 meter towers. In the entire study region of 100 turbine towers, there are 76 -80 meter towers and 24 – 65 meter towers. Of these, an average of 11.5 – 65m towers were surveyed per round (of 50 tower surveys), and 38.5 – 80m towers surveyed per round.

The survey consists of searchers walking in concentric circles around the tower's base at distances of 15, 30, 40, 50, 60, 70, 80, 90 and 100 meters, and also around the base of each tower (Figure 2). While walking around each ring, the searcher using the unaided eye, alternately scans an area that extends for 5m in either side of his track (7-1/2 m on one side of the 15 and 30-meter circles), yielding a total of 105 meters scanned. The surveyors use range finders to initially establish and periodically check the distance of each circular route from the tower. Data recorded at the beginning of the surveys includes meteorological data (cloud cover, temperature, and wind velocity) and ground cover information (crop type and height). In addition, the start and finish times are recorded for each tower searched (see Appendix A). In order to avoid having the towers continually surveyed during the same time of day, each round started 3 towers beyond where the previous survey was started.

When a carcass or injured bird or bat is found, the searchers perform a thorough investigation and documentation of the incident using the protocols listed in the Wildlife Response and Reporting System (WRRS). An incident report number is assigned and an incident report form filled out for each find (Appendix B). A GPS is used to determine geographic coordinates, and a range finder and compass are used to determine distance and bearing from the tower. The carcass is photographed in the position in which it is found (in situ) using a digital camera. After identifying the animal by species (including age and sex when possible), an examination is performed to determine the nature and extent of any injuries, and whether any scavenging or insect infestation has occurred. The time since death is estimated and recorded. In case of dismemberment, the surveyors search the vicinity to locate all body parts. Loose feathers are only considered fatalities if enough feathers are found to represent a dead bird. All loose feathers are collected in order to avoid identifying the feathers as an additional kill during the next survey of the tower. The carcass is then placed in a plastic bag labeled with date, species, tower number, and incident report number, and taken to a freezer to be stored in accordance with the FWS permit requirements. When carcasses are found at times and locations outside of one of the standardized surveys conducted as part of this study, such as during avian surveys or while driving between sites, the carcass is processed as above but it is classified as an "incidental" find.

When an injured animal is found, the searchers record the same data collected for a carcass (noting however, that it is an injury and not a fatality). The searchers then capture and restrain the animal in a manner to avoid either further injury to the animal or injury to the survey crew. Once the animal is secured it is transported to a wildlife rehabilitator or veterinarian. The hospital accession number and the final disposition of the animal are recorded on the report form.

Only in those cases where the injury to the animal can be linked to a specific tower is a tower number recorded as the location in the report. When no corroborating information that the injury is linked to a tower is available, the animal is simply recorded as having been found "ON SITE". For instance, if a bird is found injured with a broken wing but is still mobile, it would not be associated with a specific wind turbine tower because it could have moved.

If the carcass or injured animal found is listed as a threatened or endangered species, the Avian Respondent, listed in the WRRS, is notified immediately by phone, and collection of the dead animal is delayed until specific direction for proceeding is received from the U.S. Fish and Wildlife Service. All Golden Eagle fatalities are reported to the U.S. Fish and Wildlife Service.

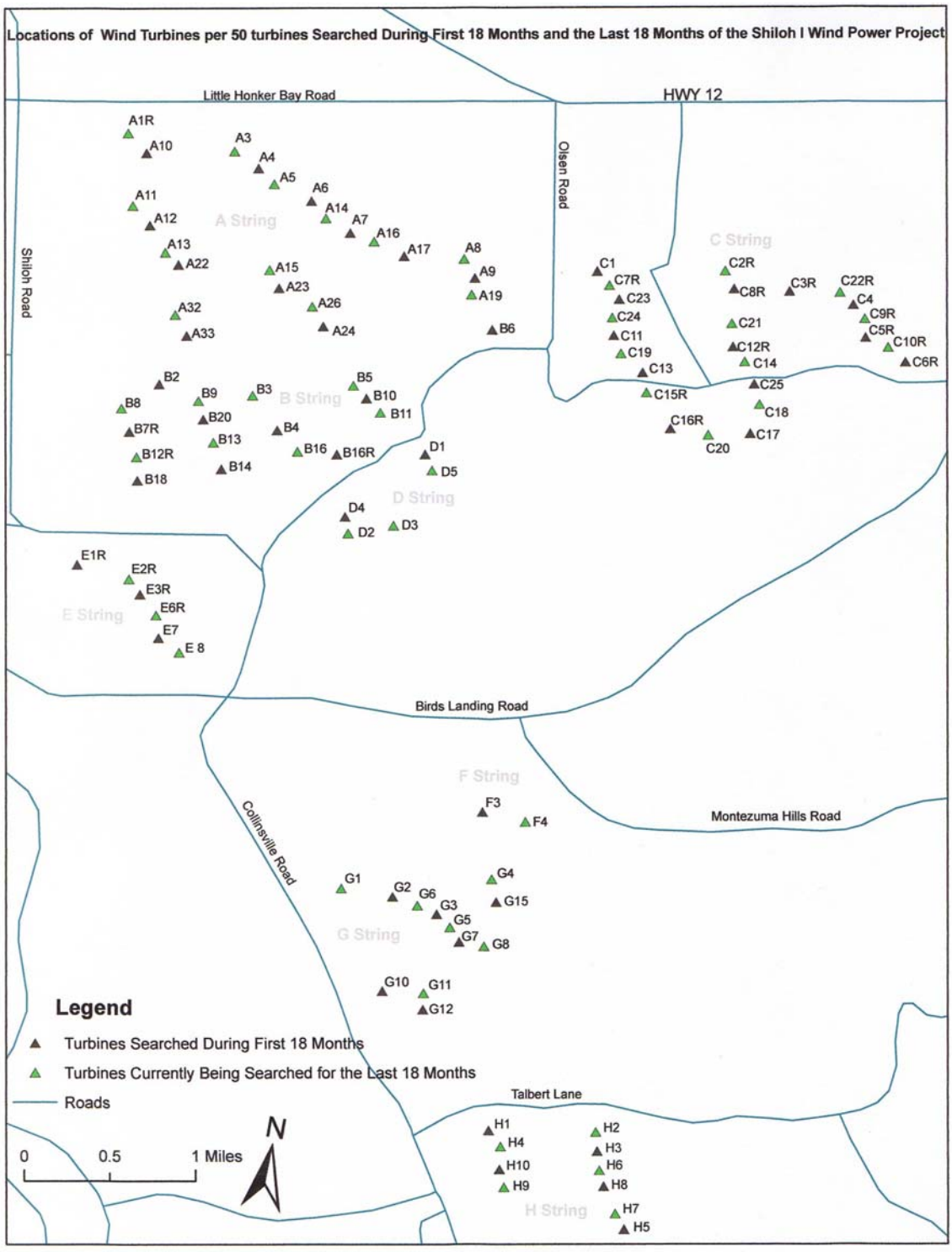


Figure 1. Locations of wind turbine towers per 50 turbines searched during the first 18 months and the last 18 months of the Shiloh I Wind Power Project.

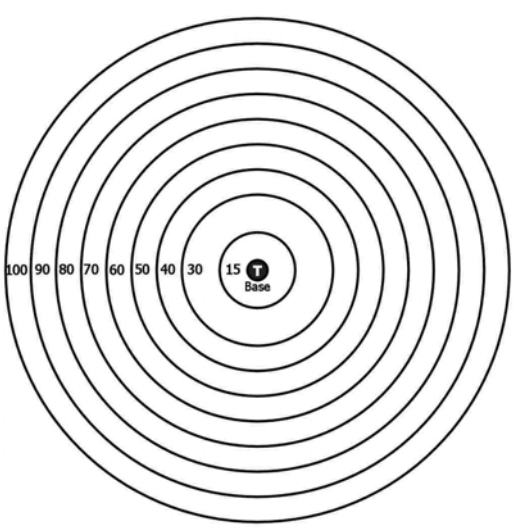


Figure 2. Search pattern for wind turbine tower carcass survey (distance in meters)

2.3 Searcher Efficiency and Scavenger Removal

It is recognized that the number of carcasses found under the towers is lower than the total number of birds and bats likely to have been killed. There are at least three factors that need to be accounted for. The first is the possibility that the searchers will miss carcasses due to the amount of ground cover or the size and coloration of the species making it difficult to spot them. A second possibility is that the carcasses are removed prior to the time the searchers arrive on location after the collision event occurred. Finally, the estimate of incidents must be adjusted by the ratio of the number of towers searched to the number of operational towers in the wind project area. Applying these correction factors to the actual number of carcasses found during standardized surveys reduces underestimation of mortality due to these factors. Several scavenger removal and searcher efficiency studies conducted throughout the study duration in 2006 and 2007 estimated the proportion of carcasses missed by the searchers and the proportion removed by scavengers within 7-day search cycles.

We made the following adjustments to extrapolate the mortality counts to estimated mortality for the entire Shiloh I Project Area (the Project). We adjusted the number of incidents found, previously corrected for Project Set-up Period and Area Searched, (*C*), for Scavenger efficiency (*Sc*), Search efficiency (*Se*) and Proportion of towers searched to the total of 100 operational towers in the Project (*Ps*).

a) Proportion of test carcasses left by scavengers within the search period (*Sc*).
Scavenger efficiency (*Sc*) was measured in May 6-8, 2006, October 31 and November 1, 2007, February 12 and 20, 2008, by placing 48 small bird carcasses (European Starling size), 19 medium bird carcasses (Rock Pigeon size), 11 large bird carcasses (Red-tailed Hawk sized), and 52 bat carcasses, on searched areas in the Shiloh I Project. We monitored carcasses, daily for 7 days and then once after two weeks, for evidence of scavenging. The status of each carcass was reported as intact, scavenged or completely removed, and the extent of scavenging was described. The probability of a collision event is equally

distributed over all days of the search cycle (7 days). Thus, the overall duration between carcass fall and discovery is approximately half the actual search cycle (3.5 days). For example, if a carcass was discovered at a 7-day search site, it had an equal probability of having hit the tower on each of the previous 7 nights. The average time between impact and discovery is (1 + 2 + 3 + 4 + 5 + 6)/6 = 3.5 days (rounded to 4 days). Thus, the scavenge rate was calculated for the number of test carcasses that remained visible (body of carcass removed/severely scavenged) after 4 days.

b) Proportion of carcasses not missed by observers in the search efficiency trials (*Se*). Search efficiency trials were conducted for each observer by having an independent technician place carcasses (total 48 small birds, 19 medium birds, 11 large birds and 56 bats under towers in the Project, without the knowledge of the searcher. The search efficiency trials coincided with the scavenge trials (May 2006 October and November 2007 and February 2008). The searchers recorded all carcasses that they discovered, including carcasses planted by the independent wildlife technician. Planted evidence of collisions was later removed from the database and a mean search efficiency rate (*Se*) was calculated.

c) Proportion of towers searched to the total of 100 operational towers in the windfarm (*Ps*). *Ps* for the 50 7-day sites was 50:100.

Thus, $\hat{C} = \dfrac{C}{Sc \times Se \times Ps}$

Where $\hat{C}$ = Adjusted total number of kills estimated in the project area.

The variance of the number of kills found was first calculated per tower using standard methods. Then, we calculated the variance due to the correction factors *Sc* and Se, using the variance of a product formula (Goodman, 1960). The variance of the product of *R*, *E* and *P* is:

$$\mathrm{Var}(\hat{C}) = \hat{C}^2 \times \left[\frac{\mathrm{var\,C}}{\mathrm{C}^2} + \frac{\mathrm{var}(Sc \times Se)}{(Sc \times Se)^2} \right]$$

2.4 Prey Observations

Potential prey species for raptors, such as rodents, rabbits, other larger mammals, reptiles and amphibians, were recorded when seen. These observations were generally made during standardized wind turbine carcass surveys, however were not made systematically during the first year of this project. Systematic data collection of prey species observed during carcass surveys commenced in year two (April 2007). Data collected for each observation included species name, the number of individuals seen, their approximate location, and the survey tower number.

2.5 Vegetative Cover

Ground cover data was recorded at the beginning of the standardized surveys. Data recorded included vegetation/crop type and height. Vegetation types included: fallow, hay, oat, pasture,

rye, safflower, wheat, and tilled soil. Vegetation height was classified as short (<6"), medium (6"-12"), or tall (>12").

3.0 RESULTS

3.1 Clean Sweep Surveys

For the first 18 months of this three-year survey, a total of 99 clean sweep surveys were conducted March 28 through April 8, 2006, totaling 2 rounds of virtually 50 (n=49.5) tower surveys (50 tower searches being the standard unit of tower searches per round) at every tower except one (A16) of the project area's 100 wind turbine towers. Heavy equipment and construction personnel surrounded A16 preventing surveys. Carcasses found included: 1 European Starling, 3 Red-tailed Hawks, 1 Western Meadowlark, and 1 Hoary Bat. In October 2007 (the halfway point of the three year study cycle), clean sweeps were conducted at the set of 50 turbines which were not surveyed during the first 18 months between October 8th and 10th. There were a total of 7 carcasses found, including: 2 American Kestrels, 1 Turkey Vulture, 1 Rock Pigeon, 1 Western Meadowlark, 1 unidentified species of blackbird, and 1 Hoary Bat (see Appendix C for data on these incidents). Clean sweeps at all 100 towers were considered searched during this second set of clean sweep surveys, as standardized surveys at the first set of 50 towers was conducted within 2 weeks prior to commencing with surveys at the second set of 50 towers.

3.2 Standardized Surveys

3.2.1 Summary of Search Effort

A total of 78 near-complete rounds (n = 77.42) of standardized searches were conducted between April 10, 2006 and October 3, 2007 (Table 1) on 362 days (66% of the days of the 18 month period), for a total of nearly 3871 complete individual turbine searches. For various reasons, some towers could not be completely surveyed every week. The reasons towers were not surveyed or were only partially surveyed included: presence of impenetrable tall and thorny safflower groundcover, application of biosolids/manure or pesticides/herbicides, presence of heavy equipment present near tower, or temporary loss of permission from landowner to be on the land. Biosolids refer to sewage treatment plant solid waste used as a fertilizer. The details of the rounds and dates towers were surveyed is shown in Table 1. The average number of wind turbine towers surveyed during the first 18 months of this project was 49.63. For the purposes of our analyses and discussion, we have rounded this number up to 50 wind turbine towers. For the last 6 months of the study at the other set of 50 wind turbines, a total of 24 complete rounds were surveyed at 50 wind turbine towers, on 100 days (55% of the days during that period), for a total of 1200 individual turbine surveys. The average number of days between successive searches for each tower during the entire two years was 7.0 days (Standard Deviation = 1.52).

Table 1. Summary of rounds of fatality searches during 2 years of Shiloh I carcass surveys at wind turbine towers: clean sweeps and standardized surveys

Year	Round No.	Dates Surveyed
Clean Sweep of 99 Wind Turbine Towers		
2006	Round 1 & 2	March 28, 29, 30, 31 & April 1, 2, 5, 6, 7, 8 *(T#A16 not surveyed*)*
Carcass Surveys of 50 Wind Turbine Towers		
2006	Round 1	April 10, 11, 12, 13, 14
	Round 2	April 17, 18, 19, 20, 21
	Round 3	April 24, 25, 26, 27, 28, 29
	Round 4	May 1, 2, 3, 4, 5
	Round 5	May 8, 9, 10, 11, 12, 13
	Round 6	May 15, 16, 17, 18, 19
	Round 7	May 21, 22, 23, 24, 25 *(T#C3R, C8R, C23 not surveyed*)*
	Round 8	May 30, 31 & June 1, 2, 3
	Round 9	June 5, 6, 7, 8
	Round 10	June 10, 11, 12, 13, 14, 15 *(T#A9, A23, A24 partially surveyed **)*
	Round 11	June 17, 18, 19, 21, 22, 23, 24 *(T#A9, A23, A24 partially surveyed **)*
	Round 12	June 26, 27, 28, 29, 30 *(T#A9, A23, A24 partially surveyed **)*
	Round 13	July 3, 5, 6, 7 *(T#A9, A23, A24 partially surveyed **)*
	Round 14	July 10, 11, 12, 13, 14 *(T#A9, A23, A24 partially surveyed **)*
	Round 15	July 17, 18, 19, 20, 21 *(T#A9, A23, A24 partially surveyed **)*
	Round 16	July 24, 25, 26, 27, 28 *(T#A9, A23, A24 partially surveyed **)*
	Round 17	July 31 & August 1, 2, 3, 4 *(T#A9, A23, A24 partially surveyed **)*
2006	Round 18	August 7, 8, 9, 10, 11 *(T#A9, A23, A24 partially surveyed **)*
	Round 19	August 14, 15, 16, 17, 18 *(T#A9, A23, A24 partially surveyed **)*
	Round 20	August 21, 22, 23, 24, 25 *(T#A23 partially surveyed **)*
	Round 21	August 28, 29, 30, 31 & September 1
	Round 22	September 5, 6, 7, 8, 9
	Round 23	September 11, 12, 13, 14, 15 *(T#B16R partially surveyed***)*
	Round 24	September 18, 19, 20, 21, 22 *(T#B10 not surveyed*)*
	Round 25	September 25, 26, 27, 28, 29 *(T#A23 not surveyed*)*
	Round 26	October 1, 2, 3, 4, 5, 6, 7
	Round 27	October 9, 10, 11, 12, 13
	Round 28	October 16, 17, 18, 19, 20, 21
	Round 29	October 23, 24, 25, 26, 27
	Round 30	October 30, 31 & November 1, 2, 3, 4
	Round 31	November 6, 7, 8, 9
	Round 32	November 13, 14, 15, 16, 17
	Round 33	November 19, 20, 21, 22
	Round 34	November 27, 28, 29, 30 & December 1, 2
	Round 35	December 4, 5, 6, 7
	Round 36	December 11, 13, 14, 15
	Round 37	December 18, 19, 20, 22
	Round 38	December 26, 27, 28, 29, 30
2007	Round 39	January 2, 3, 4, 5
	Round 40	January 6, 8, 9, 10, 11
	Round 41	January 15, 16, 17, 18 *(T#C3R not surveyed*)*
	Round 42	January 22, 23, 24, 25, 26, 27 *(T#B20 not surveyed*)*

Year	Round No.	Dates Surveyed
	Round 43	January 29, 30, 31 & February 1, 2
2007	Round 44	February 5, 6, 7, 8
	Round 45	February 12, 13, 14, 15, 16
	Round 46	February 18, 19, 20, 21, 22, 23, 24
	Round 47	February 27, 28 & March 1, 2
	Round 48	March 5, 6, 8, 9, 10
	Round 49	March 12, 13, 14, 15
	Round 50	March 19, 20, 21, 22
	Round 51	March 26, 27, 28, 29
	Round 52	April 2, 3, 4, 5
	Round 53	April 9, 10, 12, 13
	Round 54	April 16, 17, 18, 19
	Round 55	April 23, 24, 25, 26
	Round 56	April 30 & May 1, 2, 3, 4
	Round 57	May 7, 8, 9, 10
	Round 58	May 14, 15, 16, 17
	Round 59	May 21, 22, 23, 24, 25
	Round 60	May 29, 30, 31 & June 1
	Round 61	June 4, 5, 6, 7
	Round 62	June 11, 12, 13, 14
	Round 63	June 18, 19, 21, 22
	Round 64	June 25, 26, 27, 28
	Round 65	July 2, 3, 4, 5
	Round 66	July 9, 10, 11
	Round 67	July 16, 17, 18, 19
	Round 68	July 23, 24, 25, 26
	Round 69	July 30, 31 & August 1
	Round 70	August 6, 7, 8, 10
	Round 71	August 13, 14, 15, 16
	Round 72	August 20, 21, 22, 23, 24
	Round 73	August 27, 28, 29, 30
	Round 74	September 3, 4, 5, 6, 7
	Round 75	September 10, 11, 12, 13
	Round 76	September 17, 18, 19, 20
	Round 77	September 24, 25, 26
	Round 78	October 1, 2, 3

Clean Sweep of Second Set of 50 Wind Turbine Towers (not surveyed during first 18 months)

2007	Complete Round	October 8, 9, 10

Carcass Surveys of Second Set of 50 Wind Turbines Towers (not surveyed during first 18 months)

2007	Round 1	October 15, 16, 17, 18, 19
	Round 2	October 22, 23, 24, 25
	Round 3	October 29, 30, 31 & November 1
	Round 4	November 5, 6, 7, 9, 10
	Round 5	November 12, 13, 14, 15
	Round 6	November 19, 20, 21

Year	Round No.	Dates Surveyed
	Round 7	November 26, 27, 28, 29
	Round 8	December 3, 4, 6, 7
	Round 9	December 10, 11, 12
	Round 10	December 17, 19, 20, 21
	Round 11	December 23, 24, 26, 27, 28
	Round 12	December 29, 30, 31 & January 2, 3
	Round 13	January 7, 9, 10, 11, 12, 13
	Round 14	January 14, 15, 16, 17
	Round 15	January 21, 22, 23, 24, 25, 26
	Round 16	January 28, 29, 30 & February 1
	Round 17	February 4, 5, 6
	Round 18	February 11, 12, 13
	Round 19	February 18, 19, 20, 21
	Round 20	February 25, 26, 27, 28
	Round 21	March 3, 4, 5
	Round 22	March 10, 11, 12, 13
	Round 23	March 17, 18, 19, 21
	Round 24	March 24, 25, 26, 27

Survey Summary		First 18 Months	Last 6 Months	Total (2 YEARS)
Standardized Surveys	Total # Field Days	362	100	462
	Total # of Rounds	77.42	24	101.42
	Average # of Towers Surveyed / Round	49.62	50	49.71
	Total # of Individual Surveys	3870.95	1200	5070.95
	Total # Searcher-Hours in Field	3779.7	1089.42	4869.12
	Average # Searcher-Hours / Survey	0.98	0.91	0.96
	Average # Searcher-Minutes / Survey	58.6	54.5	57.6
Clean Sweep Surveys	Total # Field Days	10	3	13
	Total # of Rounds	2	1	2.98
	Average # of Towers Surveyed / Round	49.5	50	50
	Total # of Individual Surveys	49.5	50	149
	Total # Searcher-Hours in Field	132.05	45.33	177.38
	Average # Searcher-Hours per Survey	1.33	0.91	1.19
	Average # Searcher-Minutes per Survey	80	54.4	71.3

* The reasons surveys at specified towers were not conducted include: application of biosolids/manure or pesticides/herbicides, heavy equipment present near tower, or temporary loss of permission from landowner to be on the land.

** Partial surveys of wind turbine towers A9, A23, and A24 were due to tall, thorny safflower ground cover preventing all survey area to be searched. The proportions of the area surveyed for each of these towers are as follows: A9 ~ 50% (Rounds 10-19), A23 ~ 15% (Rounds 10-20), and A24 ~ 30% (Rounds 10-19).

*** Partial survey of wind turbine tower B16R was due to the spreading of manure/biosolids, allowing only 30% of the survey area to be searched for Round 23.

3.2.2 Incident Species Composition and Unadjusted Fatality Rates

During the first two years of this study, a grand total of 429 incidents were recorded. Of 429 wind turbine related incidents, 387 incidents were found during standardized surveys, and an additional 35 were found in between surveys, or "incidentally", and all of these latter incidents were classified as "incidental" finds (Table 2; Appendix D and E). In addition to these wind turbine related incidents, a total of 7 incidents were collected which were deemed caused by something other than wind turbines based on their locations and/or conditions. "Other" possible causes include: predators, barbed wire fence, or harvesting equipment. Three of these "Other" cause related incidents were found during standardized surveys, and 4 were incidental (see Appendix F).

A total of 297 wind turbine related avian incidents were recorded by searchers during standardized surveys, representing 50 species and 17 unidentified birds (1 of these was a blackbird, 3 were sparrows, 1 a swallow, and 12 were not identified to species but classified as passerines,; Table 2). Of the 50 avian species, 9 were raptor species including American Kestrel (22), Merlin (1), Peregrine Falcon (1), Red-tailed Hawk (13), Ferruginous Hawk (2), Northern Harrier (2), Golden Eagle (1), Barn Owl (2), and Great Horned Owl (3), comprising a total of 47 raptor incidents found during the 2 year period. The largest number of carcasses found were songbirds, this group comprised 196 incidents identified to 29 different species plus unidentified species. There were a total of 4 waterfowl incidents, (Mallards). Water bird species comprised 14 incidents, including 9 American Coots, 1 Sora, 2 Virginia Rails, 1 Killdeer, and 1 Black-crowned Night-Heron. Other avian species included a mixed group of Mourning Doves, Rock Pigeons, Turkey Vultures, Ring-necked Pheasants, a Chukar, and 2 Northern Flickers (Tables 2 and 3), comprising 6 species involved in 35 incidents. There was 1 unidentified bird, classified as a large non-passerine. Ninety (90) bat carcasses were found by searchers, representing 4 different species including Hoary Bat (39), Mexican Free-tailed Bat (47), Silver-haired Bat (2), and Western Red Bat (2).

The number of wind turbine related incidents found per total installed megawatt capacity per year was calculated to provide a comparable metric between different wind power projects. The individual wind turbine MW of 1.5 was multiplied by the number of wind turbine towers (50) searched during the first two years of this study to yield a total installed megawatt capacity of 75.0 MW. Another unit for comparison purposes, the number of incidents per turbine tower per year, was also calculated (Table 2). The highest fatality rates occurred in the Western Meadowlark and Red-winged Blackbird, followed by Mexican Free-tailed Bat, Hoary Bat, American Kestrel, and Mourning Dove. About 3.0 birds and 0.9 bats per tower per year were found at wind turbine towers during this project to date.

Table 2. Unadjusted number of incidents per species during the first 2 years of surveys per total installed megawatt capacity* per year, and per turbine per year, at the Shiloh I Project Area, April 2006 – March 2008, found during standardized surveys

Species Name	YEAR ONE (50 Turbines)	YEAR TWO (50 Turbines)	Total	# Incidents per Mw/Year	# Incidents per Turbine/Year	Incidental**
Bird Species						
American Coot	2	7	9	0.0600	0.09	
American Goldfinch	1		1	0.0067	0.01	
American Kestrel	15	7	22	0.1467	0.22	
American Pipit	4	1	5	0.0333	0.05	
Barn Owl	1	1	2	0.0133	0.02	5
Black-crowned Night Heron		1	1	0.0067	0.01	
Black-headed Grosbeak	1		1	0.0067	0.01	
Black-throated Gray Warbler	1	2	3	0.0200	0.03	
Brewer's Blackbird	6	6	12	0.0800	0.12	
Chukar	1		1	0.0067	0.01	
Dark-eyed Junco, slate	1		1	0.0067	0.01	
European Starling	2	3	5	0.0333	0.05	
Ferruginous Hawk		2	2	0.0133	0.02	
Golden Eagle	0	1	1	0.0067	0.01	2
Golden-crowned Kinglet	1		1	0.0067	0.01	
Golden-crowned Sparrow	1		1	0.0067	0.01	
Great Horned Owl		3	3	0.0200	0.03	
Hammond's Flycatcher	1		1	0.0067	0.01	
Horned Lark	5	8	13	0.0867	0.13	1
House Finch		1	1	0.0067	0.01	
House Sparrow	1		1	0.0067	0.01	
Killdeer		1	1	0.0067	0.01	1
Lincoln's Sparrow		1	1	0.0067	0.01	
MacGillivray's Warbler		2	2	0.0133	0.02	
Mallard	4		4	0.0267	0.04	
Merlin***		1	1	0.0067	0.01	
Mourning Dove	8	11	19	0.1267	0.19	
Northern Flicker	1	1	2	0.0133	0.02	
Northern Harrier***	2		2	0.0133	0.02	
Northern Mockingbird	1		1	0.0067	0.01	
Orange-crowned Warbler				0.0000	0.00	1
Pacific Slope Flycatcher		1	1	0.0067	0.01	
Peregrine Falcon		1	1	0.0067	0.01	
Prairie Falcon***				0.0000	0.00	1
Red-tailed Hawk	6	7	13	0.0867	0.13	7
Red-winged Blackbird	26	10	36	0.2400	0.36	4

Species Name	YEAR ONE (50 Turbines)	YEAR TWO (50 Turbines)	Total	# Incidents per Mw/Year	# Incidents per Turbine/Year	Incidental**
Ring-necked Pheasant	1	3	4	0.0267	0.04	1
Rock Pigeon	4	3	7	0.0467	0.07	2
Ruby-crowned Kinglet		1	1	0.0067	0.01	
Savannah Sparrow	3	2	5	0.0333	0.05	
Sora		1	1	0.0067	0.01	
Townsend's Warbler		2	2	0.0133	0.02	
Tree Swallow	3		3	0.0200	0.03	1
Tricolored Blackbird***	1		1	0.0067	0.01	
Turkey Vulture		2	2	0.0133	0.02	1
Virginia Rail	1	1	2	0.0133	0.02	
Warbling Vireo		1	1	0.0067	0.01	1
Western Meadowlark	41	25	66	0.4400	0.66	1
Western Wood Pewee				0.0000	0.00	1
White-crowned Sparrow	2		2	0.0133	0.02	
Wilson's Warbler	2	4	6	0.0400	0.06	1
Winter Wren				0.0000	0.00	1
Yellow Warbler***	1	3	4	0.0267	0.04	
Yellow-breasted Chat***	1		1	0.0067	0.01	
Unidentified Blackbird spp.		1	1	0.0067	0.01	
Unidentified Duck spp.				0.0000	0.00	1
Unidentified Passerine spp.	9	3	12	0.0800	0.12	
Unidentified Sparrow spp.	3		3	0.0200	0.03	
Unidentified Swallow spp.	1		1	0.0067	0.01	
Unknown bird spp.		1	1	0.0067	0.01	
Subtotal Avian Species	**165**	**132**	**297**	**1.9800**	**2.97**	**33**
Bat Species						
Hoary Bat	24	15	39	0.2600	0.39	1
Mexican Free-tailed Bat	26	21	47	0.3133	0.47	1
Silver-haired Bat	1	1	2	0.0133	0.02	
Western Red Bat	1	1	2	0.0133	0.02	
Subtotal Bat Species	**52**	**38**	**90**	**0.6000**	**0.90**	**2**
Grand Total	**217**	**170**	**387**	**2.5800**	**3.87**	**35**

* A total installed megawatt capacity of 75.0 MW was calculated by multiplying individual turbine MW of 1.5 by the number of wind turbine towers surveyed per round throughout the 2 year survey of 50.
**Number of individuals found incidentally and not during standardized surveys. NOT included in the Total for that species
******* Denotes California Species of Special Concern (CSC)

The number of wind turbine related incidents found per total installed megawatt capacity per year, and per turbine per year was calculated for each species grouping (Table 3). The greatest unadjusted rate of fatality occurred in passerines (1.96 incidents/turbine/year, 1.31 incidents/Mw/year) followed by bats (0.90 incidents/turbine/year, 0.60 incidents/Mw/year) and raptors (0.47 incidents/turbine/year, 0.31 incidents/Mw/year).

Table 3. Unadjusted number of incidents per species group during the first 2 years of surveys per total installed megawatt capacity* per year, and per turbine per year, at the Shiloh I Project Area, April 2006 – March 2008, found during standardized surveys

Species Group	YEAR ONE	YEAR TWO	# Incidents	# Incidents per Mw/Year	# Incidents per Turbine/Year
Bird Species					
Raptor	24	23	47	0.3133	0.47
Passerine	119	77	196	1.3067	1.96
Waterfowl	4	0	4	0.0267	0.04
Water Bird	3	11	14	0.0933	0.14
Other Bird	15	20	35	0.2333	0.35
Unknown		1	1	0.0067	0.01
Bat species	52	38	90	0.6000	0.9
Grand Total	**217**	**170**	**387**	**2.58**	**3.87**

* A total installed megawatt capacity of 75.0 MW was calculated by multiplying individual turbine MW of 1.5 by the number of wind turbine towers surveyed per round throughout the 2 year survey of 50.

For purpose of our analyses, "raptors" included all eagles, hawks, kites, falcons, harriers, and owls (predatory birds). Non-protected non-native species including Rock Pigeon and European Starling were included in analyses, fatality maps and data tables.

We looked at the number of incidents recorded per year to determine if there were yearly differences (Tables 2 and 3). Although numbers are still low, there appeared to be notable differences in the numbers of incidents per species between years in several species. There were a greater number of incidents of American Kestrel, Mallard, Red-winged Blackbird, Western Meadowlark, Hoary Bat, and to a lesser extent, Mexican Free-tailed Bat in the year one versus year two, and a slightly greater number of incidents of American Coot and Great Horned Owl in the second year than the first. Insect prey for blackbirds, bats and kestrels may have been in greater abundance in 2006 (year one) as rainfall was much greater in 2006 than 2007.

Differences between the numbers of incidents per year were even more pronounced when species were lumped into species groups (Table 3). Passerine, bat and waterfowl incidents, and to a lesser degree, raptors, were found in the greatest numbers in year one. Waterbirds and "other" birds, a mixed group of species, were found in greater numbers in year two than year one. Overall, the total number of incidents of all species combined was slightly greater in year one than year two.

All but four of the incidents found the first two years of this study during standardized surveys were fatalities. Four injured birds were found, including an American Pipit, Western

Meadowlark, Savannah Sparrow, and Red-tailed Hawk, all of which were semi-mobile and therefore were considered "ON SITE" and not associated with a specific wind turbine tower. Their injuries were, however, consistent with collision with a wind turbine. Three of the four injured birds were taken to Lindsay Wildlife Hospital, and one, the Red-tailed Hawk, was very mobile and not captured. The following information details these incidents:

1. April 12, 2006. A juvenile American Pipit was found with a broken right wing 46 meters north of Tower C1.
2. June 23, 2006. A juvenile Western Meadowlark was found 99 meters WSW of Tower C17. It appeared to be trying to fly, with its left wing was severed at the elbow.
3. February 28, 2007. An adult Savannah Sparrow was found unable to fly, 90 meters south of Tower A9.
4. June 5, 2007. An adult Red-tailed Hawk was observed approximately 100 meters west of Tower H1. Its left wing appeared to be injured, however it was still mobile and unable to be captured.

In addition to the four injured birds found during standardized surveys, one Golden Eagle was found far outside the study range, and was thus categorized as an incidental find.

1. March 10, 2007. One adult male Golden Eagle was found incidentally 200 meters WSW of Tower F3. Its primaries on left wing were gone, it had fractured metacarpals and could not fly (but was still mobile), was therefore non-releasable. As per our protocols the bird was transferred to the Lindsay Wildlife Hospital, Walnut Creek, CA. We wer subsequently informed that it had been euthanized.

None of the carcasses or injured birds found is listed as federally or state threatened or endangered, however one juvenile male Peregrine Falcon was found 102 meters southeast of tower E2R on November 13, 2007. The status of the Peregrine Falcon, previously federally and state endangered, is currently "delisted", and classified as "SDC", or a state delisting candidate species. Nine incidents were California Species of Special Concern, including a Merlin, 2 Northern Harriers, a Tricolored Blackbird, 4 Yellow Warblers and a Yellow-breasted Chat. Two Burrowing Owl incidents were also found during standardized searches, but were considered caused by "Other" means, and not deemed wind turbine tower (or met tower) related. One Prairie Falcon was found incidentally, at tower C12R. One Golden Eagle, a Protected Species, was found during the second year of this study within the standardized search area. Another Golden Eagle was found incidentally outside the standardized search area.

Three incidents found during standardized surveys were banded birds. These birds were processed like other incidents, the band number was recorded, and the incident was reported to the appropriate banding group. These incidents included one Red-tailed Hawk, and two Mallards. The following information details these incidents:

1. April 12, 2006. An adult female Mallard was found 22 meters east southeast of Tower C11. Its estimated date of death was April 10, 2006. This bird was banded in California (exact location still to be given) on July 14, 2004. ID# SH-004-06, Band # 1757-36370.

2. April 27, 2006. A second adult female Mallard was found 13 meters south southeast of Tower H1. Its estimated date of death was April 25, 2006. This bird was banded in California (exact location still to be given) on July 23, 2005. ID# SH-008-06, Band # 1737-75069.
3. May 24, 2007. A juvenile male Red-tailed Hawk was found 56 meters east northeast of Tower B7R. Its estimated date of death was May 18, 2007. This bird was born in Pittsburg, California in 2006, and had been banded on December 15, 2006 near Birds Landing, California. ID# SH-104-07, Band # 1177-54423.

3.2.3 Temporal Distribution of Incidents

The number of wind turbine associated incidents found during standardized surveys was calculated per month for each species grouping. The estimated month of death or injury was determined by subtracting the estimated number of days since death or injury from the report date. The estimated month of death or injury could not be calculated for 7 incidents because the number of days since death could not be accurately determined from the condition of those carcasses. Those carcasses were either scavenged at a faster rate than the other carcasses, or were too deteriorated to date, suggesting that they went unobserved during one or more round of searches. These (7) carcasses with unknown estimated months of death were excluded from our estimated month of death (or injury) analyses of the remaining carcasses. See Appendices D and E for those incidents with unknown number of days since death or injury.

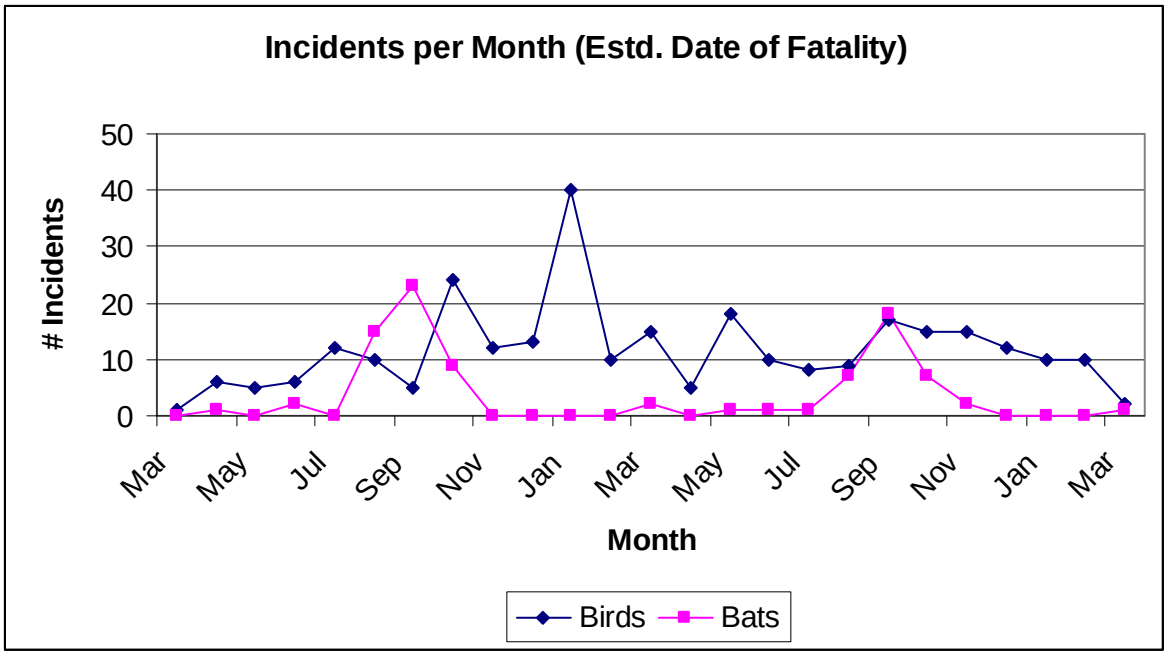
The greatest number of incidents occurred during the month of January of 2007, with a total of 40 (~10.5% of the total) incidents in that month alone, 34 (85%) of them passerine species (Table 4). Sixteen raptor incidents found during year one (~67% of that year's total) were found during the fall migration and pre-breeding seasons, between October 2006 and January 2007. The number of raptor incidents found during those same months the following year only comprised 52% of the raptors for the second year. The three waterfowl incidents with known estimated dates of death occurred in April 2006 (3 Mallards). Few "water bird" incidents were found in year one (n=3), however incidents of species within this group were fairly evenly distributed throughout the year in year two, when about 79% of all water bird incidents were found. Twenty-nine percent of all "other" bird incidents (n=10) were recorded in August and September 2007. Six of these incidents were Mourning Doves, 2 were Rock Pigeons, and 2 were Turkey Vultures.

A large number of bat incidents occurred during the fall migration months, with 47 carcasses recorded between August and October 2006, representing 90% of bats found in year one, and 52% of all bat incidents found during the entire two year study period. During the same months in 2007, a similar but lesser peak was observed, with only 32 bat incidents found, comprising 84% of bats found in year two, and about 36% of the two-year bat total.

Table 4. Number of wind turbine related incidents per species grouping per month*

	2006										2007												2008			
Species Group	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	**Total**
Raptor				1	4			8	1	4	3		3	1	4	3			2	3	5	3	1	1		**47**
Passerine	1	3	3	5	7	6	4	14	10	8	34	10	9	3	14	4	7	3	8	9	7	5	7	8	2	**191**
Waterfowl		3																								**3**
Water Bird						1							2			2		1	1		2	3	1	1		**14**
Other Bird			2		1	3	1	2	1	1	3		1	1		1	1	4	6	3	1	1	1			**34**
Unknown Bird																		1								**1**
Total Birds	**1**	**6**	**5**	**6**	**12**	**10**	**5**	**24**	**12**	**13**	**40**	**10**	**15**	**5**	**18**	**10**	**8**	**9**	**17**	**15**	**15**	**12**	**10**	**10**	**2**	**290**
Bat		**1**		**2**		**15**	**23**	**9**					**2**		**1**	**1**	**1**	**7**	**18**	**7**	**2**				**1**	**90**
Total Birds and Bats	**1**	**7**	**5**	**8**	**12**	**25**	**28**	**33**	**12**	**13**	**40**	**10**	**17**	**5**	**19**	**11**	**9**	**16**	**35**	**22**	**17**	**12**	**10**	**10**	**3**	**380**

*Estimated month of death or injury was calculated by subtracting estimated number of days since death or injury from the report date. These numbers include incidents with known estimated month of death or injury, found during standardized surveys only.



*Estimated month of death or injury was calculated by subtracting estimated number of days since death or injury from the report date. These numbers include incidents with known estimated month of death or injury, found during standardized surveys only.

Figure 3. Number of wind turbine related incidents (birds and bats) per month, from March 2006-March 2008*

Twenty-eight percent (n=13) of all raptor incidents found during the two years of study (all American Kestrels and Red-tailed Hawks) were recorded during the first fall migration between October and December 2006 (Table 5). Another 23% of raptor incidents were found during same months the following year (October through December 2007). Two Northern Harrier fatalities were recorded, one in June 2006 (during nesting season) and one in March 2007, both of which were adult males. During March of 2007 during the breeding season for most raptor species, an American Kestrel and Red-tailed Hawk were found. One adult male Golden Eagle incident was found in December 2007. A single Merlin was found in April 2007. During the 2007 fall migration, three additional raptor species were found: 1 Peregrine Falcon (November), 2 Ferruginous Hawks (November and December), and 3 Great Horned Owls (October, November, and the following January).

Table 5. Number of wind turbine related raptor incidents per species per month*

	2006							2007												2008			
Raptor Species	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	**Total**
Golden Eagle																			1				1
Red-tailed Hawk		1			2		2			1		3	1			1		1			1		13
Ferruginous Hawk																		1	1				2
American Kestrel		3			6	1	2	2		1		1	2			1	2		1				22
Merlin											1												1
Peregrine Falcon																		1					1
Northern Harrier	1									1													2
Barn Owl								1										1					2
Great Horned Owl																	1	1		1			3
Total	**1**	**4**			**8**	**1**	**4**	**3**		**3**	**1**	**4**	**3**			**2**	**3**	**5**	**3**	**1**	**1**		**47**

*Estimated month of death or injury, calculated by subtracting estimated number of days since death or injury from the report date. These numbers include incidents with known estimated month of death or injury, which were associated with wind turbine towers and found during standardized surveys only.

The majority (73%) of raptor incidents which could be identified to age were adults (Table 6), however 50% of American Kestrels were not identified to age because of missing feathers or body parts. Of those that were identifiable, 9 were adults and 2 were first year birds. Of 13 Red-tailed Hawk incidents, 7 were adults, 4 were first year birds, and 2 were of unknown age. The Golden Eagle was an adult. The majority of other raptor incidents which could be identified to age were adults, with the exception of 1 of 2 Ferruginous Hawks and 1 Peregrine Falcon.

3.2.4 Age Classes of Raptors

Table 6. Age classes of raptor wind turbine tower related incidents

Species	Adult	First Year	Unknown	Total
Golden Eagle	1			1
Red-tailed Hawk	7	4	2	13
Ferruginous Hawk	1	1		2
American Kestrel	9	2	11	22
Merlin	1			1
Peregrine Falcon		1		1
Northern Harrier	2			2
Barn Owl	0		2	2
Great Horned Owl	1		2	3
Total	22	8	17	47

3.2.5 Spatial Distribution of Incidents

To determine if there are a statistically greater number of incidents occurring in one area than another, we divided the wind project area into two areas for spatial distribution analyses. These two areas are defined as follows: 1) North of Birds Landing Road, which encompasses 38 wind turbine towers (rows A, B, C, D, and E), hereafter referred to as "the north"; and 2) South of Birds Landing Road, with 12 wind turbine towers (rows F, G, and H), referred to as "the south". In comparison to the north, the southern area consists of steeper hills of higher elevations, which open up to a broad plain running south to the Sacramento River and Suisun Marsh. Based on observation from the first two years of this study, there also appears to be less variety of crops in the south, with the land used for growing mostly hay, and to a lesser degree wheat and oats.

If the incidents are randomly spread throughout the area, with no difference between the north and the south, the number of incidents would be proportionate to the number of wind turbines in each of these areas. There are 38 wind turbines north of Bird Landing Road, and 12 in the south. Therefore the number of incidents would be expected to reflect a 3.2 to 1 ratio (38 to 12 ratio) in these two regions if there is no difference between the north and south regions.

3.2.5.1 Raptors

Raptor incidents were distributed widely throughout the project area (Figure 3), with 4.9 times more incidents north of Birds Landing Road than south, slightly more than would be expected based on a random distribution. Distribution of actual individual species' incidents (using only standardized survey incident data) appear to show disproportionately greater numbers of

American Kestrel incidents north of Bird Landing Road than south (10:1) than expected in a random distribution (Table 7) . However, the difference in proportion was not significant according to a chi-squared analysis, as the actual number of incidents was fairly low (Chi-square test, Yates' $\chi^2 = 1.32$, df = 1, p = 0.25). Twice as many Red-tailed Hawks were found in the north than south, which was only slightly less than expected based on the number of towers searched in each of these areas, however, this was not a significant difference from the expected proportion (Chi-Square test, $\chi^2 = 0.02$, df = 1, p = 0.89, ns). Incidents of all other species of raptors combined were slightly more numerous north of Birds Landing Road than south (4.7:1), however the number of incidents of these species is too small at the end of two years to draw any conclusions. There were several (9) wind turbine towers with 2 or more raptor incidents in the north. Tower A4 had 3 American Kestrel incidents.

Raptor incident numbers were low, and where tests were possible, we did not discern any evident pattern of fatality (or injury) between north and south sites.

Table 7. Comparison of raptor incident distribution to wind turbine tower distribution*

	Number			Ratio	
	North	South	Total	North	South
Number of Turbines	38	12	50	3.2	1
Incidents					
American Kestrel	20	2	22	10	1
Red-tailed Hawk	9	4	13	2.3	1
Golden Eagle	1	0	1	1	0
Merlin	1	0	1	1	0
Peregrine Falcon	1	0	1	1	0
Ferruginous Hawk	2	0	2	2	0
Northern Harrier	1	1	2	1	1
Barn Owl	1	1	2	1	1
Great Horned Owl	3	0	3	3	0
Total Raptors	**39**	**8**	**47**	**4.9**	**1**

*Project area divided into two regions, North and South of Birds Landing Road. Note: Includes data from standardized surveys only.

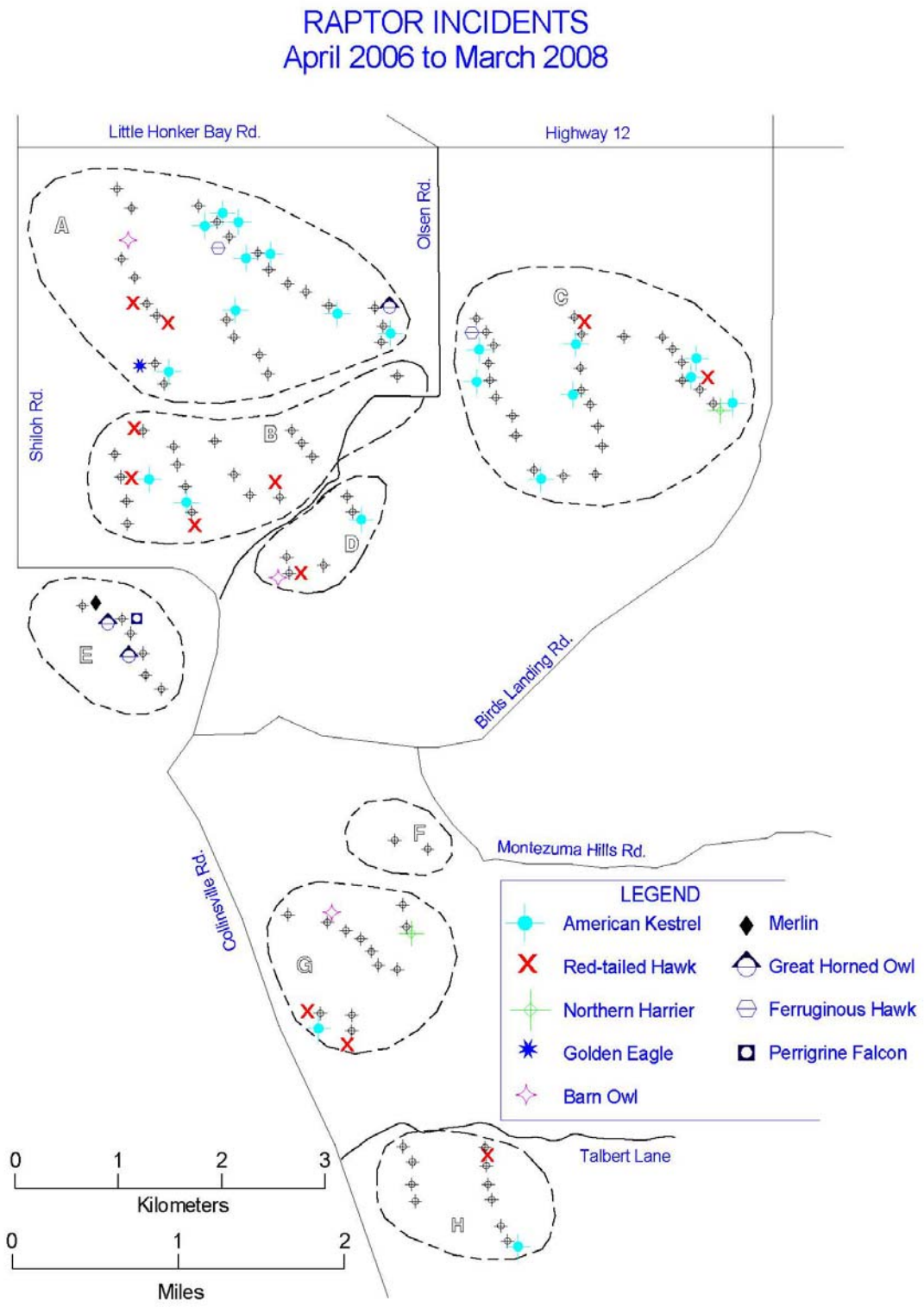


Figure 4. Locations of raptor incidents (found during standardized surveys) in the Shiloh I Project Site, April 2006 through March 2008

Note: Maps include incidents considered to be associated with a wind turbine only, and not those found "ON SITE" (injured birds).

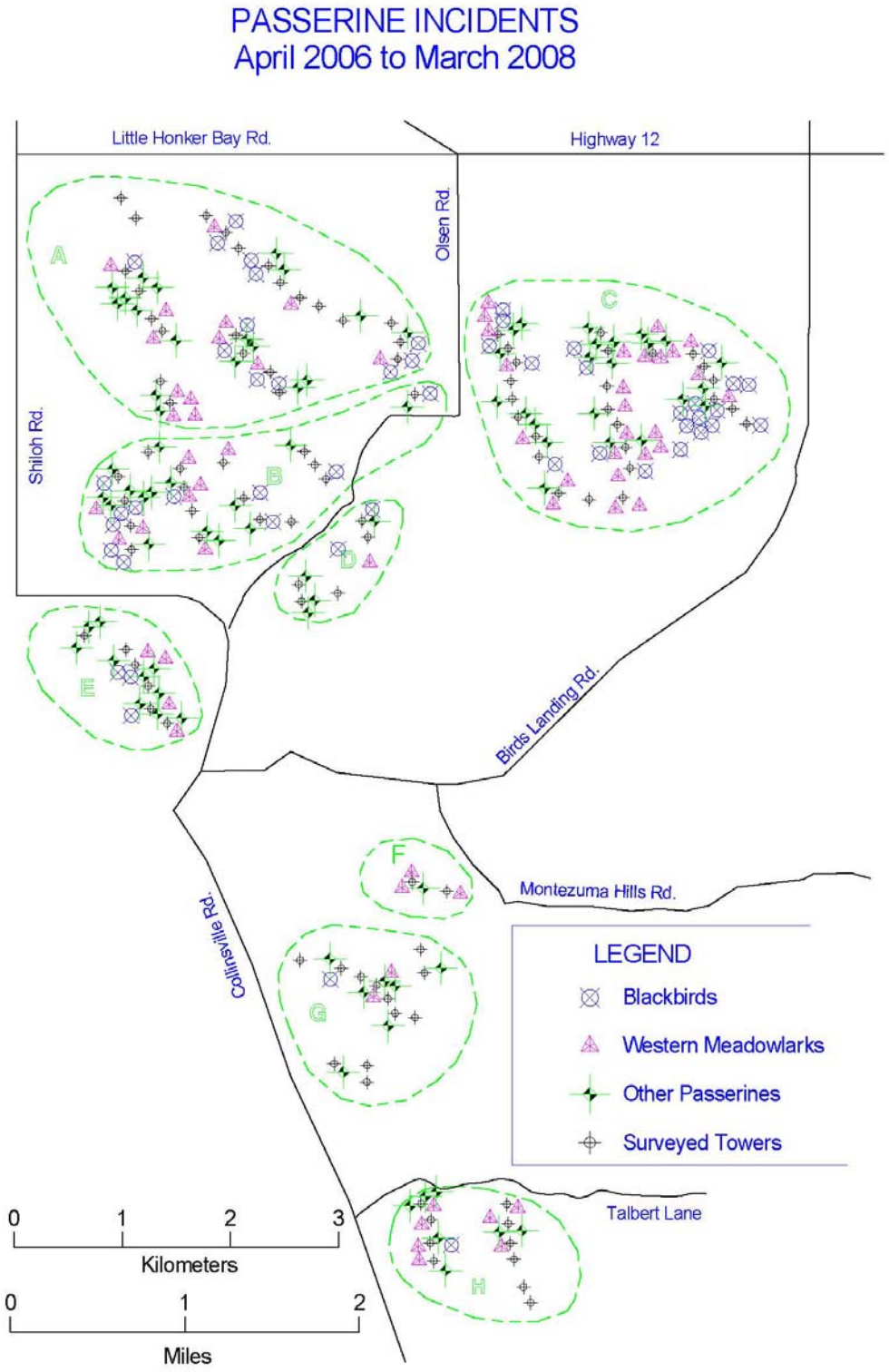


Figure 5. Locations of passerine avian incidents found during standardized surveys in the Shiloh I Project Site, April 2006 through March 2008

Note: Maps include incidents considered to be associated with a wind turbine only, and not those found "ON SITE" (injured birds).

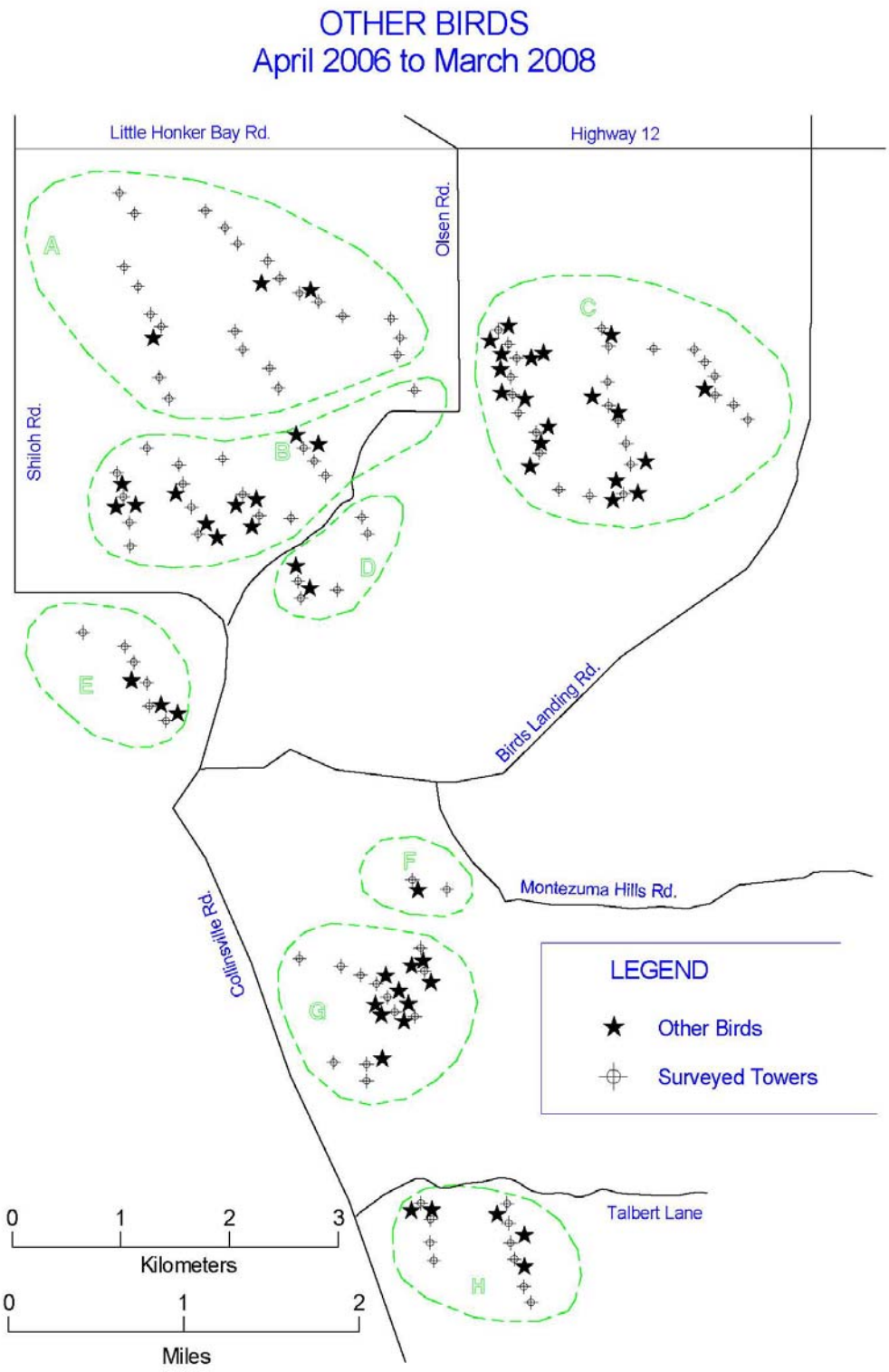


Figure 6. Locations of other (non-raptor, non-passerine) avian species incidents found during standardized surveys in the Shiloh I Project Site, April 2006 through March 2008

Note: Maps include incidents considered to be associated with a wind turbine only, and not those found "ON SITE" (injured birds).

3.2.5.2 Non-Raptors

Incidents of non-raptor species appeared to be concentrated in the northern region of the project area (Figures 5 and 6). Passerine species accounted for the majority of incidents in the north, with 5.5 times greater songbird fatalities in the north than the south (Table 8). The difference in proportion of passerine incidents between northern and southern sites, however, was not significantly greater than that expected from the numbers of towers in each area (Chi-square Test, $\chi^2 = 2.13$, df = 1, p = 0.3314). Western Meadowlarks and mixed species of blackbirds (n=101) comprised ~sixty-one percent of passerine incidents found in the north, and were found in ratios of 4 to 1 and 24 to 1, north to south, respectively. Twenty-six (49%) of 53 meadowlark incidents found in the north were found in the C grouping of towers, with 5 incidents found at tower C25 alone. The large proportion (n=22, 46%) of blackbird incidents found in the north were also found within the C towers, with 9 incidents occurring at a single tower, C5R.

The numbers of incidents of all other non-raptor, non-passerine avian species groups, or "Other Birds" (Table 8 and Figure 6), also showed no significant difference from expected proportions (Chi-square test, $\chi^2 = 0.19$, df = 1, p = 0.66). Preliminary results appear to show a cluster of water bird and waterfowl in the north in the C grouping of towers, with 8 of 12 (67%) of these incidents occurring in this region. Interestingly, there is a stock pond located between towers C8 and C23, and the majority of water bird and waterfowl incidents were located not far from this region (to the west, southwest, or south of tower C8).

Table 8. Comparison of all non-raptor avian incident distribution (by species group) to wind turbine tower distribution*

	Number			**Ratio**	
	North	South	Total	North	South
Number of Turbines	38	12	50	3.2	1
Incidents					
Passeriformes (songbird)	166	30	196	5.5	1
Waterfowl	2	2	4	1	1
Water Birds (rail, coot, heron)	10	4	14	2.5	1
Other (dove, pheasant, flicker, etc.)	26	9	35	2.9	1
Unid. bird spp. (non-passerine)	1	0	1	1	0
Total Non-Raptor Avian Species	**205**	**45**	**250**	**4.6**	**1**

*Project area divided into two regions, North and South of Birds Landing Road. Note: Includes data from standardized surveys only.

3.2.5.3 Bats

Bat incidents were 5 times more numerous in the north than the south of Birds Landing Road. Looking at species individually, the Mexican Free-tailed Bat incidents were concentrated in the north (6.8:1), and showed no evidence of a significant difference in fatality distribution (Chi-square test, $\chi^2 = 2.02$, df = 1, p = 0.15), and the numbers of incidents of the other bat species with a large number of incidents, the Hoary Bat, were also distributed as would be expected (Chi-square test, $\chi^2 = 0.01$, df = 1, p = 0.92) based on wind turbine numbers in the north and south (Table 9). Twenty (20) towers had 2 or more bat fatalities each. Seventy percent (70%, n=63) of all bat fatalities were found at these 20 towers, which comprised only 40% of the towers surveyed during the study. Sixteen of these towers were on the north side (A12 alone had 10 bat fatalities, 5 of them Mexican Free-tailed, 5 Hoary). Figure 6 provides a map of the locations of bat incidents (found during standardized surveys) in the Shiloh I Project Site, April 2006 through March 2008.

Table 9. Comparison of bat incident distribution to wind turbine tower distribution*

	Number			**Ratio**	
	North	South	Total	North	South
Number of Turbines	38	12	50	3.2	1
Incidents					
Hoary Bat	30	9	39	3.3	1
Mexican Free-tailed Bat	41	6	47	6.8	1
Silver-haired Bat	2	0	2	2	0
Western Red Bat	2	0	2	2	0
Total Bat Species	**75**	**15**	**90**	**5**	**1**

*Project area divided into two regions, North and South of Birds Landing Road. Note: Includes data from standardized surveys only.

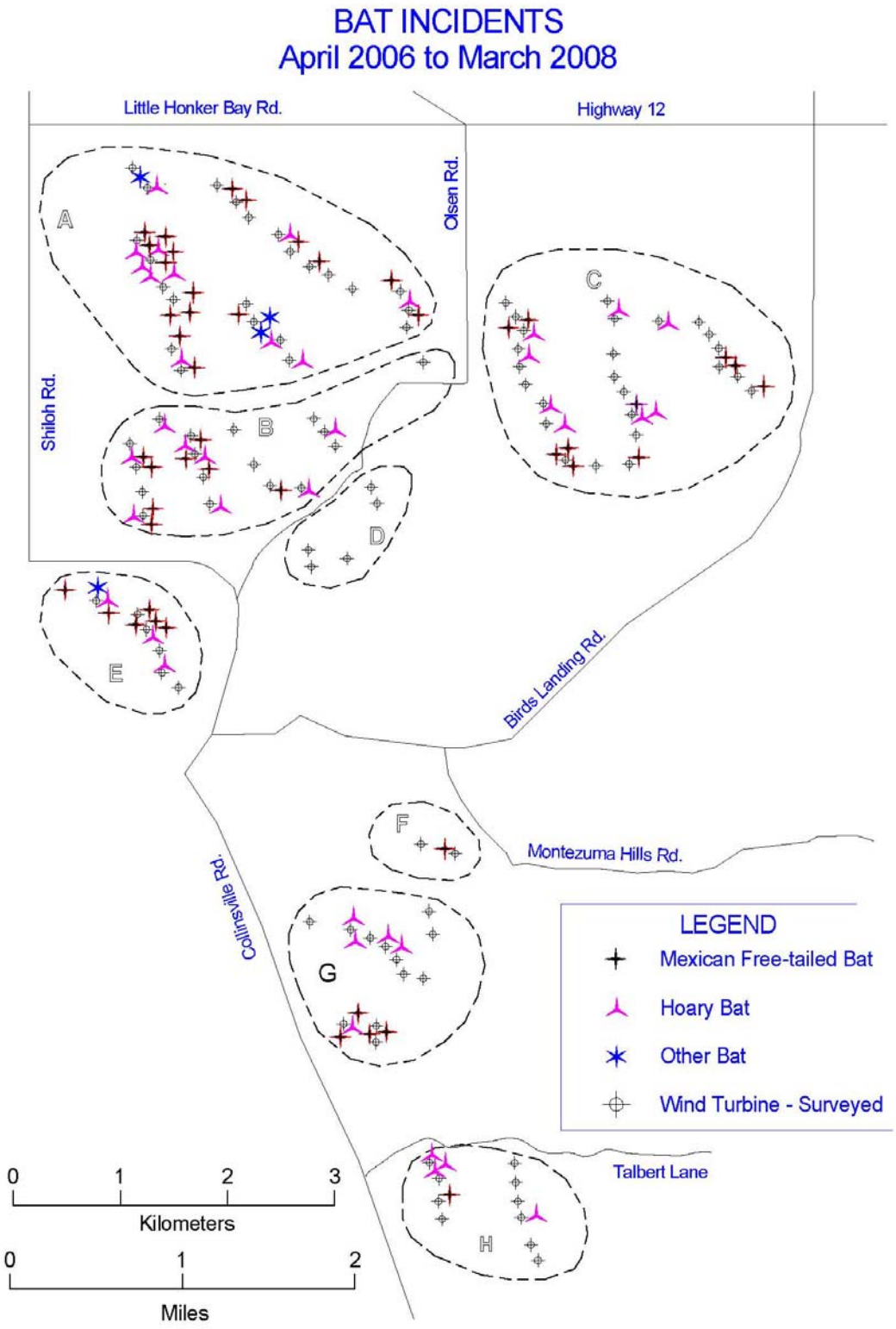


Figure 7. Locations of bat incidents found during standardized surveys in the Shiloh I Project Site, April 2006 through March 2008

3.2.6 Distance from Turbine Bases

Species were lumped into size groupings (Table 10) to determine if surveying a 105 meter radius area is an effective method for finding the majority of carcasses. The number of incidents of species (found during standardized surveys only) falling into each size grouping were then tabulated based on distance (range) from the wind turbine tower (Table 11).

Table 10. Species size groupings used in analyses

Category	Description
Small Bird	≤ 8" length (most smaller passerines)
Medium Bird	8" < X ≤ 14" length (kestrels, flickers, starlings, blackbirds, doves)
Large Bird	> 14" length (most raptors, coots, ducks, pheasants)
Bats	All small size

Of the 387 incidents found during standardized surveys, 383 could be assigned distances from a wind turbine. Four were not able to be assigned a distance because they were injured birds with some degree of mobility. Forty-six percent were located within 60 meters of a wind turbine, 56% were within 70 meters, 72% within 80 meters, 81% within 90 meters, and 95% were within 100 meters (Table 11).

Avian carcasses of all size groups tended to be located somewhat evenly over a larger distance range than bat carcasses, which tended to be located closer to the towers. A greater percentage of bat carcasses (74%) were found within 60 meters as compared to small (36%), medium (33%) and large (64%) birds.

Scavengers may move carcasses, affecting carcass distance analyses. Our previous analysis of the location of birds found at projects using the newest turbine technology (Erickson, et al., 2001, Erickson, et al, 2003), and the Orloff and Flannery (1992) experience searching under older turbine technology supported the judgment that 90% of the carcasses would be located within a circle having a 65 meter radius therefore we expected a 75 meter radius to be sufficient for finding nearly 100% of all carcasses. Sixty-three (63%) of the incidents (242 out of 383) found at Shiloh I were within 75m of the tower base.

Table 11. Number of incidents per size grouping versus distance from wind turbine tower (Shiloh I)

Species Size Group	Distance Range (meters)											Total
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-105	
Small Bird	14	3	3	5	5	11	11	18	12	26	7	**115**
Medium Bird	3	7	3	10	7	18	24	26	15	25	7	**145**
Large Bird	4	1	5	1	4	6	1	3	2	2	4	**33**
Bat	4	4	8	14	20	17	3	13	6	1	0	**90**

Species Size Group	Distance Range (meters) 0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-105	Total
Total	**25**	**15**	**19**	**30**	**36**	**52**	**39**	**60**	**35**	**54**	**18**	**383**

A greater percentage of bat carcasses (92%) were found within 60 meters as compared to small (80%), medium (87%) and large (72%) birds at High Winds (Table 12).

Table 12. Number of incidents per size grouping versus distance from wind turbine tower, at the High Winds Project Area, August 2003 through July 2005

Species Size Group	Distance Range (meters) 0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Total
Small Bird	8	3	3	7	7	9	7	2			**46**
Medium Bird	7	10	11	22	10	12	9	2			**83**
Large Bird	2	4	5	5	6	1	4	3	1	1	**32**
Bat	11	30	19	19	16	12	6	3			**116**
Total	**28**	**47**	**38**	**53**	**39**	**34**	**26**	**10**	**1**	**1**	**277***

*Of a total of 279 incidents recorded during standardized surveys, the distance from the tower was only recorded for 277 of them. Two large bird incidents (Red-tailed Hawk injuries) were considered on "SITE" and were not assigned a distance from a specific tower.

3.3 Prey Observations

3.3.1 Recorded Prey Observations

Potential prey species, such as rodents, rabbits, other larger mammals, reptiles and amphibians, were recorded incidentally when seen. These observations were made predominantly during carcass surveys, however prey observations were recorded more systematically in year two than in year one. For our analyses, only the last year of prey data were used. These analyses, however, are very preliminary at this time, as the numbers of both prey individuals and raptor incidents is still too low to make correlations.
Observations recorded during the entire two years study period included 42 Black-tailed Jackrabbits, 10 California Ground Squirrels, and 2 Pacific Gopher Snakes and 1 Racer (Table 13 and Appendix G).

Table 13. Prey observations* year at Shiloh I, April 2006 – March 2008

Prey Species	# Prey Observations YEAR 1*	YEAR 2	Grand Total
California Ground Squirrel	7	3	10

Prey Species	# Prey Observations YEAR 1*	YEAR 2	Grand Total
Black-tailed Jackrabbit	2	40	42
Pacific Gopher Snake		2	2
Racer		1	1
Total Prey Observations	**9**	**46**	**55**

*Prey observations were recorded predominantly during standardized carcass surveys, however were recorded more systematically in Year 2 than in Year 1.

3.3.2 Raptor Incidents – Prey Distribution

Year two (April 2007 through March 2008) prey observations were distributed widely throughout the project area (Table 14), with 4.2 times more prey individuals north of Birds Landing Road than south. This is not significantly different from what is expected based on the numbers of wind turbine towers surveyed in each of these two areas (Chi-Square test, $\chi^2 = 0.34$, df = 1, p = 0.56). Mammalian prey (Black-tailed Jackrabbits and California Ground Squirrels) constituted most of the prey observations.

Table 14. Comparison of prey observations recorded in year 2 (April 2007 – March 2008) to wind turbine tower distribution*

	Number			Ratio	
	North	South	Total	North	South
Number of Turbines	38	12	50	3.2	1
Incidents					
California Ground Squirrel	4	0	4	4	0
Black-tailed Jackrabbit	32	8	40	4	1
Pacific Gopher Snake	1	1	2	1	1
Racer	1	0	1	1	0
Total	**38**	**9**	**47**	**4.2**	**1**

*Project area divided into two regions, North and South of Birds Landing Road. Note: Includes data from standardized surveys only.

Similarly, the proportion of raptor incidents as a group (6.7:1, North: South, Table 15), using Year 2 data only was not significantly different from what would have been expected based on a random distribution (3.2:1), (Chi-Square Test, Yates' $\chi^2 = 0.58$ df = 1, p = 0.58, ns). Therefore preliminary analyses do not show a correlation between the locations of observed prey and raptor wind turbine strikes, though numbers may still be too low for patterns to be statistically detectable at this point in the study.

Table 15. Comparison of raptor observations recorded in year 2 (April 2007 – March 2008) to wind turbine tower distribution*

	Number			Ratio	
	North	South	Total	North	South
Number of Turbines	38	12	50	3.2	1
Incidents					
American Kestrel	6	1	7	6	1
Red-tailed Hawk	5	2	7	2.5	1
Golden Eagle	1	0	1	1	0
Merlin	1	0	1	1	0
Peregrine Falcon	1	0	1	1	0
Ferruginous Hawk	2	0	2	2	0
Barn Owl	1	0	1	1	0
Great Horned Owl	3	0	3	3	0
Total Raptors	**20**	**3**	**23**	**6.7**	**1**

We performed an additional analysis, based upon one discernible pattern in prey distribution. Prey observations were concentrated north of Birds Landing Road, with the greatest numbers recorded in the C turbine grouping in the northeast (Table 16). Forty-five percent (n=18) of jackrabbit observations were recorded at towers in the C grouping. This is nearly twice what would be expected if jackrabbits were distributed randomly, as these towers only comprise 25% of the towers surveyed (Chi-square test, $\chi^2 = 3.97$, df = 1, p = 0.05, sig.).

Raptor species observed at Shiloh that were most likely to prey upon jackrabbits include large raptors, such as Golden Eagles, Red-tailed Hawks, Ferruginous Hawks, Barn Owls and Great Horned Owls. Looking at data collected in year two only, we examined the distribution of these raptor species, contrasting turbine grouping C with the remaining turbine groupings, to test if jackrabbit preying raptors were also found in greater numbers than expected at C group turbines. These species of raptor incidents were not noted in greater proportions at C turbine groupings, compared to the remaining turbine groupings (Chi-square test, Yates' $\chi^2 = 0.24$, df = 1, p = 0.62, ns).

Table 16. Comparison of prey observations* to raptor incidents recorded within each wind turbine tower grouping in year two (April 2007 – March 2008).

YEAR TWO	Turbine Grouping								
April 07 - March 08	A	B	C	D	E	F	G	H	Grand Total
Average # of Turbines Searched Per Round	11.5	8.5	12.5	2.5	3.0	1.0	6.0	5.0	50.0
Prey Species									
Black-tailed Jackrabbit	9	5	18				6	2	40
California Ground Squirrel		2	2						4
Pacific Gopher Snake			1				1		2
Racer					1				1
Grand Total	**9**	**7**	**21**		**1**		**7**	**2**	**47**

YEAR TWO	Turbine Grouping								
April 07 - March 08	A	B	C	D	E	F	G	H	Grand Total
Raptor Species									
Golden Eagle	1								1
Red-tailed Hawk	2	1	1	1			1	1	7
Ferruginous Hawk	1		1						2
American Kestrel	4		1	1				1	7
Merlin					1				1
Peregrine Falcon					1				1
Barn Owl				1					1
Great Horned Owl	1				2				3
Grand Total	**9**	**1**	**3**	**3**	**4**	**0**	**1**	**2**	**23**

3.4 Vegetative Cover

3.4.1 Vegetative Composition of Study Area

The vegetative cover of the wind farm consists entirely of agricultural land. It can roughly be sorted into two types of cover, pasture and crop land.

Pasture is land which is permanently used for the grazing of sheep, horses, and cattle. The vegetation consists of mixed grasses along with a lesser amount of Mustard family plants, various thistles, among others, and is generally kept short by the grazing. While the horse pastures are continuously grazed, those areas used exclusively for sheep are only periodically grazed, with the sheep being moved from field to field as the grass becomes too short. Eleven of the surveyed tower locations are designated as pasture land.

Crop land is land that goes through cycles of cultivation, crop production, fallow and grazing, and back to crop. The crops consist mostly of grass crops – wheat, barley, oats, and hay – with safflower being the other crop. When a grass crop is to be planted, the soil will generally be cultivated in late May or June, while the soil is still moist. The soil will remain in the tilled state

throughout the summer with periodic re-tilling to break up the clumps further. In the fall the soil is fertilized, usually with liquid ammonia, although "Biosolids" (sewage treatment plant solid waste) was used on some fields in the past year. In November or December, just prior to the start of the winter rains, the fields are seeded. Harvesting of the crops usually occurs in July, but is determined by when the seed reaches the right moisture level. By the time the wheat, barley or oats are harvested the soil is usually too dry and hard to disc, so the field will be fallow the following winter, unless safflower is to be planted. Hay is usually mowed around the end of May, and allowed to dry in the field before baling and gathering. Like the other grass crops, by the time the hay is gathered, it is too late to disc in time to plant the following winter, so the field will be fallow.

Safflower is planted later in the season, around March. Since the soil is still quite moist, a less aggressive technique of cultivating is used to loosen up the soil. Harvesting of safflower occurred in August last year.

In the first twenty four months of this survey, fallow fields represented the ground cover around 30.32% of the surveyed towers, hay 7.68%, oat 1.04%, pasture 22.00%, rye 0.96, safflower 4.32%, tilled soil 11.20%, and wheat 22.48%.

Although several towers had more than one kind of cover due to fence lines running through the survey area, for the purposes of this analysis each tower was considered to have a single type of vegetation cover, that which occupied more than 50% of the survey area and surrounded the base of the tower. Vegetation height was classified as short (<6"), medium (6"-12"), or tall (>12"). At less than 6", vegetation does not obscure the surveyor's vision, while a height of more than 12" could potentially obscure the view sufficiently that the surveyor could miss some carcasses, including larger birds. Between 6" and 12" there is some possibility of missing small birds and bats, but not the larger birds.

In the first 2 years of the survey, short vegetation accounted for 68.92% of the surveyed towers, medium for 18.50%, and high for 12.58%. Comparing the percentage of incidents found on each vegetation cover type, it is clear that the percentages are not equal. For all of our vegetation-incident comparisons, we analyzed standardized data of wind-turbine related fatalities only, as injured birds were all semi-mobile and could have moved between areas of different vegetation types.

3.4.2 Incidents and Vegetation Type

Although there were somewhat fewer fatalities found on fallow ground than would be expected by the extensive percentage of ground cover consisting of this type, the second highest numbers of fatalities were located in this vegetation type. The proportion of incidents found at each vegetation type did not differ greatly from the number of towers searched with that primary vegetation type (Table 17). However, we did test for higher than expected incidents in pasture (Chi-Square Test, $\chi^2 = 2.68$, df = 1, $p > 0.10$, ns.) and lower than expected incidents in wheat (Chi-Square Test, $\chi^2 = 1.62$, df = 1, $p = 0.20$, ns.).

Table 17. Percentages of cover, and incidents by vegetative cover type

Crop Type	% Cover	# Incidents	% Incidents
Pasture	22.00%	116	30.29%
Fallow	30.32%	99	25.85%
Till	11.20%	50	13.05%
Wheat	22.48%	65	16.97%
Hay	7.68%	31	8.09%
Safflower	4.32%	13	3.39%
Oats	1.04%	8	2.09%
Rye	0.96%	1	0.26%
Totals	**100.00%**	**383**	**100.00%**

However, we theorized that visibility would be a more important factor when considering incidents involving small birds or bats. Pasture, fallow and till are either short vegetative cover or bare soil, so carcass visibility by the surveyor could be an explanation for this difference in incident distribution (Table 17).

Table 18. High Winds distribution of bird and bat incidents relative to ground cover, August 2003 – July 2005

Cover	Cover as percentage of total	Total Incidents (%)	Bat Incidents (%)	Bird Incidents (%)
Barley	8.3	6	1.7	8.7
Wheat	17.4	18.6	21.2	16.9
Fallow	45.1	44.5	42.4	45.9
Till	24.2	28.6	33.1	25.7
Other	5	1.9	1.6	2.6

Comparing vegetative cover to species group shows that bats have a higher than expected mortality in pasture (Chi Square test, χ^2=6.43, df=1, p=0.01), and a lower than expected number in till (Chi Square Test, $\chi^2 = 4.24$, df = 1, p = 0.04), (Table 19). One possible explanation for this is the increased density of insects associated with grazed pastures and the lack of insects over tilled soil. Another factor could be that the coloration of the tilled soil is closer to the coloration of the bat carcasses. Spotting the carcasses is more difficult due to the fact that there may be little or no contrast between the carcass and the exposed soil upon which it is laying.

The 'other bird' category did not show a greater than expected proportion in any vegetation type, while there are a lower number of passerines than expected in wheat. These numbers are noticeably different than the 1 year report, which could be related to the fact that the 2005-2006 rainy season was extraordinarily wet, while 2006-2007 was unusually dry which would affect vegetation and food abundance. Raptor incidents are about what would be expected, except there are a slightly greater number in wheat and oat, slightly fewer in hay, and none in safflower.

Table 19. Comparison of species group to vegetative cover type

Species group	Vegetative Cover									% by Group
	Fallow	Hay	Oats	Pasture	Rye	Safflower	Till	Wheat	Total	
Bat	27	9	0	35	0	4	3	12	90	22.7%
Other bird	18	4	1	11	0	2	4	14	54	14.4%
Passerine	46	15	6	56	1	7	35	27	193	49.5%
Raptor	8	3	1	14	0	0	8	12	46	13.4%
Totals	99	31	8	116	1	13	50	65	383	100.0%
% of fatalities	25.8%	8.1%	2.1%	30.34%	0.26%	3.4%	13.0%	17.0%	100.0%	
Percentage										
Bat	27.3%	29.0%	0.0%	30.2%	0.0%	30.8%	6.0%	18.5%	23.5%	
Other bird	18.2%	12.9%	12.5%	9.5%	0.0%	15.4%	8.0%	21.5%	14.1%	
Passerine	46.5%	48.4%	75.0%	48.3%	100.0%	53.8%	70.0%	41.5%	50.4%	
Raptor	8.1%	9.7%	12.5%	12.1%	0.0%	0.0%	16.0%	18.5%	12.0%	

3.4.3 Incidents and Vegetation Height

A comparison of species group to cover height indicates that there seems to be a visibility factor involved, with more than two-thirds of the incidents occurring in short vegetation, about one quarter in medium vegetation, and only one-sixteenth in high vegetation (Table 20). Bats, passerines and raptors all followed this pattern. The exception is the Other Bird category, with equal numbers being found in both high and medium vegetation.

Table 20. Comparison of species group to vegetative cover height

Sp. Group	High	Medium	Short	Total	% High	% Medium	% Short
Bat	3	20	67	90	3.33%	22.22%	74.44%
Other bird	6	7	41	54	11.11%	12.96%	75.93%
Passerine	12	48	133	193	6.22%	24.87%	68.91%
Raptor	2	15	29	46	4.35%	32.61%	63.04%
Totals	**23**	**90**	**270**	**383**			
% Totals	6.0%	23.5%	70.5%	100.0%			

Comparing the species size groups to cover height further supports the idea that visibility might be an underlying factor influencing why carcasses were found more heavily in short and medium height vegetation than in tall (high) vegetation. The smallest percentages of incidents were found in tall vegetation, with the most noticeable difference being in the small and medium bird and bat groups (Table 21). This all seems to suggest that the crop height plays an important part in the visibility of the fatalities, that there may be fatalities which are simply not visible to the surveyors.

Table 21. Comparison of species size to vegetative cover height

Size Group	High	Medium	Short	Totals	% High	% Medium	% Short
Bat	3	20	67	90	3.33%	22.22%	74.44%
Large Bird	4	7	22	33	12.12%	21.21%	66.67%
Medium Bird	8	36	102	146	5.22%	24.63%	70.15%
Small Bird	8	27	79	114	7.14%	23.81%	69.05%
Totals	**23**	**90**	**270**	**383**			
Percent	6.0%	23.5%	70.5%	100.0%			

3.4.4 Feeding Niche of Incidents and Vegetation

The incident species were categorized by their principle diet into 5 categories: carnivore, insectivore, omnivore, seed eaters, and vegetation eaters.[1] There was no attempt to categorize those incidents listed as unknown species, except where some taxa was suggested (E.G. "Unknown Sparrow"). A total of 370 incidents were able to be classified by feeding niche. Insectivores have a higher fatality rate than represented by the percentage of species, and both the carnivores and seed eaters have a lower fatality rate than the percentage of species would indicate (Table 22). However, none of the differences from expected percentage were significant (Chi-Square Test, Yates' $\chi^2 = 1.80$, df = 1, p = 0.76)

Table 22. Number of species and incidents by feeding niche

Feeding Niche	Number of Species	Percent of total Species	Number of Incidents	Percent of Incidents
Carnivore	10	18.5	52	13.6
Insectivore	35	64.8	256	67.6
Omnivore	1	1.8	4	1.3
Seeds	10	18.5	49	13.3
Vegetation	1	1.8	9	2.3

We then compared the number of incidents of species within each feeding niche to the cover type. A higher percentage of incidents were found in pasture and fallow, and to a lesser extent in till, wheat and hay, while a low percentage was found in oats and safflower (Table 23).

Table 23. Comparison of feeding niche to vegetative cover type

Cover	Carnivore	Insectivore	Omnivore	Seeds	Vegetation	Total	% of incidents
Pasture	14	85	0	11	2	112	30.3
Fallow	11	60	4	14	5	94	25.4
Till	8	34	0	5	1	48	13.0
Wheat	12	38	0	13	1	64	17.3
Hay	5	23	0	3	0	31	8.4
Safflower	0	10	0	2	0	12	3.2
Oats	2	5	0	1	0	8	2.2
Rye	0	1	0	0	0	1	0.3
Totals	**52**	**256**	**4**	**49**	**9**	**370**	

We also compared the percentage of incidents within each feeding niche to vegetative cover type. Although carnivores seem to have a higher percentage of incidents in fallow and pasture, and till and wheat to a lesser degree, their numbers are not far from what would be expected based on vegetative cover distribution. Although their incident numbers are higher in fallow and pasture – 55.7% - fallow and pasture account for 52.3% of the cover (Table 24).

[1] Source: Ehrlich, Paul R., David S. Dobkin & Darryl Wheye, 1988, *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*, Simon & Schuster.

Table 24. Percentage of incidents within each feeding niche versus vegetative cover type

Cover		Birds					Bats
Type	Percent	Carnivore	Insectivore	Omnivore	Seeds	Vegetation	Insectivore
Fallow	30.44%	18.75%	20.00%	100%	28.57%	55.56%	30.00%
Hay	7.39%	10.42%	8.48%	0%	6.12%	0%	10.00%
Oats	1.04%	4.17%	2.42%	0%	2.04%	0%	0%
Pasture	22.07%	29.17%	30.30%	0%	22.45%	22.22%	38.90%
Rye	0.96	0%	0.61%	0%	0%	0%	0.00%
Safflower	4.34%	0%	3.64%	0%	4.08%	0%	4.44%
Till	11.16%	16.67%	18.79%	0%	10.20%	11.11%	3.33%
Wheat	22.57%	20.83%	15.76%	0%	26.53%	11.11%	13.33%

The seed-eaters have a higher mortality in wheat and pasture, with 49.0% of the incidents found in only 44.5% of the cover. The wheat may be attractive due to the large seeds, and the pasture due to the variety of seeds. Seed-eaters also were found in high numbers in fallow and tilled fields. Fallow fields would also offer a variety of seeds, and the process of tilling the soil would also expose buried un-germinated seeds.

Insectivorous birds have a higher mortality in fallow, pasture, and till. Together, incidents found on these cover types account for 69.1% of insectivorous species incidents, while these three vegetative cover types account for only 63.5% of the total cover. Fallow fields and pasture are often grazed, which often attracts insects as a food source. However even un-grazed fields may have a higher number of insects present due to their botanical diversity as well as less disturbance by farm equipment. The high number of incidents in tilled fields is less clear. Bats have very high mortality in fallow and pasture, with 68.9% of bat incidents found on 52.32% of the cover.

3.5 Searcher Efficiency and Scavenger Removal

A scavenger removal and searcher efficiency study, conducted at different times of year over the two year period (May 6-8, 2006, October 31 and November 1, 2007, February 12 and 20, 2008) has estimated the proportion of incidents missed by the searchers and the proportion removed by scavengers within the 7 day search cycle.. Accounting for scavenging and searcher efficiency, an adjusted estimate of the total number of kills at the wind farm was calculated. The number of incidents/tower and incidents/megawatt (MW) were calculated using the estimated number of avian and bat incidents found during this two year study. These rates are readily comparable between wind farms of different sizes (different numbers of turbines and different generational capacities per turbine).

3.5.1 Adjusting Fatality Estimates

Table 25 shows the results of the scavenger study as described in the Methods. The proportion of birds not scavenged (*Sc*) within 4 days was used to adjust the number of incidents that were discovered by our searchers, in each size class (small, medium, and large birds, and bats).

Table 25. Shiloh scavenger removal study data.

Species Size Group	# of Carcasses	# Scavenged	Proportion not scavenged (Sc)
Small Birds	48	17	0.65
Medium Birds	19	8	0.58
Large Birds	11	2	0.75
Bats	52	17	0.67

Table 26 shows the results of the search efficiency study as described in the Methods, using both bird carcasses as well as artificial birds. The proportion of birds found (*Se*) was used to adjust the number of incidents that were discovered by our searchers, in each size class (small, medium, and large birds, and bats).

Table 26. Shiloh searcher efficiency study data.

Species Size Group	# of Carcasses	# Not Found	Prop. Found (Se)
Small Birds	48	39	0.19
Medium Birds	19	10	0.47
Large Birds	11	0	1.00
Bats	56	45	0.20

Tables 27 and 28 contain estimates of the number of bird and bat fatalities attributed to collisions with the total number of wind turbines at the Shiloh Project, in the first and second year of the project. They reflect corrections for Sc, Se as determined in tables 12 and 13, as well as Ps, the number of birds/bats found during searches and the subsequent estimate adjustment made using the formula described in the Methods.

The total number of incidents estimated for the project area for year one of this study is 2582 (Table 27). Raptors accounted for ~136 out of 1795 birds (~7.5%), 1.36 raptor incidents/tower. Passerines were 1374 out of 1795 birds (~76.5%), 13.7 passerine incidents/tower
Hoary bats (46%) and Mexican Free-tailed bats (50%) accounted for most of the adjusted bat incidents in year one of this study.

Table 27. Estimates for bird and bat collision mortality under 100 turbines of the Shiloh Project, Year 1 (April 10, 2006 - April 5, 2007), corrected for searcher efficiency, scavenger removal rate and proportion of towers searched.

	Birds				Total
Correction Factors	**Small**	**Medium**	**Large**	**Bats**	**Carcasses**
# Found	71	81	13	52	217
% Not Scavenged **(Sc)**	65%	58%	82%	67%	
Search Efficiency **(Se)**	19%	47%	100%	20%	
Proportion Searched Turbines **(Ps)**	50.00%	50.00%	50.00%	50.00%	
Adjusted Total	**1173**	**591**	**32**	**787**	**2582**
95% CI (±)	78	38	1	93	

The total number of incidents estimated for the project area for year two is 1865 (Table 28). Raptors accounted for 103 out of 1290 birds (~8.0%), 1.0 raptor incidents/tower. Passerines were 986 out of 1290 birds (~76.4%), 9.9 passerine incidents/tower. Hoary bats (39%) and Mexican Free-tailed bats (54%) accounted for most of the adjusted bat incidents in year two of this study. The estimated number of incidents of small and medium birds, as well as bats, were significantly higher in year 1 than 2. However, large birds, were greater in year two than year one.

Table 28. Estimates for bird and bat collision mortality under 100 turbines of the Shiloh Project, Year 2 (April 9, 2007 - March 27, 2008), corrected for searcher efficiency, scavenger removal rate and proportion of towers searched.

	Birds				Total
Correction Factors	Small	Medium	Large	**Bats**	**Carcasses**
# Found	46	65	21	38	170
% Not Scavenged **(Sc)**	65%	58%	82%	67%	
Search Efficiency **(Se)**	19%	47%	100%	20%	
Proportion Searched Turbines **(Ps)**	50%	50%	50%	50%	
Adjusted Total	**760**	**474**	**56**	**575**	**1865**
95% CI (±)	50	31	2	34	

By dividing the estimated number (adjusted for searcher efficiency and scavenger losses) of birds/bats by the number of towers searched in each year of this study, a rate of incidents/tower and incidents/megawatt (MW) can be calculated, allowing comparisons between wind farms of different sizes (different numbers of turbines and different generational capacities per turbine).

3.5.2 Species Fatality Estimates

Tables 29 and 30 show the estimated number of incidents and fatality rates per species within each size group for year one and year two, respectively.

Table 29. Adjusted number of incidents per species per turbine and per total installed megawatt capacity at Shiloh I, found during standardized surveys April 2005 to April 2006 (Year One).

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Birds (Large)				
Mallard	4	0.07	0.10	10
Northern Harrier*	2	0.03	0.05	5
Red-tailed Hawk	6	0.10	0.15	15
Ring-necked Pheasant	1	0.02	0.02	2
Total Large Birds	**13**	**0.21**	**0.32**	**32**
Birds (Medium)				
American Coot	2	0.10	0.15	15
American Kestrel	15	0.73	1.09	109
Barn Owl	1	0.05	0.07	7
Brewer's Blackbird	6	0.29	0.44	44
Chukar	1	0.05	0.07	7
Mourning Dove	8	0.39	0.58	58
Northern Flicker	1	0.05	0.07	7
Northern Mockingbird	1	0.05	0.07	7
Rock Pigeon	4	0.19	0.29	29
Virginia Rail	1	0.05	0.07	7
Western Meadowlark	41	1.99	2.99	299
Total Medium Birds	**81**	**3.94**	**5.91**	**591**
Birds (Small)				
American Goldfinch	1	0.11	0.17	17
American Pipit	4	0.44	0.66	66
Black-Headed Grosbeak	1	0.11	0.17	17
Black-throated Gray Warbler	1	0.11	0.17	17
Dark-eyed Junco, slate	1	0.11	0.17	17
European Starling	2	0.22	0.33	33
Golden-Crowned Kinglet	1	0.11	0.17	17
Golden-Crowned Sparrow	1	0.11	0.17	17

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Hammond's Flycatcher	1	0.11	0.17	17
Horned Lark	5	0.55	0.83	83
House Sparrow	1	0.11	0.17	17
Red-winged Blackbird	26	2.86	4.29	429
Savannah Sparrow	3	0.33	0.50	50
Tree Swallow	3	0.33	0.50	50
Tri-colored Blackbird*	1	0.11	0.17	17
White-crowned Sparrow	2	0.22	0.33	33
Wilson's Warbler	2	0.22	0.33	33
Yellow Warbler*	1	0.11	0.17	17
Yellow-breasted Chat*	1	0.11	0.17	17
Unidentified Sparrow spp.	3	0.33	0.50	50
Unidentified Swallow spp.	1	0.11	0.17	17
Unknown bird spp.	9	0.99	1.49	149
Total Small Birds	**71**	**7.82**	**11.73**	**1173**
Total Birds	**165**	**11.97**	**17.95**	**1795**
Bats				
Hoary Bat	24	2.42	3.63	363
Mexican Free-tailed Bat	26	2.62	3.93	393
Silver-Haired Bat	1	0.10	0.15	15
Western Red Bat	1	0.10	0.15	15
Total Bats	**52**	**5.24**	**7.87**	**787**
Total (Birds & Bats)	**217**	**---**	**---**	**2582**

* Denotes California Species of Special Concern (CSC).

Table 30. Adjusted number of incidents per species per turbine and per total installed megawatt capacity at Shiloh I, found during standardized surveys April 2006 to March 2007 (Year Two).

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Birds (Large)				
Black-crowned Night Heron	1	0.02	0.03	3
Ferruginous Hawk	2	0.04	0.05	5
Golden Eagle*	1	0.02	0.03	3
Great Horned Owl	3	0.05	0.08	8
Peregrine Falcon*	1	0.02	0.03	3
Red-tailed Hawk	7	0.12	0.19	19
Ring-necked Pheasant	3	0.05	0.08	8
Turkey Vulture	2	0.04	0.05	5
Unident. Duck	0	0.00	0.00	0
Unknown Bird	1	0.02	0.03	3
Total Large Birds	**21**	**0.37**	**0.56**	**56**
Birds (Medium)				
American Coot	7	0.34	0.51	51
American Kestrel	7	0.34	0.51	51
Barn Owl	1	0.05	0.07	7
Brewer's Blackbird	6	0.29	0.44	44
Killdeer	1	0.05	0.07	7
Merlin*	1	0.05	0.07	7
Mourning Dove	11	0.53	0.80	80
Northern Flicker	1	0.05	0.07	7
Rock Pigeon	3	0.15	0.22	22
Sora	1	0.05	0.07	7
Virginia Rail	1	0.05	0.07	7
Western Meadowlark	25	1.22	1.82	182
Total Medium Birds	**65**	**3.16**	**4.74**	**474**
Birds (Small)				
American Pipit	1	0.11	0.17	17
Black-throated Gray Warbler	2	0.22	0.33	33
European Starling	3	0.33	0.50	50
Horned Lark	8	0.88	1.32	132
House Finch	1	0.11	0.17	17
Lincoln's Sparrow	1	0.11	0.17	17
MacGillivray's Warbler	2	0.22	0.33	33
Pacific Slope Flycatcher	1	0.11	0.17	17
Red-winged Blackbird	10	1.10	1.65	165
Ruby-crowned Kinglet	1	0.11	0.17	17
Savannah Sparrow	2	0.22	0.33	33
Townsend's Warbler	2	0.22	0.33	33

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Warbling Vireo	1	0.11	0.17	17
Wilson's Warbler	4	0.44	0.66	66
Yellow Warbler*	3	0.33	0.50	50
Unidentified Blackbird spp.	1	0.11	0.17	17
Unidentified Passerine spp.	3	0.33	0.50	50
Total Small Birds	**46**	**5.06**	**7.60**	**760**
Total Birds	**132**	**8.60**	**12.90**	**1290**
Bats				
Hoary Bat	15	1.51	2.27	227
Mexican Free-tailed Bat	21	2.12	3.18	318
Silver-Haired Bat	1	0.10	0.15	15
Western Red Bat	1	0.10	0.15	15
Total Bats	**38**	**3.83**	**5.75**	**575**
Total (Birds & Bats)	**170**	**---**	**---**	**1865**

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Birds (Large)				
Black-crowned Night Heron	1	0.02	0.03	3
Ferruginous Hawk	2	0.04	0.05	5
Golden Eagle*	1	0.02	0.03	3
Great Horned Owl	3	0.05	0.08	8
Peregrine Falcon*	1	0.02	0.03	3
Red-tailed Hawk	7	0.12	0.19	19
Ring-necked Pheasant	3	0.05	0.08	8
Turkey Vulture	2	0.04	0.05	5
Unknown Bird	1	0.02	0.03	3
Total Large Birds	**21**	**0.37**	**0.56**	**56**
Birds (Medium)				
American Coot	7	0.34	0.51	51
American Kestrel	7	0.34	0.51	51
Barn Owl	1	0.05	0.07	7
Brewer's Blackbird	6	0.29	0.44	44
Killdeer	1	0.05	0.07	7
Merlin*	1	0.05	0.07	7
Mourning Dove	11	0.53	0.80	80
Northern Flicker	1	0.05	0.07	7
Rock Pigeon	3	0.15	0.22	22
Sora	1	0.05	0.07	7

Species Name	# Incidents	Estimated # Incidents/Mw	Estimated # Incidents/Tower	Estimate of mortality
Virginia Rail	1	0.05	0.07	7
Western Meadowlark	25	1.22	1.82	182
Total Medium Birds	**65**	**3.16**	**4.74**	**474**
Birds (Small)				
American Pipit	1	0.11	0.17	17
Black-throated Gray Warbler	2	0.22	0.33	33
European Starling	3	0.33	0.50	50
Horned Lark	8	0.88	1.32	132
House Finch	1	0.11	0.17	17
Lincoln's Sparrow	1	0.11	0.17	17
MacGillivray's Warbler	2	0.22	0.33	33
Pacific Slope Flycatcher	1	0.11	0.17	17
Red-winged Blackbird	10	1.10	1.65	165
Ruby-crowned Kinglet	1	0.11	0.17	17
Savannah Sparrow	2	0.22	0.33	33
Townsend's Warbler	2	0.22	0.33	33
Warbling Vireo	1	0.11	0.17	17
Wilson's Warbler	4	0.44	0.66	66
Yellow Warbler*	3	0.33	0.50	50
Unidentified Blackbird spp.	1	0.11	0.17	17
Unidentified Passerine spp.	3	0.33	0.50	50
Total Small Birds	**46**	**5.06**	**7.60**	**760**
Total Birds	**132**	**8.60**	**12.90**	**1290**
Bats				
Hoary Bat	15	1.51	2.27	227
Mexican Free-tailed Bat	21	2.12	3.18	318
Silver-Haired Bat	1	0.10	0.15	15
Western Red Bat	1	0.10	0.15	15
Total Bats	**38**	**3.83**	**5.75**	**575**
Total (Birds & Bats)	**170**	**---**	**---**	**1865**

* Denotes California Species of Special Concern (CSC).

The year 1 estimated fatality rate for birds is 17.95 birds/tower/year (11.97 birds/MW/year), and for bats is 7.87 bats/tower/year (5.24 bats/MW/year). The year 2 estimated fatality rate for birds is 12.90 birds/tower/year (8.60 birds/MW/year), and for bats is 5.75 bats/tower/year (3.83 bats/MW/year).

4.0 DISCUSSION

This report details the first two years results of a three-year post-construction study of the Shiloh I wind power project. This is the third fatality study of the newer turbine technology installed in the Collinsville Montezuma Hills Wind Resource Area (CMHWRA). These turbines are arrayed on generally the same type of landscape, land use patterns and habitat over which approximately 510 turbines (Kenetech 56-100 kw) of the older technology are deployed along with more than 200 turbines of the newer technology. The older turbine technology in the CMHWRA is the same as that currently used in much of the Altamont Pass Wind Resource Area and has been studied repeatedly (Howell and DiDonato 1991; Orloff and Flannery 1992, 1996; Howell 1997; Kerlinger 1997; Thelander and Rugge (2000); Smallwood and Thelander 2004). Many of the newer turbines in the Shiloh I and the High Winds projects are installed immediately adjacent to the older turbines and each other. The Shiloh I project will provide an expanded opportunity to examine and compare the effects of the change in turbine technology on the wildlife and habitat of the CMHWRA.

When this three year cycle of post-construction studies is completed we will have nine years of continuous and comparative documentation of the impacts of wind plant development in the CMHWRA. Both pre-construction and post-construction surveys will have been completed over that period of time using data collection protocols that are compatible enough to enable us to utilize the entire body of data to better understand the impact of wind plant development on a large scale. The first study in this series was commenced on August 17, 2000 (High Winds).

Due to the similarity of terrain and land use practices throughout the CMHWRA we would expect to find a strong overlap of species composition and abundance among the wind project developed areas of the WRA. If this is so, we would also expect to find comparable post-construction risk to avian species since the new technology deployed in these areas is comparable in turbine configuration (tower hub height, blade length and FAA lighting requirements), operating characteristics and turbine layout (spacing). In addition, because the same team of individuals has been conducting the pre- and post-construction surveys at both the High Winds and Shiloh I projects using the same protocols, it is reasonable to expect that the data collected should be comparable. Region specific sources of error may also remain constant over these different surveys.

Table 31 compares specific attributes of these two adjacent developments within the CMHWRA.

Table 31. Comparison of High Winds and Shiloh I attributes or metrics (includes standardized unadjusted data from the first 2 years of each study)

Attribute or Metric	Shiloh I	High Winds
Number of Turbines	50 (of 100 towers)	87.92 (of 90 towers)
Nameplate Capacity of Turbines	1.5 M	1.8 MW
Total Installed Megawatt Capacity*	75.0	158.3
Total Height of Rotor (AGL)	103.5 m	100 m
Duration of Study (years)	2	2
Study Dates	April 2006 – March 2008 (first 2 of 3 year study)	August 2003 – July 2005
Search Interval (in days)	7 days	15 days
Number of Birds Found	297	163
Number of Raptors Found	47	71
Number of Songbirds Found	196	64
Number of Bats Found	90	116
Number of Birds Killed Per Turbine Per Year	2.97	0.93
Number of Birds Killed Per Megawatt* Per Year	1.98	0.51
Number of Bats Killed Per Turbine Per Year	0.90	0.66
Number of Bats Killed Per Megawatt* Per Year	0.60	0.37

* Number of incidents per megawatt per year was calculated dividing the number of incidents (within the species group) by the total installed megawatt capacity (which was calculated by multiplying the average number of wind turbines surveyed throughout the 2 year survey period by the individual tower MW), then dividing this number by 2 years.

We turn to a comparison of the fatalities recorded between these two project sites.

4.1 Unadjusted Fatality Rates: Site Comparison

4.1.1 Shiloh I

A total of 297 wind turbine related avian incidents were recorded by searchers during standardized surveys, representing 50 species and 17 unidentified birds (1 of these was a blackbird, 3 were sparrows, 1 a swallow, and 12 were not identified to species but classified as passerines; Table 2). Of the 50 avian species, 9 were raptor species including American Kestrel (22), Merlin (1), Peregrine Falcon (1), Red-tailed Hawk (13), Ferruginous Hawk (2), Northern Harrier (2), Golden Eagle (1), Barn Owl (2), and Great Horned Owl (3), comprising a total of 47 raptor incidents found during the 2 year period. The largest number of carcasses found were

songbirds, this group comprised 196 incidents identified to 29 different species plus unidentified species. There were a total of 4 waterfowl incidents, (Mallards). Water bird species comprised 14 incidents, including 9 American Coots, 1 Sora, 2 Virginia Rails, 1 Killdeer, and 1 Black-crowned Night-Heron. Other avian species included a mixed group of Mourning Doves, Rock Pigeons, Turkey Vultures, Ring-necked Pheasants, a Chukar, and 2 Northern Flickers (Tables 2 and 3), comprising 6 species involved in 35 incidents. There was 1 unidentified bird, classified as a large non-passerine. Ninety (90) bat carcasses were found by searchers, representing 4 different species including Hoary Bat (39), Mexican Free-tailed Bat (47), Silver-haired Bat (2), and Western Red Bat (2).

4.1.2 High Winds

A total of 163 avian incidents were recorded by searchers during standardized surveys, representing 35 species (including one unidentified species of *Empidonax* flycatcher which was considered a separate species) and 10 unidentified birds (4 of these were songbirds not identified to species, 6 were bird remains not identifiable to a taxonomic group). Of the 35 species, 7 were raptor species including American Kestrel, Red-tailed Hawk, Ferruginous Hawk, Rough-legged Hawk, White-tailed Kite, Golden Eagle, and Barn Owl. There were a total of 71 raptor incidents found during this two year study. There were 60 incidents of songbirds identified to 17 different species plus unidentified species (3 warblers, 1 blackbird). Other avian species found included a mixed group of vultures, pheasants, doves, rails, flickers, swifts and one cormorant, comprising 11 species and 22 incidents.

The average number of turbines searched during this period at High Winds was 87.92, compared to 50 at Shiloh I. Fatality rates (in number of incidents per megawatt per year, and number of incidents per turbine per year) were calculated for both Shiloh and High Winds and are given in Table 32.

Table 32. Unadjusted number of incidents per species per total installed megawatt capacity* per year, and per turbine per year, at Shiloh I (April 2006 – March 2008) and High Winds (August 2003 - July 2005), found during 2 years of standardized surveys

	Shiloh I			High Winds		
Species	# **Incidents** (Ave 50 turbines)	# **Incidents*** per MW/Yr	# **Incidents** per Turbine/Yr	# **Incidents** (Ave 88 turbines)	# **Incidents*** per MW/Yr	# **Incidents** per Turbine/Yr
Birds						
American Coot	9	0.0600	0.0900	2	0.0063	0.0114
American Goldfinch	1	0.0067	0.0100			
American Kestrel	22	0.1467	0.2200	45	0.1421	0.2559
American Pipit	5	0.0333	0.0500	2	0.0063	0.0114
Barn Owl	2	0.0133	0.0200	2	0.0063	0.0114
Black-crowned Night Heron	1	0.0067	0.0100			
Black-headed Grosbeak	1	0.0067	0.0100			
Black-throated Gray Warbler	3	0.0200	0.0300			
Brewer's Blackbird	12	0.0800	0.1200	2	0.0063	0.0114
Chukar	1	0.0067	0.0100			
Common Moorhen				1	0.0032	0.0057
Common Yellowthroat **				1	0.0032	0.0057
Dark-eyed Junco, slate	1	0.0067	0.0100			
Double-crested Cormorant**				1	0.0032	0.0057
Empidonax species				1	0.0032	0.0057
European Starling	5	0.0333	0.0500	6	0.0190	0.0341
Ferruginous Hawk	2	0.0133	0.0200	1	0.0032	0.0057
Golden Eagle	1	0.0067	0.0100	1	0.0032	0.0057
Golden-crowned Kinglet	1	0.0067	0.0100			
Golden-crowned Sparrow	1	0.0067	0.0100			
Great Horned Owl	3	0.0200	0.0300			
Hammond's Flycatcher	1	0.0067	0.0100			
Horned Lark	13	0.0867	0.1300	17	0.0537	0.0967
House Finch	1	0.0067	0.0100			
House Sparrow	1	0.0067	0.0100			
Killdeer	1	0.0067	0.0100			
Lincoln's Sparrow	1	0.0067	0.0100	1	0.0032	0.0057
MacGillivray's Warbler	2	0.0133	0.0200			
Mallard	4	0.0267	0.0400			
Merlin**	1	0.0067	0.0100			
Mourning Dove	19	0.1267	0.1900	2	0.0063	0.0114
Northern Flicker	2	0.0133	0.0200	2	0.0063	0.0114
Northern Harrier**	2	0.0133	0.0200			
Northern Mockingbird	1	0.0067	0.0100			
Orange-crowned Warbler				1	0.0032	0.0057
Pacific Slope Flycatcher	1	0.0067	0.0100			

Species	Shiloh I # Incidents (Ave 50 turbines)	Shiloh I # Incidents* per MW/Yr	Shiloh I # Incidents per Turbine/Yr	High Winds # Incidents (Ave 88 turbines)	High Winds # Incidents* per MW/Yr	High Winds # Incidents per Turbine/Yr
Peregrine Falcon	1	0.0067	0.0100			
Red-tailed Hawk	13	0.0867	0.1300	18	0.0569	0.1024
Red-winged Blackbird	36	0.2400	0.3600	14	0.0442	0.0796
Ring-necked Pheasant	4	0.0267	0.0400	2	0.0063	0.0114
Rock Pigeon	7	0.0467	0.0700	2	0.0063	0.0114
Rough-legged Hawk				1	0.0032	0.0057
Ruby-crowned Kinglet	1	0.0067	0.0100	2	0.0063	0.0114
Savannah Sparrow	5	0.0333	0.0500			
Sora	1	0.0067	0.0100	3	0.0095	0.0171
Townsend's Warbler	2	0.0133	0.0200	3	0.0095	0.0171
Tree Swallow	3	0.0200	0.0300	1	0.0032	0.0057
Tricolored Blackbird**	1	0.0067	0.0100			
Turkey Vulture	2	0.0133	0.0200	2	0.0063	0.0114
Virginia Rail	2	0.0133	0.0200	3	0.0095	0.0171
Warbling Vireo	1	0.0067	0.0100	2	0.0063	0.0114
Western Meadowlark	66	0.4400	0.6600	3	0.0095	0.0171
Western Wood-Pewee				1	0.0032	0.0057
White-crowned Sparrow	2	0.0133	0.0200			
White-tailed Kite				3	0.0095	0.0171
White-throated Swift				2	0.0063	0.0114
Wilson's Warbler	6	0.0400	0.0600	1	0.0032	0.0057
Yellow Warbler**	4	0.0267	0.0400	2	0.0063	0.0114
Yellow-breasted Chat**	1	0.0067	0.0100			
Unidentified Bird	1	0.0067	0.0100	6	0.0190	0.0341
Unidentified Blackbird	1	0.0067	0.0100	1	0.0032	0.0057
Unidentified Passerine	12	0.0800	0.1200			
Unidentified Sparrow	3	0.0200	0.0300			
Unidentified Swallow	1	0.0067	0.0100			
Unidentified Warbler				3	0.0095	0.0171
Subtotal Bird Species	**297**	**1.9800**	**2.9700**	**163**	**0.5148**	**0.9270**
Bats						
Hoary Bat	39	0.2600	0.3900	62	0.1958	0.3526
Mexican Free-tailed Bat	47	0.3133	0.4700	48	0.1516	0.2730
Silver-haired Bat	2	0.0133	0.0200	2	0.0063	0.0114
Western Red Bat	2	0.0133	0.0200	4	0.0126	0.0227
Subtotal Bat Species	**90**	**0.6000**	**0.9000**	**116**	**0.3664**	**0.6597**
Grand Total	**387**	**2.5800**	**3.8700**	**279**	**0.8812**	**1.5867**

*Number of incidents per megawatt per year was calculated dividing the number of incidents by the total installed megawatt capacity (which was calculated by multiplying the average number of wind turbines surveyed throughout the 2 year survey period by the individual tower MW, 1.5 for Shiloh I and 1.8 for HW), then dividing this number by 2 years. For Shiloh I, total megawatt capacity was 75.0 MW, and for High Winds, it was 158.3 MW.
**Denotes California Species of Special Concern (CSC)

Comparison of unadjusted fatality rates between the 2 years of data recorded from each of these two project areas has been simplified below in Tables 33 and 34. Table 33 reports the number of raptor incidents per turbine per year for each site. Most raptor species were found in small numbers (single digits) during 2 years of these two studies, thus concluding differences between sites is not possible. Unadjusted fatality rates for the two species found in the greatest numbers, American Kestrels (Chi-square test, $\chi^2 = 0.23$, df = 1, p = 0.63, ns) and Red-tailed Hawks (Chi-square test, $\chi^2 = 0.35$, df = 1, p = 0.55, ns), were not significantly different between sites, when contrasted with the proportion of turbines searched at each site. There were approximately 1.2 times as many kestrels found per turbine searched per year at High Winds than Shiloh I, and 1.3 times as many Red-tailed Hawks found at Shiloh I than High Winds. There were just under 2 times as many Barn Owls found per turbine at Shiloh I than High Winds.

Table 33. Unadjusted number of raptor incidents species per turbine per year at Shiloh I (April 2006 – March 2008) and at High Winds (August 2003 - July 2005), found during 2 years of standardized surveys

	Shiloh I		High Winds	
Species Name	**# Incidents**	**# Incidents per turbine/year**	**# Incidents**	**# Incidents per turbine/year**
American Kestrel	22	0.2200	45	0.2559
Merlin	1	0.0100		
Peregrine Falcon	1	0.0100		
Red-tailed Hawk	13	0.1300	18	0.1024
Golden Eagle	1	0.0100	1	0.0057
Northern Harrier	2	0.0200		
White-tailed Kite			3	0.0171
Ferruginous Hawk	2	0.0200	1	0.0057
Rough-legged Hawk			1	0.0057
Barn Owl	2	0.0200	2	0.0114
Great Horned Owl	3	0.0300		
Total Raptor Incidents/Turbine/Year	**47**	**0.4700**	**71**	**0.4038**

Comparison of unadjusted fatality rates per tower, between species groups at these two project areas (Table 34), shows a greater fatality rate for passerines (5.4 times more passerine incidents, Chi-square test, $\chi^2 = 96.40$, df = 1, $p < 0.001$, Sig.) at the Shiloh site. However, raw data showed only 1.4 times more bat incidents (Chi-square test, $\chi^2 = 1.90$, df = 1, p = 0.17, ns) and raptor incidents (Chi-square test, $\chi^2 = 0.35$, df = 1, p = 0.55, ns) per tower per year at Shiloh than at High Winds. There were also more incidents of "All Other Birds" (5.1 times as many) however the most notable difference between individual species' incidents within this grouping were in Mourning Doves and Rock Pigeons, which were found in greater numbers at the Shiloh I site. The unadjusted fatality rate of Mourning Doves at Shiloh I was approximately 17 times that of High Winds (0.1900/turbine/year versus 0.0114/turbine/year respectively). Rock Pigeons are an unprotected introduced species, therefore are not of concern, however ~6 times as many of this species were found at Shiloh I than at High Winds.

Table 34. Unadjusted number of incidents per species group per turbine per year at Shiloh I (April 2006 – March 2008) and at High Winds (August 2003 – July 2005), found during the first 2 years of standardized surveys

Species Group	Shiloh I # Incidents/ turbine/year	High Winds # Incidents/ turbine/year
Avian		
Raptor (including owls)	0.4700	0.4038
Passerine (incl. unidentified spp.)	1.9600	0.3640
Waterfowl (ducks)	0.0400	*
Water Bird (coots, rails, herons, cormorants)	0.1300	0.0569
All Other Bird (doves, flickers, pheasants, vultures)	0.3500	0.0682
Unidentified Bird	0.0100	0.0341
Bat	0.9000	0.6597
Total Incidents/Turbine/Year	**3.8600**	**1.5867**

* Only found incidentally, one Snow Goose.

Differences in search protocol may be partly responsible for the greater observances of incidents per turbines searched and the per MW capacity of each turbine. There were fewer turbines searched (50) at Shiloh I compared to an average of 87.92 at the High Winds. However, the 50 turbines at the Shiloh I project site were searched more frequently, every seven days, compared with the 15 day search interval between turbine searches at the High Winds project site. Further, the search radius at each tower in the High Winds project was 75m from the base of the tower, compared to 105m at the Shiloh I project. Thus, the area searched per tower (34,636m^2) at Shiloh was nearly 2 times the amount searched per tower at High Winds (17,671m^2).

If search efficiency and amount of scavenging activity at these two WRA's were assumed to be the same, much of the differences in raw data of bats found at each site could be attributed to these differences in search protocol. However, the larger differences in observed passerine fatalities imply that scavenge and search efficiency rates can only explain part of the difference, and that the final estimate of mortality at Shiloh would be expected to show a greater number of total passerines killed per tower per year in the extrapolated data.

4.2 Night Migrant Fatalities

As with most other turbine facilities across the United States, the numbers of fatalities of night migrants was very low at the Shiloh I facility during the first 2 years of this study. The numbers were especially small in comparison with fatality rates of these birds at tall communication towers in the Midwestern and eastern United States where fatalities involving hundreds or even thousands of birds in a single night have been found dead in a single migration season. Those towers have two types of Federal Aviation Administration lighting (steady burning and flashing lights), multiple sets of guy wires, and are almost always in excess of 500 feet (152 m). An examination of the numbers of night migrating bird (songbirds, rails, common moorhen, coots, and herons) and bat fatalities found during fall (August through November) and spring (mid-February through May) migrations at turbines with FAA lights versus turbines without such

lights did not reveal a significant difference (Table 35). There was also no difference between the numbers of incidents of night migrant species and non-night migrant species at lit towers versus those that were not lit. Of the 38 night migrating birds (29 songbirds and 9 waterfowl and water birds), 29% were found dead at turbines equipped with flashing red lights as opposed to 71% being found at turbines that did not have FAA lights. These percentages are close to the representation of the percentage of towers with and without FAA lights (33% had FAA lights and 67% did not have lights). A chi-square test revealed that there was not a significant deviation from the expected number of night migrant fatalities at lit turbines as opposed to unlit turbines (Chi-square test, $\chi^2 = 0.17$, $df = 1$, P = 0.68, ns). If the red flashing lights attracted birds to turbines, a disproportionately greater number of these fatalities would have been found at turbines with lights, which was not the case.

A similar examination of the numbers of bat fatalities at turbines with FAA lights versus turbines without such lights reveals a similar relation. Of all wind turbine related bat fatalities which occurred during fall or spring migrations, 31% were found at turbines with FAA lights and 69% were found at turbines without such lights. These proportions do not deviate significantly from those expected if bats collided with towers randomly and irrespective of whether FAA lights were present (Chi-square test, $\chi^2 = 0.04$, $df = 1$, P = 0.85, ns).

Table 35. The number of incidents of night migrating birds and bats, and non-migrating birds, found during fall (August - November) and spring (mid-February - May) migrations during the first two years of standardized surveys, at towers with and without FAA red-blinking lights.

	NO LIGHT		RED BLINKING LIGHT		Total
	#	%	#	%	#
Wind Turbines Surveyed*	**33.5**	**67%**	**16.5**	**33%**	**50***
Night Migrant Incidents					
Bats	59	69%	27	31%	86
Passerine	21	72%	8	28%	29
Waterbird/Waterfowl	6	66.7%	3	33.3%	9
Night Migrant Subtotal	**86**	**71%**	**38**	**29%**	**124**
Non-Night Migrant Incidents	88	68%	42	32%	130
Non-Night Migrant Subtotal	**88**	**68%**	**42**	**32%**	**130**
Total # Incidents	**174**	**69%**	**80**	**31%**	**254**

* The number of wind turbines searched during the first 2 years of this study with and without lights was calculated based on the proportion of rounds conducted at each tower type (lit or not).

For both bats and birds, there is no evidence that FAA lighting in the form of L-864 and L-810 flashing red lights attracted birds to towers and that the presence of those lights cause large scale fatality events at wind turbines.

As with most other sites in the western and Midwestern United States, the rates of night migrating songbirds (and ancillary species) appears to be lower than 1 bird per turbine per year. The fact that the Shiloh I and most other western turbines are only 339.5 feet (103.5 m) in height, do not have guy wires, and have only flashing red strobe-like lights may explain the scarcity of night migrant fatalities at those turbines. Kerlinger (2004a, 2004b) has recently demonstrated that flashing red, strobe-like lights (L-864) of the type recommended by FAA and used most often on wind turbines do not appear to attract night migrants like the combination of the same lights in combination with L-810 steady burning red lights. In the Shiloh I project, the L-810 units were modified to be blinking lights. These results continue to suggest that wind turbines in the western United States, like communication towers, do not appear to kill large or significant numbers of night migrants. Determining the exact number of night migrants is difficult, however, as the birds involved may be resident breeders. However, Erickson 2001 attempts to summarize the range of night migrant incidents noted at several wind farm sites in the US.

4.3 Spatial Distribution of Incidents

4.3.1 Raptors

Raptor incidents were distributed widely throughout the project area with nearly five times as many incidents north of Birds Landing Road than south. This concentration of raptor incidents in the north was not significantly different from what was expected based on a random distribution. There were nine wind turbine towers with 2 or more raptor incidents in the north, and two towers in the south. Tower A4 had 3 American Kestrel incidents. At the end of 2 years of surveys, raptor incident numbers were low, and where tests were possible, we did not discern any evident pattern of fatality (or injury) between north and south sites.

At this point, those topographic features identified in 1998 by Curry and Kerlinger of the location of most of the recorded Altamont Golden Eagle and Red-tailed Hawk fatalities are not comparable to the topographic features associated with turbines locations of Shiloh I fatalities. Preventive actions were taken in the siting of these turbines in an attempt to avoid the types of risky topographic situations identified in the Altamont.

The position of the turbine in a string as is the case of the end of row turbines may be more important for determining fatalities. However, the spacing requirements of the current turbine technology results in turbine arrays which are simply not comparable to the deployment patterns of older technology turbines in the Altamont (or older turbines adjacent to the High Winds turbines).

4.3.2 Non-Raptors.

Incidents of non-raptor species appeared to be concentrated in the northern region of the project area. Passerine species accounted for the majority of incidents in the north, with 5.5 times greater songbird fatalities in the north than the south. The difference in proportion of passerine incidents between northern and southern sites, however, was not significantly greater than that expected from the numbers of towers in each area. The numbers of incidents of all other non-

raptor, non-passerine avian species groups, or "Other Birds", also showed no significant difference from expected proportions.

4.3.3 Bats

Bat incidents were 5 times more numerous in the north than the south of Birds Landing Road. Looking at species individually, the Mexican Free-tailed Bat incidents were concentrated in the north (6.8:1), however neither this species nor the Hoary Bat showed evidence of a significant difference in fatality distribution than what would be expected based on wind turbine numbers in the north and south. Twenty towers had 2 or more bat fatalities each. Seventy percent (70%, n=63) of all bat fatalities were found at these 20 towers, which comprised only 40% of the towers surveyed during the study. Sixteen of these towers were on the north side, and one tower alone (A12) had 10 bat fatalities. Two turbines down the same row, A23, had 4 more bat fatalities. These towers are located in the most northwesterly corner of the wind project, and all but 3 of these incidents were found during the months of fall migration. Influences such as topographic features, availability of insect prey, presence of roosting trees or structures, or possibly light sources could have influenced the presence or absence of bats in different regions. We will look into possible factors surrounding these towers with multiple incidents which might be attracting bats. There are both trees and barns located within 1/4-1 mile of A string turbines.

4.4 Seasonal Distribution of Incidents

Based on estimated month of death (or injury), the greatest number of incidents occurred during the month of January of 2007, with ~eleven percent of all incidents found during that month alone. The majority (85%) of these were passerines. Thirty-four percent of raptor incidents occurred during the fall migration and pre-breeding seasons in year one, between October 2006 and January 2007. The number of raptor incidents found during those same months the following year only comprised 26% of the total raptors for the two year study. The greatest number of bat incidents occurred during the fall migration period, with 52% of all bat carcasses found between August and October 2006. There were nearly one and a half times as many bat incidents in August and September of 2006 (n=47) than in the same months in 2007 (n=32).

4.5 Tower Height and Incident Distribution

Analysis of incidents by species groups and tower height (65 meters versus 80 meters) showed no difference from what would be expected based on distribution of towers of each height surveyed (Table 36). With the exception of bats, all species groups (all avian) either did not have large enough numbers to detect trends, or were close to what would be expected based on a random distribution. Nearly twice as many bats were found at 80 meters towers than would be expected based on the number of 80 meter towers searched. However, this result was not significant (Chi-square test, $\chi^2 = 2.15$, $df = 1$, P = 0.14, ns).

Table 36. Comparison of incident distribution (by species group) to wind turbine tower height

	Tower Height			Ratio	
	65m	**80m**	**Total**	**65m**	**80m**
Number of Turbines* surveyed per round	11.5	38.5	50	1	3.35
Bird Species					
Raptor	14	33	47	1	2.4
Passerine	42	154	196	1	3.7
Waterfowl	2	2	4	1	1
Water Bird	4	10	14	1	2.5
Other Bird	10	25	35	1	2.7
Unknown bird spp.	1		1	1	0
Subtotal Bird Species	**73**	**224**	**297**	**1**	**3.1**
Bat Species	12	78	90	1	6.5
Subtotal Bat Species	**12**	**78**	**90**	**1**	**6.5**
Grand Total	**85**	**302**	**387**	**1**	**3.6**

4.6 Adjusted Fatality Rates

4.6.1 Site Comparison: Shiloh I and High Winds

In support of our earlier conclusion that unadjusted fatality rates at Shiloh I were generally higher than that of High Winds, we find that the difference in rates is even greater after adjustments for search efficiency, scavenge rates and proportion of turbines searched have been made. Adjusted fatality rates show a higher than expected estimate of bird incidents at Shiloh I. These differences are primarily driven by the correction for search efficiency for small birds and bats at Shiloh I. Our current Search Efficiency testing indicated that only ~19% of small birds and ~20% of bats were found in each search round. Difficult site conditions included vegetation at various stages of growth and harvest, as well as uneven ground due to tillage, at some sites.

Table 37. Adjusted number of incidents per species per total installed megawatt capacity* per year at Shiloh I (April 2006 – March 2008) and High Winds (August 2003 - July 2005), averaged over 2 years of standardized surveys

		Unadjusted incidents over 2 years		Adjusted Incidents (Corrected for Sc, Se, Ps)			
Size	Species	HW incidents (2yrs, 90 turbines, 1.8MW)	SH incidents (2 yrs, 100 turbines, 1.5MW)[1]	HW est. # incidents/MW/yr	SH1 est. # incidents/MW/yr	HW estimate of mortality/yr	SH1 estimate of mortality/yr
Medium	American Coot	2	9	0.0065	0.22	1	32.8
Small	American Goldfinch	--	1		0.06	0	8.3
Medium	American Kestrel	45	22	0.2127	0.53	32.5	80.2
Small	American Pipit	2	5	0.0217	0.28	3.5	41.3
Medium	Barn Owl *	2	2	0.0155	0.05	2.5	7.3
Large	Black-crowned Night Heron	--	1		0.01	0	1.2
Small	Black-Headed Grosbeak	--	1		0.06	0	8.3
Small	Black-throated Gray Warbler	--	3		0.17	0	24.8
Medium	Brewer's Blackbird	2	12	0.0236	0.29	3.5	43.8
Medium	Chukar	--	1		0.06	0	8.3
Medium	Common Moorhen	1		0.0034	0.00	0.5	0.0
Small	Common Yellowthroat ***	1		0.0101	0.00	1.5	0.0
Small	Dark-eyed Junco, slate	--	1		0.06	0	8.3
Large	Double-crested Cormorant	1		0.0067	0.00	1	0.0
Small	*Empidonax* species	1		0.0101	0.00	1.5	0.0
Small	European Starling	6	5	0.0655	0.28	10	41.3
Large	Ferruginous Hawk ***	1	2	0.0067	0.02	1	2.4
Large	Golden Eagle ***	1	1	0.0067	0.01	1	1.2
Small	Golden-crowned Kinglet	--	1		0.06	0	8.3
Small	Golden-crowned Sparrow	--	1		0.06	0	8.3
Large	Great Horned Owl	--	3		0.02	0	3.7
Small	Hammond's Flycatcher	--	1		0.06	0	8.3
Small	Horned Lark	17	13	0.1824	0.72	28	107.4

Size	Species	Unadjusted incidents over 2 years: HW incidents (2yrs, 90 turbines, 1.8MW)	Unadjusted incidents over 2 years: SH incidents (2 yrs, 100 turbines, 1.5MW)[1]	Adjusted Incidents (Corrected for Sc, Se, Ps): HW est. # incidents/MW/yr	Adjusted Incidents (Corrected for Sc, Se, Ps): SH1 est. # incidents/MW/yr	HW estimate of mortality/yr	SH1 estimate of mortality/yr
Small	House Finch	--	1		0.06	0	8.3
Small	House Sparrow	--	1		0.06	0	8.3
Medium	Killdeer	--	1		0.02	0	3.6
Small	Lincoln's Sparrow	1	1	0.0101	0.06	1.5	8.3
Small	MacGillivray's Warbler	--	2		0.11	0	16.5
Large	Mallard	--	4		0.22	0	33.0
Medium	Merlin*	--	1		0.02	0	3.6
Medium	Mourning Dove	2	19	0.0236	0.46	3.5	69.3
Medium	Northern Flicker	2	2	0.0194	0.05	3	7.3
Large	Northern Harrier	--	2		0.11	0	16.5
Medium	Northern Mockingbird	--	1		0.06	0	8.3
Small	Orange-crowned Warbler	1		0.0101	0.00	1.5	0.0
Small	Pacific Slope Flycatcher	--	1		0.06	0	8.3
Large	Peregrine Falcon*	--	1		0.01	0	1.2
Large	Red-tailed Hawk *	18	13	0.1363	0.11	21	15.9
Small	Red-winged Blackbird	14	36	0.1476	1.98	23.5	297.3
Large	Ring-necked Pheasant	2	4	0.0101	0.03	1.5	4.9
Medium	Rock Pigeon	2	7	0.0217	0.17	3.5	25.5
Large	Rough-legged Hawk	1		0.0062	0.00	1	0.0
Small	Ruby-crowned Kinglet	2	1	0.0236	0.06	3.5	8.3
Small	Savannah Sparrow	--	5		0.28	0	41.3
Medium	Sora	3	1	0.0318	0.02	5	3.6
Small	Townsend's Warbler	3	2	0.0329	0.11	5	16.5
Small	Tree Swallow	1	3	0.0093	0.17	1.5	24.8
Small	Tricolored Blackbird*	--	1		0.06	0	8.3
Large	Turkey Vulture	2	2	0.0129	0.02	2	2.4

		Unadjusted incidents over 2 years		Adjusted Incidents (Corrected for Sc, Se, Ps)			
Size	**Species**	**HW incidents (2yrs, 90 turbines, 1.8MW)**	**SH incidents (2 yrs, 100 turbines, 1.5MW)[1]**	**HW est. # incidents/MW/yr**	**SH1 est. # incidents/MW/yr**	**HW estimate of mortality/yr**	**SH1 estimate of mortality/yr**
Large	Unidentified Duck	--	--	--	--	--	--
Small	Unidentified Bird	6	10	0.0673	0.08	10	12.2
Small	Unidentified Blackbird	1	1	0.0101	0.06	1.5	8.3
Small	Unidentified Passerine spp.	--	3		0.17	0	24.8
Small	Unidentified Sparrow spp.	--	3		0.17	0	24.8
Small	Unidentified Swallow spp.	--	1		0.06	0	8.3
Small	Unidentified Warbler	3		0.0329	0.00	5	0.0
Medium	Virginia Rail	3	2	0.0318	0.05	5	7.3
Small	Warbling Vireo	2	1	0.0194	0.06	3	8.3
Medium	Western Meadowlark	3	66	0.0329	1.60	5	240.7
Small	Western Wood-Pewee	1		0.0101	0.00	1.5	0.0
Small	White-crowned Sparrow	--	2		0.11	0	16.5
Large	White-tailed Kite	3		0.0230	0.00	3.5	0.0
Small	White-throated Swift	2		0.0236	0.00	3.5	0.0
Small	Wilson's Warbler	1	6	0.0093	0.33	1.5	49.5
Small	Yellow Warbler ***	2	4	0.0194	0.22	3	33.0
Small	Yellow-breasted Chat*	--	1		0.06	0	8.3
	TOTAL	**163**	**297**	**1.36**	**10.2**	**419**	**1528.2**
Bat	Hoary Bat	62	39	1.0902	1.97	165.5	295.0
Bat	Mexican Free-tailed Bat	48	47	0.8249	2.37	128	355.5
Bat	Silver-haired Bat	2	2	0.0341	0.10	5.5	15.1
Bat	Western Red Bat	4	2	0.0694	0.10	10.5	15.1
	TOTAL*	**116**	**90**	**2.02**	**4.5**	**309.5**	**680.7**

1. Fifty turbines searched per round

The average bird fatality rate over both years at Shiloh I is 10.28 bird incidents/Mw/year, which is higher than the average bird fatality rate at the nearby High Winds WRA (1.36 bird incidents/Mw/year). Similarly, the average estimate of bat incidents per turbine at Shiloh I, 4.54 bat incidents/Mw/year is higher than the average bat fatality rate at High Winds (2.02 bat incidents/Mw/year).

When examining differences between species groups at the two projects, the situation becomes clearer. The number of raptors (consisting of large and medium sized birds) at Shiloh I (0.88 incidents/Mw/year) is only slightly higher than at High Winds (0.41 incidents/Mw/year). The major difference in fatality rates were derived from the smaller carcasses (i.e. bats, mentioned previously, as well as small birds). Passerine bird incidents at Shiloh (8.01 incidents/Mw/year) were much higher (~ 11 times) than at High Winds (0.71 incidents/Mw/year).

Differences in the searcher efficiency rates has a dramatic effect on the number of adjusted fatalities projected. For the most part the core of the search team at the High Winds site are conducting the Shiloh I Surveys. As we have noted the adjacent projects share many common features in terms of topography, land use and relative abundance and use by an overlapping list of species. If the Shiloh I search efficiency rates were similar to those recorded at High Winds the adjusted per turbine and per Mw numbers of incidents comes closer to the differences reported in the unadjusted incidents as shown below.

Shiloh Year 1:
7.67 Birds/Tower, 5.11 Birds/Mw
5.55 Bats/Tower, 3.70 Bats/Mw
Shiloh Year 2:
5.92 Birds/Tower, 3.94 Birds/Mw
4.05 Bats/Tower, 2.70 Bats/Mw

Differences in search protocol was also responsible for the greater observances of incidents per turbines searched and the per MW capacity of each turbine. The search radius at each turbine in the High Winds project was 75 m from the base of the tower, compared to 105m at the Shiloh I project. Thus, the area searched per tower (34,636m^2) at Shiloh was nearly 2 times the amount searched per tower at High Winds (17,671m^2). Preliminary analysis indicates that 37% (142 out of 383 incidents over 2 years, Table 11) were noted outside the 75m circumference at Shiloh I. This area was not searched at High Winds. The current comparison does not account for this difference in total search area or any potential differences in fall patterns at the two sites.

These are the rates if we had counted only the incidents within 75m at Shiloh I, AND used the High Winds Searcher Efficiency rates which were compiled by the same team of searchers employed on the Shiloh I site.
Year 1:

Birds: 4.28 birds/tower/year, 2.85 bird/Mw/Year
Bats: 4.48 bats/tower/year, 2.99 bats/Mw/Year
Year 2:
Birds: 3.41 birds/tower/year, 2.27 birds/Mw/Year

Bats: 3.20 bats/tower/year, 2.13 bats/Mw/Year

The number of fatalities recorded at Shiloh I were greater than those found at High Winds. However, the differences were exacerbated by the differences in searcher efficiency and the differences in search protocols.

4.6.2 Shiloh I Comparison with Regional Averages

The year 1 estimated fatality rate for birds at Shiloh I is 17.95 birds/tower/year (11.97 birds/MW/year), and for bats is 7.87 bats/tower/year (5.24 bats/MW/year). The year 2 estimated fatality rate for birds is 12.90 birds/tower/year (8.60 birds/MW/year), and for bats is 5.75 bats/tower/year (3.83 bats/MW/year). These rates, or their averages, mentioned in text above and in Tables 29 and 30, are much greater than most of those seen at other post-construction wind project surveys. However, the per Mw rate is comparable to the highest rates seen in recent studies.

Results presented by the National Research Council (NRC 2007) recent review described several avian mortality studies with estimated incidents ranging from 0 birds/tower to 7.70 birds/tower, and from 0 birds/MW to 11.67 birds/MW (Table 38). A more recent study in New York (Jain et al. 2007) noted bird fatality rates as high as 9.59 birds/tower/season. The estimated fatality rates at the Shiloh I Project are higher than those of other similarly designed studies.

Table 38. Bird mortality reported at U.S. wind-energy projects (from NRC 2007)

Wind Project	Study Period	# Turbines	Turbine MW	Project MW	All Bird Mortality Turbine per period	All Bird Mortality MW per period	Reference
Pacific Northwest							
Stateline, OR/WA[1]	July 2001 – Dec 2003	454	0.66	300	**1.93**	2.92	Erickson et al. 2004
Vansycle, OR[1]	Jan 1999 – Dec 1999	38	0.66	25	**0.63**	0.95	Erickson et al. 2004
Combine Hills, OR[1]	Not Available	41	1.00	41	**2.56**	2.56	Young et al. 2005
Klondike, OR[1]	Feb 2002 – Feb 2003	16	1.50	24	**1.42**	0.95	Johnson et al. 2003
Nine Canyon, WA[1]	Sep 2002 – August 2003	37	1.30	62	**3.59**	2.76	Erickson et al. 2003
Rocky Mountain							
Foote Creek Rim, WY, Phase I[2]	Nov 1998 – Dec 2000	72	0.60	43	**1.50**	2.50	Young et al. 2001
Foote Creek Rim, WY, Phase II[2]	June 2001 – June 2002	33	0.75	25	**1.49**	1.99	Young et al. 2003
Upper Midwest							
Wisconsin[3]	Late July 1999 –May 2001	31	0.66	20	**1.30**	1.97	Howe et al. 2002
Buffalo Ridge, MN, Phase I[3]	Apr 1994–Dec 1995; 15 Mar–15 Nov 1996–1999	73	0.30	33	**0.98**	3.27	Johnson et al. 2002
Buffalo Ridge, MN, Phase I[3]	15 Mar 1998 –15 Nov 1999; 15 Jun 2001– 15 Sep 2002	143	0.75	107	**2.27**	3.03	Johnson et al. 2002
Buffalo Ridge, MN, Phase II[3]	15 Mar 1999 –15 Sep 1999; 15 Jun 2001 –15 Sep 2002	139	0.75	104	**4.45**	5.93	Johnson et al. 2002
Top of Iowa[3]	15 Mar 2003 –15 Dec 2004	89	0.90	80	**1.29**	1.44	Koford et al. 2005
East							
Buffalo Mountain, TN[4]	1 Sep 2000 – 30 Sep 2003	3	0.66	2	**7.70**	11.67	Nicholson 2001, 2002
Mountaineer, WV[4]	4 Apr 2003 – 22 Nov 2003	44	1.50	66	**4.04**	2.69	Kerns and Kerlinger 2004
Maple Ridge, NY[3,4]	30 Apr 2007 -14 Nov 2007	195	1.65	322	**3.49-4.13**	2.12-2.50	Jain et al. 2007

[1] Agricultural/grassland/Conservation Reserve Program (CRP) lands

[2] Short-grass prairie

[3] Agricultural

[4] Forest

Note: Where studies include more than one year, final estimates were reported on a per year basis.

The range of bat mortality as reviewed at wind projects across the US, is much greater than that of birds, from 0.07 bats/tower to 10 bats/tower (Erickson 2002). However, recent studies (Kerns and Kerlinger 2004, Arnett 2005 and Fiedler 2005) reported rates at a higher range, (~48 bats/tower/fall period) with the highest fatality rate at 69.6 bats/tower/fall study period (Nicholson 2001, 2002). The fatality rates of bats at the Shiloh I project, while substantial, are at the low end of this range.

4.7 Management Implications/Future Research

The unanswered question to date is whether these projected numbers reflect a substantial and real increase of fatalities at the Shiloh I wind site and/or reflect a difference in execution of the studies on site. Several elements need to be examined. One area for review is the searcher efficiency rate.

The protocols for conducting searcher efficiency testing will be evaluated to attempt to identify the causes of this disparity, such as increased focus on individual searching effectiveness and an assessment of the placement of test carcass procedures.

Search area was clearly another factor which directly contributes to the likelihood of finding more birds/bats. The search area was a radius of 75 meters for High Winds and 105 meters for Shiloh I nearly twice the size.

We recommend continuing to search the larger area to complete the study. However, in order to conform with the California Guidelines regarding the size of the search area, we should continue to include for analysis only those birds found within the 75 meter guideline. We also recommend switching to a grid search pattern which we employ at other areas. Advantages of this procedure is that the searcher can more easily stay on the search track and ostensibly able to concentrate more effectively on the area to be searched. These changes would make the third year data more compatible with other projects implementing the new Guidelines.

Another area for exploration is whether more effort is needed to differentiate between turbine caused fatalities and other potential sources within the project area. Current practice of assigning the source of fatality, in the absence of evidence not immediately obvious, it is assumed that all fatalities within the wind plant are turbine related. Establishing control sites and carefully examining the carcasses found in the extended search area might provide valuable data.

The weekly interval between searches was twice as great (7 days at Shiloh I and 14 days at High Winds). We recommend continuing to conduct the searches on a weekly interval and attempt to assess the impact, if any, of this difference on the adjusted rates of this factor.

We will also continue with analysis of the data gathered to date in order to firm up our understanding of the factors influencing the high adjusted rates at Shiloh I.

5.0 REFERENCES*

Anderson, R. 1998. California Energy Markets, Jan. 23, 1998, No. 448:13.

Anderson, R., et al. 2000. Avian monitoring and risk assessment at Tehachapi and San Gorgonio, WRAS. Proceedings of the National Avian Wind Power Interaction Workshop III, May, 1998, San Diego, CA. National Wind Coordinating Committee/RESOLVE, Inc.

Arnett, E.B., technical editor. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patters of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Avery, M.L., P.F. Springer, and N.S. Dailey. 1980. Avian mortality at man-made structures: an annotated bibliography. U.S. Fish & Wildlife Service, FWS/OBS-80/54.

California Energy Commission. 1989. Avian mortality at large wind energy facilities in California: identification of a problem. California Energy Commission staff report P700-899-001

Cooper, B.A., C.B. Johnson, and R.J. Ritchie. 1995. Bird migration near existing and proposed wind turbine sites in the eastern Lake Ontario region. Report to Niagara Mohawk Power Corp., Syracuse, NY.

Crawford, R.L., and R.T. Engstrom. 2001. Characteristics of avian mortality at a north Florida television tower: A 29-year study. J. Field Ornithology 72:380-388.

Curry, R., and P. Kerlinger. 2000. The Altamont Avian Plan. Proceedings of the National Avian Wind Power Interaction Workshop III, May, 1998, San Diego, CA. National Wind Coordinating Committee/RESOLVE, Inc.

Demastes, J.W., and J. M. Trainer. 2000. Avian risk, fatality, and disturbance at the IDWGA Wind Farm, Algona, IA. Report to Univ. N. Iowa, Cedar Falls, IA.

Ehrlich, Paul R., David S. Dobkin & Darryl Wheye, 1988, *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*, Simon & Schuster.

Erickson, W.P., G.D. Johnson, M.D. Strickland, and K. Kronner. 2000. Avian and bat mortality associated with the Vansycle Wind Project, Umatilla County, Oregon: 1999 study year. Tech. Report to Umatilla County Dept. of Resource Services and Development, Pendleton, OR.

Erickson, W., G.D. Johnson, M.D. Strickland, K.J. Sernka, and R. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of collision mortality in the United States. White paper prepared for the National Wind Coordinating Committee, Avian Subcommittee, Washington, DC.

Erickson, W., M.D. Strickland 2003. Spring Nocturnal Migration Rates, Fatality Rates and Collision Risk Indices at Wind Projects. A report to Windpark Solution, LLC , Big Sandy, MT.

Erickson, W., M.D. Strickland 2003. Review of Three Radar Studies in Montana and Comparison to Methods and Results other Studies. A report to Windpark Solution, LLC , Big Sandy, MT.

Erickson, W., K. Kronner, and B. Gritski. 2003. Nine Canyon Wind Power Project avian and bat monitoring report, September 2002-August 2003. Report to Nine Canyon Technical Advisory Committee and Energy Northwest.

Erickson, W., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project wildlife monitoring annual report, results for the period July 2001 – December 2003. Prepared for to FPL Energy, Stateline Technical Advisory Committee, Oregon Department of Energy, by Western EcoSystems Technology, Pendleton, OR. December 2004.
Erickson, W., K. Kronner, and B. Gritski. 2003. Nine Canyon Wind Power Project avian and bat monitoring report. September 2002-August 2003. Prepared for Nine Canyon Technical Advisory Committee and Energy Northwest.

Fiedler, J.K., T. H. Henry, R. D. Tankersley, and C. P. Nicholson. 2007
Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority, Knoxville. <http://www.tva.gov/environment/bmw_report>

Flath, Dennis, 2003. Pre-Construction Use and Mortality of Vertebrate Wildlife at Judith Wind Resource Area. Report to Windpark Solutions, Big Sandy, MT.

Harmata, Alan R., D.L. Flath, 2003. Pre-Construction Use and Mortality of Vertebrate Wildlife at Judith Wind Resource Area. Report to Windpark Solutions, Big Sandy, MT.

Harmata, Alan A., 2002. Vernal Avian Use of Judith Gap Wind Resource Area: Spatio-temporal Use and Preliminary Data Collection for Impact Assessment. Report to AMERSCO Energy Services, Houston, TX.

Harmata, Alan A., 2003. Radar Monitoring of Avian Activity in the Vicinity of Judith Wind Resource Area, Whetland County, Montana. Report to Windpark Solutions, Big Sandy, MT.

Heintzelman, D.S. 1986. The migrations of hawks. Indiana University Press, Bloomington, IN. 369 pp.

Higgins, K.F., R.G. Osborn, C.D. Dieter, and R.E. Usgaard. 1996. Monitoring of seasonal bird activity and mortality at the Buffalo Ridge Wind Resource Area, Minnesota, 1994-1995. Report for Kenetech Windpower, Inc.

Howe, R., and R. Atwater. 1999. The potential effects of wind power facilities on resident and migratory birds in eastern Wisconsin. Report to Wisconsin Department of Natural Resources.

Howell, J. A. 1997. Avian mortality at rotor swept area equivalents, Altamont Pass and Montezuma Hills, CA. Report to Kenetech Windpower, Livermore, CA.

Howell, J.A., and J.E. DiDonato. 1991. Assessment of avian use and mortality related to wind turbine operations, Altamont Pass, Alameda and Contra Costa counties, California, Sept. 1988 through August 1989. Final Rept. for Kenetech Windpower, San Francisco, CA.

Hunt, G. 2002. Golden Eagles in a perilous landscape: Predicting the effects of mitigation for wind turbine blade-strike mortality. California Energy Commission Report – P500-02-043F, Sacramento, CA.

Ihde, S., and E. Vauk-Henzelt. 1999. Vogelschutz und Windenergie. Bundesverband WindEnergie e.V., Osnabruck, Germany.

Jacobs, M. 1995. Avian mortality and windpower in the Northeast. Windpower 1994 Annual meeting.

Janss, G. 2000. Bird behavior in and near a wind farm at Tarifa, Spain: management considerations. Proc. National Avian - Wind Power Planning Meeting III, San Diego, CA, May 1998. National Wind Coordinating Committee, Washington, DC.

Johnson, G.D., D.P. Young, Jr., W.P. Erickson, M.D. Strickland, R.E. Good, and P. Becker. 2000. Avian and bat mortality associated with the initial phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming: November 3, 1998-October 31, 1999. Report to SeaWest Energy Corp. and Bureau of Land Management.

Johnson, G.D., D.P. Young, W.P. Erickson, C.E. Derby, M.D. Strickland, and R. E. Good. 2000. Wildlife monitoring studies SeaWest Windpower Project, Carbon County, Wyoming, 1995-1999. Prepared for SeaWest Energy Corporation and BLM by WEST, Cheyenne, WY.

Johnson, G., W. Erickson, J. White, and R. McKinney. 2003. Avian and bat mortality during the first year of operation at the Klondike Phase I Wind Project, Sherman County, Oregon. Report to Northwestern Wind Power.

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879-887.

Kerlinger, P. 1989. Flight strategies of migrating hawks. University of Chicago Press, Chicago, IL. pp. 389.

Kerlinger, P. 1995. How birds migrate. Stackpole Books, Mechanicsburg, PA. pp. 228.

Kerlinger, P. 2000a. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Proceedings of the National Wind/Avian Planning Meeting III, San Diego, CA, May 1998.

Kerlinger, P. 2000b. Avian mortality at communications towers: a review of recent literature, research, and methodology. Report to the U.S. Fish and Wildlife Service. www.fws.gov/r9mbmo

Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. US DOE, National Renewable Energy Laboratory – available on that agency's website.

Kerlinger, P., R.Curry, L.Culp, A. Hasch, A.Jain, C. Wilkerson, W. Fischer. 2006. Post-Construction Avian and Bat Fatality Monitoring Study for the High Winds Wind Power Project Solano County, California: Two Year Report, FPL Energy

Kerlinger, P. and R. Curry. 1997. Analysis of Golden Eagle and Red-tailed Hawk fatalities on Altamont Ownership Consortium property within the Altamont Wind Resource Area (AWRA). Report from Altamont Avian Plan for the Ownership Consortium and U.S. Fish & Wildlife Service.

Kerlinger, P., and F. R. Moore. 1989. Atmospheric structure and avian migration. In Current Ornithology, vol. 6:109-142. Plenum Press, NY.

Kerlinger, P., R. Curry, and R. Ryder. 2000. Ponnequin Wind Energy Project avian studies, Weld County, Colorado: summary of activities during 2001. Report to Public Service Company of Colorado and Technical Review Committee.

Kerns, J. and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Report to FPL Energy and Mountaineer Wind Energy Center Technical Review Committee.

Leddy, K., K. F. Higgins, and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 111:100-104.

Lowther, S. 2000. The European perspective: some lessons from case studies. Proc. National Avian - Wind Power Planning Meeting III, San Diego, CA, May 1998. National Wind Coordinating Committee, Washington, DC.

Marti Montes, R., and L. Barrios Jaque. 1995. Effects of wind turbine power plants on the Avifauna in the Campo de Gibraltar Region. Spanish Ornithological Society.

Martin, E.M., and P. I. Padding. 2002. Preliminary estimates of waterfowl harvest and Hunter activity in the United States during the 2001 hunting season. United States Fish and Wildlife Service Division of Migratory Bird Management, Laurel, MD.

National Research Council. Environmental Impacts of Wind-Energy Projects Committee on Environmental Impacts of Wind Energy Projects, Committee on Environmental Impacts of Wind EnergyProjects, 2007. ISBN: 978-0-309-10830-0, 394 p.

Nicholson, C.P. Buffalo Mountain Windfarm bird and bat mortality monitoring report,

October 2000-September 2002. Tennessee Valley Authority, Knoxville, TN.

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County wind resource areas, 1989-1991. California Energy Commission, Sacramento, CA.

Orloff, S., and A. Flannery. 1996. A continued examination of avian mortality in the Altamont Pass wind resource area. California Energy Commission, Sacramento, CA.

Pedersen, M.B., and E. Poulsen. 1991. Impact of a 90 m/2MW wind turbine on birds – avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Dansek Vildundersogelser, Haefte 47. Miljoministeriet & Danmarks Miljoundersogelser.

Smallwood, K.S. and C.G. Thelander.2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report by BioResource Consultants to the California Energy Commission, Public Interest Energy-Research-Environmental Area, Contract No. 500-01-019: L. Spiegel, Program Manager. 363 pp.+ appendices.

Strickland, D., et al. 2000. Avian use, flight behavior, and mortality on the Buffalo Ridge, Minnesota Wind Resource Area. Proceedings of the National Avian Wind Power Interaction Workshop III, May, 1998, San Diego, CA. National Wind Coordinating Committee/RESOLVE, Inc.

Thelander, C.G., and L. Rugge. 2000. Avian risk behavior and fatalities at the Altamont Wind Resource Area. US DOE, National Renewable Energy Laboratory SR-500-27545, Golden, CO.

Trapp, J. L. 1998. Bird kills at towers and other man-made structures: an annotated partial bibliography (1960-1998). U.S. Fish and Wildlife Service web report: www.fws.gov/r9mbmo.

Winkelman, J. E. 1990. Disturbance of birds by the experimental wind park near Oosterbierum (Fr.) during building and partly operative situations (1984-1989). RIN-report 90/9, DLO Institute for Forestry and Nature Research, Arnhem.

Winkelman, J. E. 1992. The impact of Sep wind park near Oosterbierum (Fr.), The Netherlands, on birds, 2: nocturnal collision risks. RIN Rep. 92/3. DLO-Instituut voor Bos-en Natuuronderzoek, Arnhem, Netherlands.

Winkelman, J. E. 1995. Bird/wind turbine investigations in Europe. Proceedings of National Avian-Wind Planning Meeting, Denver, CO, July 1994. Pp. 110-119. (see other references and summaries within this Proceedings volume).

Young, E.A., G. Wiens, and M. Harding. 2000. Avian surveys for the wind turbine site and the Jeffrey Energy Center, Western Resources, Pottawatomie County, Kansas, October 1998-October 1999, Project #KRD-9814. Report to Western Resources Inc, and Kansas Electric Utilities Program, Topeka, KS.

Zalles, J.I., and K.L. Bildstein. In press. Raptor Watch: A Global Directory of Raptor Migration Sites. Hawk Mountain Sanctuary Association.

*Not all of the above references are cited specifically in the text. In some cases the references were consulted and information (or lack of information) was noted without citing the specific reference.

APPENDIX A. SHILOH I WIND POWER PROJECT AVIAN CARCASS SURVEYS DATA SHEET

Page ____ of ____

Date_____ Observers _____
Notes:_____

Loc	Time		Fatalities		Ground Cover/Crop Type (give % cover, ave. height, whether standing or cut crop)						Weather			
Turb#	Start	Finish	#	Brief Notes	Gravel	Tilled	Wheat	Barley	Saff.	Fallow	Temp F	Wind Speed	Dir	% Cloud

APPENDIX B. SHILOH I WILDLIFE INCIDENT REPORT DATA SHEET.

SHILOH I
Wildlife Incident Report

SECTION NO. 1 - DISCOVERY DATA

Report Date: _____ Recovery Date: _____ ID#: _____

Reporting Crew: _____ Injury / Fatality Complete / Dismembered / Feathers / Bones

SECTION NO. 2 - LOCATION OF FIND

Parts: Bearing and Distance from tower/pole: Structure: _____

List parts by size:	Distance	Degrees
Part 1: _____	_____	_____
Part 2: _____	_____	_____
Part 3: _____	_____	_____

Location Remarks: _____
_____

SECTION NO. 3 - WILDLIFE IDENTIFICATION

Species: Field marks used:
_____ _____
Age: _____ Sex: _____ Band: No ___ Yes ___ Unknown ___ (Leg(s) missing)

SECTION NO. 4 - OBSERVATIONAL DATA

Describe the physical condition of the find at the time of discovery:
_____
_____
_____

Describe Scavenging Activity: _____
Estimated Time Since Death or Injury (days): <1, <4, <7, <14, <30, >30, UNK Photos: _____

Carcass Condition:
____ 1 - Fresh
____ 2 - Decomposing (early stage)
____ 3 - Decomposing (late stage)
____ 4 - Desiccated
____ 5 - N/A

Infestation Activity: ____ Yes ____ No
____ Fly Larvae (maggots)_____
____ Adult Flies _____
____ Beetles_____
____ Ants_____
____ Other_____

Eyes: __N/A __Round, Fluid Filled __Partially Dehydrated __Flat __Sunken __Amorphous/Empty

Other Field Notes: _____
_____

APPENDIX C. LIST OF 13 INCIDENTS FOUND DURING CLEAN SWEEP SURVEYS AT SHILOH I, MARCH 28 - APRIL 8, 2006 (CLEAN SWEEP 1 at 99 towers) AND OCTOBER 8 – 10, 2007 (CLEAN SWEEP 2 at 50 towers).

Report Date	Clean Sweep	Estimated Month of Death	Species Name	Fatality /Injury	Species Group	Tower	Distance (m)	Degrees (GN)**	Days Since Death
3/28/2006	1	MAR	European Starling	Fatality	Passerine	A9	19	282	1
3/30/2006	1	MAR	Red-tailed Hawk	Fatality	Raptor	B11*	61	274	1
3/30/2006	1	MAR	Red-tailed Hawk	Fatality	Raptor	B11*	40	48	14
3/31/2006	1	MAR	Red-tailed Hawk	Fatality	Raptor	B2	55	56	14
4/2/2006	1	MAR	Western Meadowlark	Fatality	Passerine	C2R*	77	320	14
4/8/2006	1	APR	Hoary Bat	Fatality	Bat	G11*	31	0	1
10/8/2007	2	Unknown	Unidentified Blackbird	Fatality	Passerine	A1R	100	337	UNK
10/8/2007	2	Unknown	American Kestrel	Fatality	Raptor	A16	32	52	UNK
10/8/2007	2	Unknown	American Kestrel	Fatality	Raptor	A8	11	244	UNK
10/8/2007	2	Unknown	Western Meadowlark	Fatality	Passerine	A15	98	28	UNK
10/8/2007	2	OCT	Hoary Bat	Fatality	Bat	B5	29	158	1
10/9/2007	2	Unknown	Turkey Vulture	Fatality	Other Bird	D3	14	99	UNK
10/10/2007	2	Unknown	Rock Pigeon	Fatality	Other Bird	G5	54	26	UNK

* Tower was surveyed only during clean sweeps, and not during standardized surveys.

** Degrees Geographic North represents degrees from tower to carcass.

APPENDIX D. LIST OF 387 INCIDENTS FOUND DURING STANDARDIZED SURVEYS AT WIND TURBINE TOWERS AT SHILOH I, APRIL 2006- MARCH 2008.

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-070-07	3/15/2007	Mar-07	American Coot	Fatality	Water Bird	G7	97	244	4
SH-071-07	3/19/2007	Mar-07	American Coot	Fatality	Water Bird	A7	65	19	1
SH-109-07	6/11/2007	Jun-07	American Coot	Fatality	Water Bird	G7	67	96	7
SH-158-07	9/17/2007	Sep-07	American Coot	Fatality	Water Bird	C17	94	64	7
SH-222-07	11/19/2007	Nov-07	American Coot	Fatality	Water Bird	D2	24	324	4
SH-235-07	12/11/2007	Dec-07	American Coot	Fatality	Water Bird	H2	52	172	4
SH-237-07	12/12/2007	Dec-07	American Coot	Fatality	Water Bird	C15R	73	170	4
SH-014-08	2/1/2008	Jan-08	American Coot	Fatality	Water Bird	H6	95	50	7
SH-025-08	2/19/2008	Feb-08	American Coot	Fatality	Water Bird	C9R	98	194	14
SH-035-07	1/29/2007	Jan-07	American Goldfinch	Fatality	Passerine	C5R	36	198	1
SH-030-06	7/19/2006	Jul-06	American Kestrel	Fatality	Raptor	B7R	19	134	7
SH-035-06	7/27/2006	Jul-06	American Kestrel	Fatality	Raptor	C12R	79	212	7
SH-039-06	8/7/2006	Jul-06	American Kestrel	Fatality	Raptor	A6	58	54	14
SH-100-06	10/3/2006	Oct-06	American Kestrel	Fatality	Raptor	A4	40	137	4
SH-110-06	10/9/2006	Oct-06	American Kestrel	Fatality	Raptor	C5R	58	34	7
SH-112B-06	10/10/2006	Oct-06	American Kestrel	Fatality	Raptor	G10	39	128	4
SH-118-06	10/13/2006	Oct-06	American Kestrel	Fatality	Raptor	C16R	102	120	7
SH-120-06	10/16/2006	Oct-06	American Kestrel	Fatality	Raptor	C6R	33	84	4
SH-128-06	10/20/2006	Oct-06	American Kestrel	Fatality	Raptor	C23	18	182	7
SH-142-06	11/16/2006	Nov-06	American Kestrel	Fatality	Raptor	C8R	53	241	1
SH-158-06	12/13/2006	Dec-06	American Kestrel	Fatality	Raptor	C11	10	244	7
SH-166-06	12/22/2006	Dec-06	American Kestrel	Fatality	Raptor	A4	51	77	1
SH-043-07	1/31/2007	Jan-07	American Kestrel	Fatality	Raptor	A4	70	34	7
SH-050-07	2/6/2007	Jan-07	American Kestrel	Fatality	Raptor	A6	29	268	7
SH-078-07	3/27/2007	Mar-07	American Kestrel	Fatality	Raptor	B14	75	324	7
SH-100-07	5/21/2007	May-07	American Kestrel	Fatality	Raptor	H5	75	88	4
SH-111-07	6/13/2007	Jun-07	American Kestrel	Fatality	Raptor	A33	86	2	7
SH-114-07	6/18/2007	Jun-07	American Kestrel	Fatality	Raptor	A17	53	84	7
SH-172-07	9/25/2007	Sep-07	American Kestrel	Fatality	Raptor	A9	59	115	4
SH-201-07	10/23/2007	Oct-07	American Kestrel	Fatality	Raptor	C9R	73	334	7
SH-209-07	11/1/2007	Oct-07	American Kestrel	Fatality	Raptor	A15	70	289	7
SH-003-08	1/3/2008	Dec-07	American Kestrel	Fatality	Raptor	D5	71	320	7
SH-002-06	4/12/2006	Apr-06	American Pipit	Injury	Passerine	C1	46	350	4
SH-014-07	1/16/2007	Jan-07	American Pipit	Fatality	Passerine	E1R	80	16	7
SH-015-07	1/16/2007	Jan-07	American Pipit	Fatality	Passerine	E3R	102	267	7
SH-051-07	2/7/2007	Feb-07	American Pipit	Fatality	Passerine	B7R	96	12	7
SH-022-08	2/11/2008	Feb-08	American Pipit	Fatality	Passerine	B8	90	264	7
SH-021-07	1/24/2007	Jan-07	Barn Owl	Fatality	Raptor	G2	87	14	7
SH-230-07	12/3/2007	Nov-07	Barn Owl	Fatality	Raptor	D2	89	227	7
SH-116-07	6/21/2007	Jun-07	Black-crowned Night Heron	Fatality	Water Bird	C13	73	122	7
SH-057-06	8/30/2006	Aug-06	Black-headed Grosbeak	Fatality	Passerine	C13	80	6	4
SH-101-06	10/4/2006	Oct-06	Black-throated Gray Warbler	Fatality	Passerine	A24	96	34	4
SH-097-07	5/17/2007	May-07	Black-throated Gray Warbler	Fatality	Passerine	B20	47	44	7
SH-146-07	9/4/2007	Sep-07	Black-throated Gray Warbler	Fatality	Passerine	G7	64	64	4
SH-144-1-06	11/20/2006	Nov-06	Brewer's Blackbird	Fatality	Passerine	B6	62	31	7
SH-146-06	11/21/2006	Nov-06	Brewer's Blackbird	Fatality	Passerine	C25	10	340	4
SH-154-06	12/6/2006	Nov-06	Brewer's Blackbird	Fatality	Passerine	E3R	91	216	7
SH-167-06	12/26/2006	Dec-06	Brewer's Blackbird	Fatality	Passerine	B16	59	219	7
SH-045-07	2/2/2007	Jan-07	Brewer's Blackbird	Fatality	Passerine	C23	93	299	7
SH-080-07	4/3/2007	Mar-07	Brewer's Blackbird	Fatality	Passerine	C13	93	126	7

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-086-07	5/1/2007	Apr-07	Brewer's Blackbird	Fatality	Passerine	C8R	81	34	7
SH-128-07	8/1/2007	Jul-07	Brewer's Blackbird	Fatality	Passerine	A4	61	136	7
SH-224-07	11/26/2007	Nov-07	Brewer's Blackbird	Fatality	Passerine	C22	78	24	7
SH-001-08	1/2/2008	Dec-07	Brewer's Blackbird	Fatality	Passerine	A15	48		7
SH-017-08	2/4/2008	Jan-08	Brewer's Blackbird	Fatality	Passerine	B12R	64	7	7
SH-020-08	2/11/2008	Feb-08	Brewer's Blackbird	Fatality	Passerine	A26	18	36	4
SH-081-07	4/5/2007	Mar-07	Chukar	Fatality	Other Bird	H8	91	100	7
SH-121-06	10/18/2006	Oct-06	Dark-eyed Junco, slate	Fatality	Passerine	H3	80	328	1
SH-153-06	12/5/2006	Dec-06	European Starling	Fatality	Passerine	C25	2	85	4
SH-053-07	2/15/2007	Feb-07	European Starling	Fatality	Passerine	C1	9	301	7
SH-105-07	5/30/2007	May-07	European Starling	Fatality	Passerine	A6	85	84	7
SH-026-08	2/25/2008	Feb-08	European Starling	Fatality	Passerine	C7R	5	298	4
SH-033-08	3/11/2008	Mar-08	European Starling	Fatality	Passerine	E8	15	64	4
SH-212-07	11/8/2007	Nov-07	Ferruginous Hawk	Fatality	Raptor	A5	42	254	4
SH-243-07	12/27/2007	Dec-07	Ferruginous Hawk	Fatality	Raptor	C7R	103	168	4
SH-240-07	12/20/2007	Dec-07	Golden Eagle	Fatality	Raptor	A32	25	230	4
SH-116-06	10/12/2006	Oct-06	Golden-crowned Kinglet	Fatality	Passerine	B14	80	81	4
SH-132-06	10/25/2006	Oct-06	Golden-crowned Sparrow	Fatality	Passerine	A12	100	271	4
SH-207-07	10/31/2007	Oct-07	Great Horned Owl	Fatality	Raptor	E6R	56	336	7
SH-217-07	11/13/2007	Nov-07	Great Horned Owl	Fatality	Raptor	E2R	70	186	7
SH-009-08	1/15/2008	Jan-08	Great Horned Owl	Fatality	Raptor	A8	102	16	4
SH-137-06	10/27/2006	Oct-06	Hammond's Flycatcher	Fatality	Passerine	C5R	19	173	1
SH-044-06	8/17/2006	Aug-06	Hoary Bat	Fatality	Bat	G2	41	357	4
SH-047-06	8/23/2006	Aug-06	Hoary Bat	Fatality	Bat	C3R	33	52	4
SH-051-06	8/24/2006	Aug-06	Hoary Bat	Fatality	Bat	E3R	28	80	7
SH-052-06	8/25/2006	Aug-06	Hoary Bat	Fatality	Bat	A24	80	66	4
SH-053-06	8/25/2006	Aug-06	Hoary Bat	Fatality	Bat	H8	79	52	4
SH-055-06	8/29/2006	Aug-06	Hoary Bat	Fatality	Bat	B14	98	60	7
SH-056-06	8/29/2006	Aug-06	Hoary Bat	Fatality	Bat	B7R	59	7	4
SH-061-06	8/31/2006	Aug-06	Hoary Bat	Fatality	Bat	G3	81	44	4
SH-062-06	9/1/2006	Aug-06	Hoary Bat	Fatality	Bat	A10	48	76	7
SH-063-06	9/1/2006	Aug-06	Hoary Bat	Fatality	Bat	A6	57	53	7
SH-067-06	9/6/2006	Aug-06	Hoary Bat	Fatality	Bat	C8R	79	11	7
SH-069-06	9/8/2006	Sep-06	Hoary Bat	Fatality	Bat	H1	70	102	4
SH-071-06	9/11/2006	Sep-06	Hoary Bat	Fatality	Bat	C11	90	22	1
SH-072-06	9/12/2006	Sep-06	Hoary Bat	Fatality	Bat	C25	70	69	1
SH-073-06	9/12/2006	Sep-06	Hoary Bat	Fatality	Bat	C25	80	37	14
SH-076-06	9/14/2006	Sep-06	Hoary Bat	Fatality	Bat	A12	77	76	1
SH-077-06	9/15/2006	Sep-06	Hoary Bat	Fatality	Bat	A12	52	312	1
SH-078-06	9/15/2006	Sep-06	Hoary Bat	Fatality	Bat	A33	46	20	1
SH-087-06	9/27/2006	Sep-06	Hoary Bat	Fatality	Bat	G3	47	50	7
SH-097-06	9/29/2006	Sep-06	Hoary Bat	Fatality	Bat	B18	40	254	14
SH-099-06	10/2/2006	Sep-06	Hoary Bat	Fatality	Bat	G2	59	71	14
SH-117-06	10/13/2006	Oct-06	Hoary Bat	Fatality	Bat	C23	84	68	7
Sh-123-06	10/20/2006	Oct-06	Hoary Bat	Fatality	Bat	B2	38	108	4
SH-124-06	10/20/2006	Oct-06	Hoary Bat	Fatality	Bat	B20	36	304	4
SH-108-07	6/6/2007	May-07	Hoary Bat	Fatality	Bat	B10	16	359	7
SH-115-07	6/19/2007	Jun-07	Hoary Bat	Fatality	Bat	A12	82	24	7
SH-123-07	7/16/2007	Jul-07	Hoary Bat	Fatality	Bat	A12	27	348	14
SH-137-07	8/28/2007	Aug-07	Hoary Bat	Fatality	Bat	E1R	77	54	4
SH-139-07	8/29/2007	Aug-07	Hoary Bat	Fatality	Bat	H1	59	32	7
SH-140-07	8/29/2007	Aug-07	Hoary Bat	Fatality	Bat	H1	59	91	7
SH-141A-07	8/30/2007	Aug-07	Hoary Bat	Fatality	Bat	B16	48	8	1
SH-143-07	9/4/2007	Sep-07	Hoary Bat	Fatality	Bat	E7	80	348	1

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-148-07	9/4/2007	Sep-07	Hoary Bat	Fatality	Bat	G10	80	38	4
SH-150-07	9/6/2007	Aug-07	Hoary Bat	Fatality	Bat	A23	80	56	7
SH-151-07	9/10/2007	Sep-07	Hoary Bat	Fatality	Bat	C13	50	58	7
SH-157-07	9/12/2007	Sep-07	Hoary Bat	Fatality	Bat	B20	59	38	4
SH-183-07	10/2/2007	Sep-07	Hoary Bat	Fatality	Bat	A9	39	339	1
SH-184-07	10/2/2007	Sep-07	Hoary Bat	Fatality	Bat	A12	36	347	4
SH-197-07	10/23/2007	Oct-07	Hoary Bat	Fatality	Bat	C15R	78	24	4
SH-001-06	4/10/2006	Mar-06	Horned Lark	Fatality	Passerine	A12	102	248	14
SH-136-06	10/27/2006	Oct-06	Horned Lark	Fatality	Passerine	C8R	72	262	4
SH-152-06	12/4/2006	Nov-06	Horned Lark	Fatality	Passerine	A22	100	296	7
SH-157-06	12/13/2006	Dec-06	Horned Lark	Fatality	Passerine	B7R	71	48	7
SH-029-07	1/29/2007	Jan-07	Horned Lark	Fatality	Passerine	C8R	95	10	7
SH-082-07	4/9/2007	Apr-07	Horned Lark	Fatality	Passerine	B6	31	83	7
SH-089-07	5/9/2007	May-07	Horned Lark	Fatality	Passerine	H1	59	296	7
SH-106-07	6/4/2007	May-07	Horned Lark	Fatality	Passerine	D4	91	100	7
SH-118-07	7/3/2007	Jun-07	Horned Lark	Fatality	Passerine	A12	79	42	7
SH-120-07	7/5/2007	Jul-07	Horned Lark	Fatality	Passerine	G3	80	31	4
SH-126A-07	8/1/2007	Jul-07	Horned Lark	Fatality	Passerine	H3	71	91	4
SH-131-07	8/20/2007	Aug-07	Horned Lark	Fatality	Passerine	B14	69	24	7
SH-035-08	3/18/2008	Mar-08	Horned lark	Fatality	Passerine	H9	32	29	4
SH-206-07	10/29/2007	Oct-07	House Finch	Fatality	Passerine	B5	51	246	7
SH-016-06	6/5/2006	Jun-06	House Sparrow	Fatality	Passerine	C4	5	118	1
SH-228-07	11/28/2007	Nov-07	Killdeer	Fatality	Water Bird	B5	21	349	7
SH-200-07	10/23/2007	Oct-07	Lincoln's Sparrow	Fatality	Passerine	C9R	67	214	4
SH-092-07	5/14/2007	May-07	MacGillivray's Warbler	Fatality	Passerine	C25	80	55	7
SH-096-07	5/16/2007	May-07	MacGillivray's Warbler	Fatality	Passerine	A23	95	30	7
SH-004-06	4/12/2006	Apr-06	Mallard	Fatality	Waterfowl	C11	22	106	4
SH-005-06	4/12/2006	Apr-06	Mallard	Fatality	Waterfowl	C11	7	235	4
SH-008-06	4/27/2006	Apr-06	Mallard	Fatality	Waterfowl	H1	13	148	4
SH-075-06	9/14/2006	UNK	Mallard	Fatality	Waterfowl	H1	31	89	UNK
SH-087-07	5/2/2007	Apr-07	Merlin	Fatality	Raptor	E1R	90	48	7
SH-003-06	4/12/2006	Apr-06	Mexican Free-tailed Bat	Fatality	Bat	C23	5	355	4
SH-023-06	6/29/2006	Jun-06	Mexican Free-tailed Bat	Fatality	Bat	B18	58	54	7
SH-042-06	8/10/2006	Aug-06	Mexican Free-tailed Bat	Fatality	Bat	E3R	49	24	7
SH-060-06	8/31/2006	Aug-06	Mexican Free-tailed Bat	Fatality	Bat	E3R	49	26	14
SH-064-06	9/1/2006	Aug-06	Mexican Free-tailed Bat	Fatality	Bat	A23	8	344	7
SH-065-06	9/1/2006	Aug-06	Mexican Free-tailed Bat	Fatality	Bat	A22	51	54	7
SH-074-06	9/13/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	E1R	40	81	7
SH-080-06	9/18/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	C25	54	64	4
SH-083-06	9/21/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A12	73	348	1
SH-084-06	9/21/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A12	50	2	1
SH-085-06	9/21/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A12	49	16	1
SH-086-06	9/21/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A12	41	10	4
SH-088-06	9/27/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	G12	26	2	7
SH-089-06	9/27/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	H10	42	48	1
SH-091-06	9/28/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A12	53	8	4
SH-092-06	9/28/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A22	43	60	7
SH-093-06	9/28/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	A33	56	46	4
SH-096-06	9/29/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	B7R	47	78	14
SH-104-06	10/6/2006	Oct-06	Mexican Free-tailed Bat	Fatality	Bat	C23	36	306	1
SH-108-06	10/9/2006	Oct-06	Mexican Free-tailed Bat	Fatality	Bat	C5R	88	10	1
SH-109-06	10/9/2006	Oct-06	Mexican Free-tailed Bat	Fatality	Bat	C5R	69	54	1
SH-111-06	10/9/2006	Sep-06	Mexican Free-tailed Bat	Fatality	Bat	C6R	29	60	14
SH-119-06	10/13/2006	Oct-06	Mexican Free-tailed Bat	Fatality	Bat	C17	41	56	4

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-138-06	11/1/2006	Oct-06	Mexican Free-tailed Bat	Fatality	Bat	A4	48	51	7
SH-072-07	3/19/2007	Mar-07	Mexican Free-tailed Bat	Fatality	Bat	A7	33	26	4
SH-076-07	3/21/2007	Mar-07	Mexican Free-tailed Bat	Fatality	Bat	E3R	6	261	4
SH-142-07	9/3/2007	Aug-07	Mexican Free-tailed Bat	Fatality	Bat	B7R	89	20	7
SH-152-07	9/10/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	C16R	60	344	7
SH-161-07	9/19/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	A9	51	91	4
SH-163-07	9/20/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	B20	40	136	1
SH-173-07	9/25/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	A22	15	22	4
SH-175-07	9/26/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	C16R	24	326	4
SH-176-07	9/26/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	C16R	58	92	1
SH-177B-07	10/1/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	E1R	80	24	7
SH-178-07	10/1/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	E3R	60	11	7
SH-181-07	10/1/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	G10	34	42	7
SH-182-07	10/1/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	G10	32	112	4
SH-186-07	10/2/2007	Sep-07	Mexican Free-tailed Bat	Fatality	Bat	B18	43	120	7
SH-187-07	10/15/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	A14	59	334	4
SH-188-07	10/15/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	A8	49	306	4
SH-189-07	10/15/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	A32	31	5	4
SH-190-07	10/15/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	B16	30	62	1
SH-191-07	10/15/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	B9	15	118	4
SH-203-07	10/24/2007	Oct-07	Mexican Free-tailed Bat	Fatality	Bat	F4	5	244	7
SH-211-07	11/7/2007	Nov-07	Mexican Free-tailed Bat	Fatality	Bat	G11	75	70	4
SH-219-07	11/14/2007	Nov-07	Mexican Free-tailed Bat	Fatality	Bat	A3	43	70	7
SH-032-08	3/10/2008	Mar-08	Mexican Free-tailed Bat	Fatality	Bat	B13	40	345	4
SH-031-06	7/19/2006	Jul-06	Mourning Dove	Fatality	Other Bird	C13	35	35	7
SH-043-06	8/15/2006	Aug-06	Mourning Dove	Fatality	Other Bird	B14	0	60	7
SH-054-06	8/28/2006	Aug-06	Mourning Dove	Fatality	Other Bird	B4	41	157	7
SH-058-06	8/30/2006	Aug-06	Mourning Dove	Fatality	Other Bird	C17	33	288	1
SH-134-06	10/26/2006	Oct-06	Mourning Dove	Fatality	Other Bird	C23	54	358	7
SH-145-06	11/20/2006	Nov-06	Mourning Dove	Fatality	Other Bird	B4	15	128	4
SH-005-07	1/9/2007	Jan-07	Mourning Dove	Fatality	Other Bird	C12R	64	94	7
SH-012B-07	1/15/2007	Jan-07	Mourning Dove	Fatality	Other Bird	C1	42	187	7
SH-083-07	4/10/2007	Apr-07	Mourning Dove	Fatality	Other Bird	C17	90	305	7
SH-117-07	6/27/2007	Jun-07	Mourning Dove	Fatality	Other Bird	C23	48	32	7
SH-132-07	8/20/2007	Aug-07	Mourning Dove	Fatality	Other Bird	B14	59	94	7
SH-133-07	8/23/2007	Aug-07	Mourning Dove	Fatality	Other Bird	A22	70	260	7
SH-159-07	9/17/2007	Sep-07	Mourning Dove	Fatality	Other Bird	C12R	102	294	7
SH-164-07	9/20/2007	Sep-07	Mourning Dove	Fatality	Other Bird	B20	84	176	7
SH-165-07	9/20/2007	Sep-07	Mourning Dove	Fatality	Other Bird	C23	94	125	7
SH-174-07	9/26/2007	Sep-07	Mourning Dove	Fatality	Other Bird	B16	80	284	7
SH-195-07	10/22/2007	Oct-07	Mourning Dove	Fatality	Other Bird	B5	92	297	7
SH-202-07	10/24/2007	Oct-07	Mourning Dove	Fatality	Other Bird	E6R	37	240	7
SH-241-07	12/20/2007	Dec-07	Mourning Dove	Fatality	Other Bird	C18	14	93	1
SH-126-06	10/20/2006	Oct-06	Northern Flicker	Fatality	Other Bird	B7R	71	104	7
SH-194-07	10/17/2007	Oct-07	Northern Flicker	Fatality	Other Bird	G5	94	126	7
SH-020-06	6/18/2006	Jun-06	Northern Harrier	Fatality	Raptor	G15	29	110	7
SH-061-07	3/9/2007	Mar-07	Northern Harrier	Fatality	Raptor	C6R	7	24	1
SH-017-06	6/11/2006	Jun-06	Northern Mockingbird	Fatality	Passerine	E7	73	300	7
SH-185-07	10/2/2007	Sep-07	Pacific Slope Flycatcher	Fatality	Passerine	A33	67	254	4
SH-218-07	11/13/2007	Nov-07	Peregrine Falcon	Fatality	Raptor	E2R	102	126	7
SH-024-06	7/6/2006	Jul-06	Red-tailed Hawk	Fatality	Raptor	B2	4	46	4
SH-102-06	10/5/2006	Oct-06	Red-tailed Hawk	Fatality	Raptor	B16	75	28	4
SH-125-06	10/20/2006	Oct-06	Red-tailed Hawk	Fatality	Raptor	B14	96	130	7

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-156-06	12/7/2006	Dec-06	Red-tailed Hawk	Fatality	Raptor	G12	55	153	4
SH-165-06	12/20/2006	Dec-06	Red-tailed Hawk	Fatality	Raptor	H3	42	334	4
SH-075-07	3/21/2007	Mar-07	Red-tailed Hawk	Fatality	Raptor	C5R	86	91	4
SH-088-07	5/8/2007	May-07	Red-tailed Hawk	Fatality	Raptor	G10	74	67	4
SH-103-07	5/23/2007	May-07	Red-tailed Hawk	Fatality	Raptor	A22	85	24	4
SH-104-07	5/24/2007	May-07	Red-tailed Hawk	Fatality	Raptor	B7R	56	64	7
SH-107-07	6/5/2007	Jun-07	Red-tailed Hawk	Injury	Raptor	H1			1
SH-153-07	9/10/2007	Sep-07	Red-tailed Hawk	Fatality	Raptor	C8R	58	271	7
SH-225-07	11/26/2007	Nov-07	Red-tailed Hawk	Fatality	Raptor	D2	10	194	4
SH-016-08	2/4/2008	Feb-08	Red-tailed Hawk	Fatality	Raptor	A13	45	125	4
SH-010-06	5/15/2006	May-06	Red-winged Blackbird	Fatality	Passerine	B20	51	177	14
SH-011-06	5/17/2006	Apr-06	Red-winged Blackbird	Fatality	Passerine	H10	61	136	30
SH-014-06	5/24/2006	May-06	Red-winged Blackbird	Fatality	Passerine	A9	43	74	1
SH-019-06	6/17/2006	Jun-06	Red-winged Blackbird	Fatality	Passerine	D1	92	254	7
SH-028-06	7/17/2006	Jul-06	Red-winged Blackbird	Fatality	Passerine	A6	0	38	7
SH-029-06	7/19/2006	Jul-06	Red-winged Blackbird	Fatality	Passerine	B7R	96	154	7
SH-033-06	7/26/2006	Jul-06	Red-winged Blackbird	Fatality	Passerine	B7R	74	286	4
SH-034-06	7/26/2006	Jul-06	Red-winged Blackbird	Fatality	Passerine	B4	0	38	4
SH-037-06	7/28/2006	Jul-06	Red-winged Blackbird	Fatality	Passerine	E7	99	340	30
SH-040-06	8/7/2006	UNK	Red-winged Blackbird	Fatality	Passerine	A6	22	220	UNK
SH-090-06	9/28/2006	UNK	Red-winged Blackbird	Fatality	Passerine	A24	66	12	UNK
SH-139-06	11/3/2006	Oct-06	Red-winged Blackbird	Fatality	Passerine	B18	63	310	7
SH-006-07	1/9/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	91	180	7
SH-007-07	1/9/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	95	182	7
SH-008-07	1/9/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	102	181	7
SH-009-07	1/9/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	102	181	7
SH-012A-07	1/9/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	E3R	14	294	7
SH-019-07	1/23/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	80	248	7
SH-032-07	1/29/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	45	7	7
SH-033-07	1/29/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	55	10	7
SH-034-07	1/29/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	38	255	7
SH-036-07	1/29/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	C5R	56	113	7
SH-059-07	3/1/2007	Feb-07	Red-winged Blackbird	Fatality	Passerine	C1	52	346	7
SH-065-07	3/10/2007	Mar-07	Red-winged Blackbird	Fatality	Passerine	G2	93	237	4
SH-067-07	3/13/2007	Mar-07	Red-winged Blackbird	Fatality	Passerine	A23	2	284	4
SH-073-07	3/20/2007	Mar-07	Red-winged Blackbird	Fatality	Passerine	C1	3	240	4
SH-085-07	4/30/2007	Apr-07	Red-winged Blackbird	Fatality	Passerine	B18	59	106	7
SH-102-07	5/22/2007	May-07	Red-winged Blackbird	Fatality	Passerine	A4	99	181	7
SH-160-07	9/17/2007	Sep-07	Red-winged Blackbird	Fatality	Passerine	C8R	102	271	7
SH-162-07	9/19/2007	Sep-07	Red-winged Blackbird	Fatality	Passerine	A23	101	222	7
SH-213-07	11/9/2007	Nov-07	Red-winged Blackbird	Fatality	Passerine	A19	10	158	7
SH-215-07	11/10/2007	Nov-07	Red-winged Blackbird	Fatality	Passerine	A19	2	89	7
SH-216-07	11/13/2007	Nov-07	Red-winged Blackbird	Fatality	Passerine	C18	82	311	7
SH-244-07	12/27/2007	Dec-07	Red-winged Blackbird	Fatality	Passerine	C7R	97	240	7
SH-024-08	2/18/2008	Feb-08	Red-winged Blackbird	Fatality	Passerine	B8	100	198	7
SH-027-08	2/26/2008	Feb-08	Red-winged Blackbird	Fatality	Passerine	C15R	21	34	1
SH-022-07	1/24/2007	Jan-07	Ring-necked Pheasant	Fatality	Other Bird	G15	99	320	7
SH-233-07	12/4/2007	Nov-07	Ring-necked Pheasant	Fatality	Other Bird	G11	49	73	7
SH-018-08	2/5/2008	Jan-08	Ring-necked Pheasant	Fatality	Other Bird	E8	59	334	7
SH-034-08	3/11/2008	UNK	Ring-necked Pheasant	Fatality	Other Bird	E8	103	313	UNK
SH-013-06	5/22/2006	May-06	Rock Pigeon	Fatality	Other Bird	D4	70	9	7
SH-015-06	6/1/2006	May-06	Rock Pigeon	Fatality	Other Bird	G7	57	310	4
SH-095-06	9/29/2006	Sep-06	Rock Pigeon	Fatality	Other Bird	B7R	60	184	7
SH-160-06	12/15/2006	Dec-06	Rock Pigeon	Fatality	Other Bird	G3	91	12	7

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-125-07	7/19/2007	Jul-07	Rock Pigeon	Fatality	Other Bird	G15	80	118	7
SH-145-07	9/4/2007	Aug-07	Rock Pigeon	Fatality	Other Bird	G7	78	124	7
SH-179-07	10/1/2007	Sep-07	Rock Pigeon	Fatality	Other Bird	G15	80	324	7
SH-199-07	10/23/2007	Oct-07	Ruby-crowned Kinglet	Fatality	Passerine	C2R	98	155	7
SH-079-06	9/15/2006	Sep-06	Savannah Sparrow	Fatality	Passerine	B4	62	144	7
SH-159-06	12/14/2006	Dec-06	Savannah Sparrow	Fatality	Passerine	E3R	1	68	4
SH-056-07	2/28/2007	Feb-07	Savannah Sparrow	Injury	Passerine	A9	90	176	1
SH-180-07	10/1/2007	Sep-07	Savannah Sparrow	Fatality	Passerine	G10	70	72	4
SH-242-07	12/23/2007	Dec-07	Savannah Sparrow	Fatality	Passerine	E6R	34	93	14
SH-112A-06	10/9/2006	Oct-06	Silver-haired Bat	Fatality	Bat	E1R	44	66	4
SH-170-07	9/25/2007	Sep-07	Silver-haired Bat	Fatality	Bat	A10	17	353	1
SH-135-07	8/27/2007	Aug-07	Sora	Fatality	Water Bird	C1	98	27	4
SH-090-07	5/10/2007	May-07	Townsend's Warbler	Fatality	Passerine	B16	89	70	4
SH-121-07	7/9/2007	Jul-07	Townsend's Warbler	Fatality	Passerine	A33	53	242	7
SH-036-06	7/27/2006	Jul-06	Tree Swallow	Fatality	Passerine	C3R	43	20	4
SH-066-06	9/6/2006	Aug-06	Tree Swallow	Fatality	Passerine	C8R	10	275	7
SH-046-07	2/5/2007	Jan-07	Tree Swallow	Fatality	Passerine	E3R	99	48	7
SH-037-07	1/29/2007	Jan-07	Tricolored Blackbird	Fatality	Passerine	C6R	100	284	7
SH-134-07	8/27/2007	Aug-07	Turkey Vulture	Fatality	Other Bird	B7R	25	74	4
SH-154-07	9/10/2007	Sep-07	Turkey Vulture	Fatality	Other Bird	C8R	25	337	4
SH-099-07	5/21/2007	May-07	Unidentified Blackbird spp.	Fatality	Passerine	C25	82	258	7
SH-115-06	10/12/2006	Oct-06	Unidentified Passerine spp.	Fatality	Passerine	B2	71	42	7
SH-122-06	10/19/2006	UNK	Unidentified Passerine spp.	Fatality	Passerine	A12	68	30	UNK
SH-127-06	10/20/2006	Oct-06	Unidentified Passerine spp.	Fatality	Passerine	B7R	92	1	7
SH-143-06	11/16/2006	Nov-06	Unidentified Passerine spp.	Fatality	Passerine	E7	57	334	7
SH-155-06	12/6/2006	Nov-06	Unidentified Passerine spp.	Fatality	Passerine	G2	91	356	7
SH-001-07	1/4/2007	Dec-06	Unidentified Passerine spp.	Fatality	Passerine	E1R	91	14	7
SH-002-07	1/4/2007	Dec-06	Unidentified Passerine spp.	Fatality	Passerine	G3	73	173	7
SH-030-07	1/29/2007	Jan-07	Unidentified Passerine spp.	Fatality	Passerine	C3R	90	291	7
SH-044-07	2/1/2007	Jan-07	Unidentified Passerine spp.	Fatality	Passerine	A12	93	227	7
SH-147-07	9/4/2007	Aug-07	Unidentified Passerine spp.	Fatality	Passerine	G15	85	6	7
SH-171-07	9/25/2007	Sep-07	Unidentified Passerine spp.	Fatality	Passerine	A17	71	46	7
SH-192-07	10/16/2007	Oct-07	Unidentified Passerine spp.	Fatality	Passerine	C19	71	21	7
SH-135-06	10/26/2006	Oct-06	Unidentified Sparrow spp.	Fatality	Passerine	C13	86	112	7
SH-140-06	11/9/2006	Nov-06	Unidentified Sparrow spp.	Fatality	Passerine	C16R	3	174	7
SH-020-07	1/23/2007	Jan-07	Unidentified Sparrow spp.	Fatality	Passerine	C8R	87	174	7
SH-098-06	10/2/2006	Sep-06	Unidentified Swallow spp.	Fatality	Passerine	D4	49	34	7
SH-149-07	9/6/2007	Aug-07	Unknown bird spp.	Fatality	Unknown bird spp.	A9	59	346	7
SH-041-06	8/8/2006	Aug-06	Virginia Rail	Fatality	Water Bird	C23	68	74	4
SH-236-07	12/11/2007	Dec-07	Virginia Rail	Fatality	Water Bird	A14	89	255	4
SH-098-07	5/17/2007	May-07	Warbling Vireo	Fatality	Passerine	B7R	30	11	7
SH-006-06	4/12/2006	Apr-06	Western Meadowlark	Fatality	Passerine	C12R	63	354	4
SH-018-06	6/15/2006	Jun-06	Western Meadowlark	Fatality	Passerine	C25	67	316	4
SH-022-06	6/23/2006	Jun-06	Western Meadowlark	Injury	Passerine	C17	99	246	1
SH-032-06	7/19/2006	Jul-06	Western Meadowlark	Fatality	Passerine	C13	47	68	7
SH-046-06	8/21/2006	Aug-06	Western Meadowlark	Fatality	Passerine	A33	100	2	7
SH-049-06	8/24/2006	UNK	Western Meadowlark	Fatality	Passerine	C5R	80	49	UNK
SH-050-06	8/24/2006	Aug-06	Western Meadowlark	Fatality	Passerine	E1R	61	76	7
SH-068-06	9/6/2006	Aug-06	Western Meadowlark	Fatality	Passerine	C3R	60	58	7
SH-130-06	10/23/2006	Oct-06	Western Meadowlark	Fatality	Passerine	F3	61	0	7
SH-131-06	10/23/2006	UNK	Western Meadowlark	Fatality	Passerine	G3	42	300	UNK
SH-133-06	10/26/2006	Oct-06	Western Meadowlark	Fatality	Passerine	C23	101	95	7
SH-148-06	11/29/2006	Nov-06	Western Meadowlark	Fatality	Passerine	B7R	93	8	7

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-149-06	11/30/2006	Nov-06	Western Meadowlark	Fatality	Passerine	C17	98	24	4
SH-151-06	12/4/2006	Nov-06	Western Meadowlark	Fatality	Passerine	A12	66	106	7
SH-161-06	12/19/2006	Dec-06	Western Meadowlark	Fatality	Passerine	C16R	56	34	7
SH-168-06	12/30/2006	Dec-06	Western Meadowlark	Fatality	Passerine	A33	71	16	7
SH-003-07	1/8/2007	Jan-07	Western Meadowlark	Fatality	Passerine	B14	103	290	7
SH-011-07	1/9/2007	Jan-07	Western Meadowlark	Fatality	Passerine	E3R	91	262	7
SH-013-07	1/15/2007	Jan-07	Western Meadowlark	Fatality	Passerine	C16R	102	80	7
SH-017-07	1/17/2007	Jan-07	Western Meadowlark	Fatality	Passerine	H5	91	324	7
SH-018-07	1/23/2007	Jan-07	Western Meadowlark	Fatality	Passerine	C4	91	30	7
SH-023-07	1/25/2007	Jan-07	Western Meadowlark	Fatality	Passerine	H1	80	102	7
SH-024-07	1/26/2007	Jan-07	Western Meadowlark	Fatality	Passerine	A4	86	272	7
SH-028-07	1/29/2007	Jan-07	Western Meadowlark	Fatality	Passerine	C25	69	310	7
SH-031-07	1/29/2007	Jan-07	Western Meadowlark	Fatality	Passerine	C3R	59	254	7
SH-038-07	1/29/2007	Jan-07	Western Meadowlark	Fatality	Passerine	D1	91	76	7
SH-039-07	1/30/2007	Jan-07	Western Meadowlark	Fatality	Passerine	E3R	82	248	7
SH-041-07	1/31/2007	Jan-07	Western Meadowlark	Fatality	Passerine	G3	80	322	7
SH-042-07	1/31/2007	Jan-07	Western Meadowlark	Fatality	Passerine	H10	80	2	7
SH-047-07	2/5/2007	Jan-07	Western Meadowlark	Fatality	Passerine	F3	71	292	7
SH-052-07	2/15/2007	Feb-07	Western Meadowlark	Fatality	Passerine	B20	103	26	7
SH-054-07	2/19/2007	Feb-07	Western Meadowlark	Fatality	Passerine	A7	13	90	4
SH-055-07	2/19/2007	Feb-07	Western Meadowlark	Fatality	Passerine	A33	93	23	7
SH-057-07	2/28/2007	Feb-07	Western Meadowlark	Fatality	Passerine	A22	80	342	7
SH-058-07	2/28/2007	Feb-07	Western Meadowlark	Fatality	Passerine	A33	62	209	7
SH-060-07	3/2/2007	Feb-07	Western Meadowlark	Fatality	Passerine	C25	100	268	7
SH-066-07	3/12/2007	Mar-07	Western Meadowlark	Fatality	Passerine	H3	32	85	7
SH-068-07	3/14/2007	Mar-07	Western Meadowlark	Fatality	Passerine	C17	79	207	7
SH-069-07	3/14/2007	Mar-07	Western Meadowlark	Fatality	Passerine	C25	17	7	7
SH-074-07	3/21/2007	Mar-07	Western Meadowlark	Fatality	Passerine	C3R	36	79	7
SH-079-07	3/27/2007	Mar-07	Western Meadowlark	Fatality	Passerine	C25	102	114	7
SH-112-07	6/13/2007	Jun-07	Western Meadowlark	Fatality	Passerine	B20	90	216	7
SH-119-07	7/4/2007	Jun-07	Western Meadowlark	Fatality	Passerine	C3R	50	70	7
SH-122-07	7/10/2007	Jul-07	Western Meadowlark	Fatality	Passerine	C1	54	344	7
SH-124-07	7/17/2007	Jul-07	Western Meadowlark	Fatality	Passerine	C8R	91	339	7
SH-126B-07	8/6/2007	Jul-07	Western Meadowlark	Fatality	Passerine	C1	80	29	7
SH-136-07	8/27/2007	Aug-07	Western Meadowlark	Fatality	Passerine	C1	61	284	7
SH-196-07	10/22/2007	Oct-07	Western Meadowlark	Fatality	Passerine	B3	33	12	4
SH-198-07	10/23/2007	Oct-07	Western Meadowlark	Fatality	Passerine	C21	70	294	7
SH-204-07	10/24/2007	Oct-07	Western Meadowlark	Fatality	Passerine	H2	90	108	7
SH-205-07	10/24/2007	Oct-07	Western Meadowlark	Fatality	Passerine	H4	56	84	7
SH-210-07	11/1/2007	Oct-07	Western Meadowlark	Fatality	Passerine	A15	59	214	7
SH-214-07	11/9/2007	Nov-07	Western Meadowlark	Fatality	Passerine	A19	67	354	7
SH-226-07	11/27/2007	Nov-07	Western Meadowlark	Fatality	Passerine	F4	88	46	7
SH-229-07	11/29/2007	Nov-07	Western Meadowlark	Fatality	Passerine	B12R	91	99	7
SH-239-07	12/19/2007	Dec-07	Western Meadowlark	Fatality	Passerine	A13	97	13	7
SH-002-08	1/2/2008	Dec-07	Western Meadowlark	Fatality	Passerine	B9	69	42	7
SH-006-08	1/11/2008	Jan-08	Western Meadowlark	Fatality	Passerine	C18	87	267	7
SH-007-08	1/13/2008	Jan-08	Western Meadowlark	Fatality	Passerine	E8	71		7
SH-008-08	1/14/2008	Jan-08	Western Meadowlark	Fatality	Passerine	H6	63	304	7
SH-010-08	1/16/2008	Jan-08	Western Meadowlark	Fatality	Passerine	B12R	85	56	4
SH-011-08	1/17/2008	Jan-08	Western Meadowlark	Fatality	Passerine	C22	77	344	7
SH-015-08	2/4/2008	Jan-08	Western Meadowlark	Fatality	Passerine	A15	71	294	7
SH-019-08	2/11/2008	Feb-08	Western Meadowlark	Fatality	Passerine	A26	40	292	7
SH-023-08	2/13/2008	Feb-08	Western Meadowlark	Fatality	Passerine	H9	61	62	4
SH-029-08	2/28/2008	Feb-08	Western Meadowlark	Fatality	Passerine	A11	80	244	7

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-021-06	6/21/2006	Jun-06	Western Red Bat	Fatality	Bat	A23	23	29	1
SH-130-07	8/16/2007	Aug-07	Western Red Bat	Fatality	Bat	A23	30	254	7
SH-103-06	10/6/2006	Oct-06	White-crowned Sparrow	Fatality	Passerine	C1	87	16	4
SH-105-06	10/7/2006	Oct-06	White-crowned Sparrow	Fatality	Passerine	C11	5	181	4
SH-012-06	5/21/2006	May-06	Wilson's Warbler	Fatality	Passerine	B18	93	40	4
SH-059-06	8/30/2006	Aug-06	Wilson's Warbler	Fatality	Passerine	C12R	102	197	1
SH-093-07	5/15/2007	May-07	Wilson's Warbler	Fatality	Passerine	G3	78	47	1
SH-094-07	5/16/2007	May-07	Wilson's Warbler	Fatality	Passerine	H1	96	55	4
SH-156-07	9/12/2007	Sep-07	Wilson's Warbler	Fatality	Passerine	A23	90	38	4
SH-169-07	9/24/2007	Sep-07	Wilson's Warbler	Fatality	Passerine	F3	53	45	7
SH-082-06	9/21/2006	Sep-06	Yellow Warbler	Fatality	Passerine	A9	100	64	7
SH-095-07	5/16/2007	May-07	Yellow Warbler	Fatality	Passerine	H10	72	43	4
SH-101-07	5/22/2007	May-07	Yellow Warbler	Fatality	Passerine	H1	59	58	4
SH-110-07	6/12/2007	Jun-07	Yellow Warbler	Fatality	Passerine	A6	61	352	7
SH-070-06	9/11/2006	Sep-06	Yellow-breasted Chat	Fatality	Passerine	B7R	83	24	7

* Degrees Geographic North represents degrees from tower to carcass.
** Location data for injured birds represents where they were first located, however all injured birds were mobile, thus in analyses, they were considered “ON SITE” and not assigned to a specific turbine.

APPENDIX E. LIST OF 35 INCIDENTS FOUND INCIDENTALLY (NOT DURING STANDARDIZED SURVEYS) AT WIND TURBINE TOWERS AT SHILOH I, APRIL 2006-MARCH 2008.

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death
SH-004-08	1/3/2008	Jan-08	Barn Owl	Fatality	Raptor	D2	136	29	4
SH-045-06	8/21/2006	Aug-06	Hoary Bat	Fatality	Bat	A13	74	344	4
SH-177-07	9/26/2007	Sep-07	Horned Lark	Fatality	Passerine	C14	28	72	4
SH-220-07	11/14/2007	Nov-07	Killdeer	Fatality	Water Bird	A14	113	124	14
SH-141-06	11/10/2006	Nov-06	Mexican Free-tailed Bat	Fatality	Bat	C19	20	66	4
SH-084-07	4/17/2007	Apr-07	Orange-crowned Warbler	Fatality	Passerine	C10R	42	145	4
SH-193-07	10/16/2007	Oct-07	Prairie Falcon	Fatality	Raptor	C12R	48	106	4
SH-038-06	8/2/2006	UNK	Red-tailed Hawk	Fatality	Raptor	C21	86	68	>30
SH-162-06	12/19/2006	Dec-06	Red-tailed Hawk	Fatality	Raptor	C19	31	72	1
SH-062-07	3/9/2007	Feb-07	Red-tailed Hawk	Fatality	Raptor	C18	68	348	14
SH-063-07	3/9/2007	UNK	Red-tailed Hawk	Fatality	Raptor	C18	50	302	>30
SH-221-07	11/19/2007	Nov-07	Red-tailed Hawk	Fatality	Raptor	C8R	65	156	7
SH-007-06	4/20/2006	Apr-06	Red-winged Blackbird	Fatality	Passerine	D4	112	238	1
SH-031-08	3/8/2008	Mar-08	Red-winged Blackbird	Fatality	Passerine	A11	1	132	1
SH-026-07	1/26/2007	UNK	Rock Pigeon	Fatality	Other Bird	B16	224	32	UNK
SH-048-06	8/23/2006	Aug-06	Tree Swallow	Fatality	Passerine	C24	45	358	1
SH-021-08	2/11/2008	Feb-08	Turkey Vulture	Fatality	Other Bird	A33	27	214	7
SH-138-07	8/28/2007	Aug-07	Warbling Vireo	Fatality	Passerine	G8	64	291	4
SH-009-06	5/2/2006	Apr-06	Western Wood Pewee	Fatality	Passerine	C7R	35	99	4
SH-091-07	5/10/2007	May-07	Wilson's Warbler	Fatality	Passerine	B13	86	7	1
SH-141B-07	9/3/2007	Aug-07	Winter Wren	Fatality	Passerine	B7R	68	30	7
SH-010-07	1/9/2007	Jan-07	Barn Owl	Fatality	Raptor	D4	200	276	4
SH-016-07	1/16/2007	Jan-07	Barn Owl	Fatality	Raptor	F3	122	334	4
SH-163-06	12/19/2006	Dec-06	Western Meadowlark	Fatality	Passerine	C25	120	106	7
SH-166-07	9/20/2007	Sep-07	Unidentified Duck spp.	Fatality	Waterfowl	C23	116	0	7
SH-155-07	9/11/2007	Sep-07	Rock Pigeon	Fatality	Other Bird	F3	151	330	7
SH-231-07	12/3/2007	Nov-07	Ring-necked Pheasant	Fatality	Other Bird	E8	119	260	7
SH-223-07	11/21/2007	Nov-07	Red-winged Blackbird	Fatality	Passerine	B11	106	312	14
SH-040-07	1/30/2007	Jan-07	Red-winged Blackbird	Fatality	Passerine	E7	106	294	7
SH-164-06	12/20/2006	Dec-06	Red-tailed Hawk	Fatality	Raptor	G7	107	262	1
SH-144-2-06	11/20/2006	UNK	Red-tailed Hawk	Fatality	Raptor	B16	119	62	>30
SH-064-07	3/10/2007	Mar-07	Golden Eagle	Injury	Raptor	F3	200	254	1
SH-129-07	8/14/2007	Jul-07	Golden Eagle	Fatality	Raptor	D1	155	243	30
SH-028-08	2/28/2008	Feb-08	Barn Owl	Fatality	Raptor	A11	123	284	7
SH-027-07	1/27/2007	Jan-07	Barn Owl	Fatality	Raptor	B14	121	51	7

* Degrees Geographic North represents degrees from tower to carcass.

APPENDIX F. LIST OF 7 "OTHER" CAUSE-RELATED* INCIDENTS FOUND DURING STANDARDIZED SURVEYS AND INCIDENTALLY AT WIND TURBINE TOWERS AT SHILOH I, APRIL 2006- MARCH 2008.

ID#	Report Date	Estimated Month Death	Species Name	Fatality /Injury	Species Group	Tower	Dist (m)	Deg (GN)*	Days Since Death	Survey Type
SH-234-07	12/10/2007	DEC 07	American Kestrel	Fatality	Raptor	G7	226	206	7	Incidental
SH-048-07	2/5/2007	JAN 07	Barn Owl	Fatality	Raptor	G2	180	250	7	Incidental
SH-049-07	2/6/2007	JAN 07	Barn Owl	Fatality	Raptor	G16	196	52	7	Incidental
SH-004-07	1/8/2007	JAN 07	Burrowing Owl	Fatality	Raptor	C16	90	32	7	Standardized
SH-025-07	1/26/2007	JAN 07	Burrowing Owl	Fatality	Raptor	A4	86	288	7	Standardized
SH-107-06	10/9/2006	UNK	Unknown Passerine	Fatality	Passerine	C3	59	254	UNK	Standardized
SH-129-06	10/20/2006	SEP 06	Unknown Passerine	Fatality	Passerine	C16	110	110	30	Incidental

* "Other" Cause-related incidents were deemed not caused by wind turbines or meteorological towers, but rather by a predator, barbed wire fence, or harvesting equipment.
** Degrees Geographic North represents degrees from met tower to carcass.

APPENDIX G. INCIDENTAL PREY OBSERVATIONS AT SHILOH I, APRIL 2006 THROUGH MARCH 2008*

Year	Date	Tower	Prey Observation
1	7/12/2006	C1	1 Black-tailed Jackrabbit at base of tower
	7/12/2006	C23	1 Black-tailed Jackrabbit at base of tower
	2/1/2007	Met A	1 Black-tailed Jackrabbit
	3/2/2007	D4	3 California Ground Squirrels
	3/15/2007	C6R	3 California Ground Squirrels in gully West
	4/3/2007	B6	1 California Ground Squirrel
2	4/9/2007	B6	1 California Ground Squirrel to SE
	6/21/2007	C17	1 Black-tailed Jackrabbit 110m SW
	6/21/2007	C3R	1 Black-tailed Jackrabbit 120m SW
	7/18/2007	E1	1 Racer 90m SE
	7/19/2007	G15	1 Pacific Gopher Snake
	7/19/2007	H5	1 Black-tailed Jackrabbit 15m SE
	7/23/2007	A7	1 Black-tailed Jackrabbit NW along fence
	7/24/2007	C13	1 Black-tailed Jackrabbit on road
	7/24/2007	C17	1 Black-tailed Jackrabbit 150m SW
	7/30/2007	C1	1 Black-tailed Jackrabbit 10m N
	7/30/2007	C23	1 Black-tailed Jackrabbit 100m N
	7/30/2007	A9	1 Black-tailed Jackrabbit on road near Tower A13
	7/31/2007	C12R	1 Pacific Gopher Snake 95m E
	7/31/2007	C16R	1 Black-tailed Jackrabbit 105m SW
	8/1/2007	G15	1 Black-tailed Jackrabbit 80m NW
	8/6/2007	B6	1 Black-tailed Jackrabbit 32m SW
	8/6/2007	A12	1 Black-tailed Jackrabbit 80m SW
	8/13/2007	B10	2 Black-tailed Jackrabbit on road
	8/14/2007	C8R	1 Black-tailed Jackrabbit 94m S
	8/15/2007	G15	1 Black-tailed Jackrabbit 95m N
	8/16/2007	A7	2 Black-tailed Jackrabbits, 86m SW & 65m SE
	8/20/2007	C23	1 Black-tailed Jackrabbit 48m NE
	8/20/2007	C17	1 Black-tailed Jackrabbit 90m SW
	8/27/2007	C13	1 Black-tailed Jackrabbit 100m E
	8/27/2007	C17	1 Black-tailed Jackrabbit 120m W
	8/29/2007	H1	1 Black-tailed Jackrabbit100m NW
	9/3/2007	C16R	1 Black-tailed Jackrabbit 90m N
	9/10/2007	C8R	1 California Ground Squirrel 220m N, on fenceline
	9/10/2007	C16R	1 Black-tailed Jackrabbit on fenceline
	9/11/2007	G15	1 Black-tailed Jackrabbit 105m N
	9/13/2007	C1	1 Black-tailed Jackrabbit 80m N
	9/19/2007	A9	1 Black-tailed Jackrabbit 100m N
	10/1/2007	G15	1 Black-tailed Jackrabbit 10m
	10/3/2007	C17	1 California Ground Squirrel 130m E
	10/3/2007	C1	1 Black-tailed Jackrabbit 115m NE
	10/22/2007	B5	1 Black-tailed Jackrabbit 47m S
	10/22/2007	B9	1 Black-tailed Jackrabbit at base of tower
	10/24/2007	G11	2 Black-tailed Jackrabbits, 19m W & 75m N
	10/30/2007	C2R	1 Black-tailed Jackrabbit 15m SE
	11/9/2007	A19	1 Black-tailed Jackrabbit 71m
	11/13/2007	C9R	1 Black-tailed Jackrabbit at base of C20

Year	Date	Tower	Prey Observation
	11/21/2007	A11	1 Black-tailed Jackrabbit 50m NE
	2/4/2008	A15	1 Black-tailed Jackrabbit 80m E

* Prey observations were recorded more systematically in Year 2 than in Year 1.

APPENDIX H. PERMIT CONDITIONS REGARDING MITIGATION OF PROJECT IMPACTS.

SOLANO COUNTY PLANNING COMMISSION

CONDITIONS OF APPROVAL
SHILOH I WIND PLANT PROJECT
USE PERMIT U-03-06

1. The project shall be established and operated in substantial conformance with the plans and descriptions submitted with Use Permit Application Number U-03-06, as subsequently revised, and as described and analyzed in the Final Environmental Impact Report certified by Solano County, subject to the terms and conditions imposed on the use permit.

2. This permit shall be valid for a period of thirty (30) years, ending April 12, 2035, subject to the modification and revocation provisions of condition numbers 3 and 4. Prior to expiration of this permit, the permittee may apply for an extension to the term of this permit. An application for extension must be submitted, in writing, at least six months prior to expiration. An extension of the term of this permit shall be a discretionary action, and the County may impose additional conditions or restrictions upon the project when granting a permit extension.

3. Any substantial change in the permitted operation, facilities, or structures, as determined by the Director of Resource Management, shall require a revision of the use permit. A revision of the permit shall be a discretionary action, and the County may impose additional conditions or restrictions upon the project when granting a permit revision.

4. Non-compliance with any condition(s) of the use permit shall be cause for revocation of the use permit, in accordance with County procedures, and for payment of bonds to the County.

5. Site inspections of the construction and operation of the project may be conducted by the County Department of Resource Management at any time, at the discretion of said Department, in order to assess compliance with project plans and all conditions of the use permit.

6. The County of Solano, its officers and employees shall not be responsible for injuries to property or person arising from the issuance or exercise of this permit or by the negligence or wrongful act of the permittee. The permittee shall defend, indemnify, and hold harmless the County of Solano, its officers, employees, and agents, from any claim, liability, loss, or legal action arising from any such injuries, and shall reimburse the County for all legal costs and attorney fees related to any claim or litigation based on such injuries.

7. The permittee shall defend, indemnify, and hold harmless the County of Solano, its officers, employees, and agents, from any claims, actions, or proceedings seeking to attack, set aside, void, or annul, in whole or in part, the County's approval of the Use Permit. The County agrees that it shall cooperate in the defense of any such challenge at Permittee's cost.

8. If the permittee challenges the approval by the Planning Commission and/or Board of Supervisors of any condition of approval in an action filed in a court of law, which action is brought within the time period provided for by law, the approval of this project by the Planning Commission and/or Board of Supervisors shall be suspended pending dismissal or final resolution of such action.

9. If any condition of approval of this project is invalidated by a court of law, the entire project shall be reviewed by the Planning Commission and/or Board of Supervisors and substitute conditions may be imposed at the Planning Commission and/or Board of Supervisors.

10. The site shall be maintained in a neat and orderly manner and kept free of accumulated junk and debris.

11. The use shall be operated in such a manner as to not constitute a nuisance or be detrimental to health, safety, comfort, or general welfare of the people of the County, or be detrimental to adjacent properties or improvements or to the general welfare of the County.

12. The Permittee shall be responsible for taking reasonable measures as may be required by the County to prevent light, glare, traffic congestion, visual distraction or other impacts which constitute a nuisance to the adjacent properties, persons or property in the surrounding area.

13. The permit shall be considered exercised, pursuant to Section 28-53 (j)(2) of the Solano County Code, upon issuance of Solano County building permits.

14. Prior to issuance of a building permit, all requirements of the Solano County Environmental Health Services Division shall be met including:

    a) A Hazardous Materials Business Plan shall be submitted if required by Solano County Environmental Management, Hazardous Materials Section.

    b) Based on the number of people served and on the number of service connections a permit may be required by the State of California Division of Drinking Water for the water system.

15. Prior to issuance of a building permit, all requirements of the Solano County Public Works - Engineering Division shall be met including:

    a) The permittee shall enter into an agreement as required by the Public Works - Engineering Division and provide security for the maintenance and repair of the public roads used for access and hauling of equipment and materials for the construction of the project.

    b) The permittee shall apply for, obtain and comply with the requirements of required encroachment permits and transportation permits from the Transportation Department. The encroachment permits shall be for any construction within the public right of way. The transportation permits will be for hauling any loads that exceed legal limits.

16. All requirements of the Solano County Department of Resource Management's Building Division shall be met including:

    a) The permittee shall obtain building permits from the Solano County Building and Safety Division prior to construction, erection, enlargement, altering, repairing, moving, improving, removing, converting, demolishing any building or structure, fence or retaining wall regulated by the Solano County Building Laws. Submit four (4) sets of plans to the Building and Safety Division for plan review and obtain permits prior to beginning any improvements.

b) Except as exempted in Chapter 31 of the Solano County Code, no person shall commence or perform any grading, filling, excavation, or clearing of vegetation for any purpose without having first obtained a grading permit from the Department of Environmental Management.

17. Prior to issuance of building permits, the permittee shall submit a bond or other guarantee, in an amount determined by the Director of Resource Management, to cover the cost to dismantle and remove from the site any wind turbine generators which are abandoned (cease to operate for a period of one year) or are required to be removed. Said bond shall be updated periodically by an amount determined by the Director of Resource Management to reflect current economic conditions and construction cost index. Said bonds shall remain in force and shall not be released or cancelled unless and until the same is authorized in writing by the Director of Resource Management upon closure and clean-up of the project.

18. FAA Notification - Permittee shall provide evidence of notification to the FAA, pursuant to FAA CFR Part 77, Paragraph 77.13(a)(1) and the results of the analysis, for the meteorological towers and any new or altered turbine location not previously cleared (Determination of No Hazard to Air Navigation) by the FAA.

19. Where a turbine setback of less than three times (3x) the total turbine height is provided to the nearest property line, the Permittee shall furnish to the Department of Resource Management evidence that an agreement has been reached with the owner of the neighboring property where the setback reduction would occur, prior to installation of the affecting turbine.

20. Following commencement of operation of the project and on each annual anniversary of said commencement, the permittee shall submit to the Director of Resource Management a brief status report containing at least the following information: Description and changes to rated capacity of all equipment installed, relevant meteorological data collected, and actual electric power generated to date broken down into appropriate time categories.

21. The permittee shall notify the County Department of Resource Management of any tower collapse, blade throw, fire, or injury to worker, within 24 hours of any such occurrence.

22. An environmental consultant shall be contracted by the County, at the Permittee's expense, to oversee compliance of the Project’s Mitigation Monitoring and Reporting Program.

23. Mitigation Measure AES-6: Lighting. Prior to commencing operation, the Permittee shall light turbines for aviation warning in accordance with FAA requirements only. The turbines shall not be lighted for any other reasons.

24. Mitigation Measure AES-7: Decommissioning Turbines. At such time as the Project is decommissioned, the Permittee shall comply with the following:

a) Remove all facilities to a depth of 3 feet below grade and dispose unsalvageable material at authorized sites;

b) Restore the soft surface to original condition as is reasonably possible;

c) Implement reclamation that is based on site-specific requirements and techniques commonly employed at the time the area is to be reclaimed, and which shall include regarding and revegetation of all disturbed areas; and,

d) Reclaim or leave in place all decommissioned roads, based on landowner preference.

25. Mitigation Measure AIR-1: Emissions Controls. During Project construction, the Permittee shall reduce emissions from construction equipment exhaust by implementing the following mitigation measures to the extent feasible and practicable:

a) Minimizing idling time (e.g., 5-minute maximum);

b) Maintaining properly tuned equipment; and

c) Limiting the hours of operation of heavy-duty equipment and/or the amount of equipment in use (BAAQMD 1999).

26. Mitigation Measure AIR-2: Dust Control Plan. Permittee shall comply with the following:

a) During Project construction, emissions of airborne dust shall be controlled using industry-accepted dust control measures, as shown in tables 7.3-3 through 7.3-5 of the DEIR.

b) Prior to commencement of construction activities, the Permittee shall prepare and submit to the County for approval, a Construction Fugitive Dust Control Plan to describe how to minimize fugitive dust generated by construction activities in accordance with tables 7.3-3 through 7.3-5 of the DEIR and Bay Area Air Quality Management District and Yolo-Solano Air Quality Management District requirements. The Plan shall include the following:

i) A description of each active operation that may result in the generation of fugitive dust;

ii) Identification of all sources of fugitive dust (e.g., earthmoving, storage piles, and vehicular traffic); and

iii) A description of the control measures to be applied to each of the sources of dust emissions identified above. The description shall be sufficiently detailed to demonstrate that the applicable best available control measure(s) as specified in the table 7.3-3 of the DEIR, labeled Fugitive Dust Control Measures for Bay Area Quality Management District, will be utilized and/or installed during all periods of active operations.

c) In the event that there are special technical circumstances (e.g., non-economic), including safety, which prevent the use of at least one of the required mitigation measures for any of the sources identified, a justification statement shall be provided to explain the reason(s) why the required control measures cannot be implemented.

d) Disturbed areas that would not be covered with surface structures, such as buildings and pavement, following construction activities shall be stabilized. This may include installation of suitable vegetation to minimize future on-site soil loss and off-site sedimentation.

27. Mitigation Measure BIO-1: Restoration of Project Area. The Permittee shall implement the following measures, to the extent feasible:

a) Confine construction to necessary work areas. Prior to commencement of construction activities, fence or flag both the construction area and exclusion areas, such as wetlands and

sensitive plants, to minimize the construction footprint and prevent intrusions into the surrounding areas.

b) During site preparation and development, minimize disturbance to habitats and vegetation. Clearing of vegetation, grading, and other soil disturbance shall be restricted to those areas required for construction.

c) During construction activities, clearing and grading of large areas shall be avoided. For example, staging areas shall be located to the extent feasible in areas with little or no vegetation, such as in or adjacent to the gravel parking lot at the existing O&M building, rather than in agricultural fields or grasslands. The staging area shall also be setback at least 250 feet from vernal pools, 100 feet from wetlands and streams, and 500 feet from ponds.

d) During construction activities, maintain a 500-foot setback from groves of mature trees, which may provide habitat for raptors protected by the CDFG. After construction, and prior to Project operation, the Permittee shall reseed or restore the construction areas to pre-construction conditions. Areas cleared of vegetation shall be seeded with grasses or other vegetation as follows:

i) Revegetation shall be implemented in accordance with Solano County guidelines and the input of local farmers/farm residents.

ii) Disturbed or graded areas shall be planted with fast-growing and deep-rooted grasses or ground cover, preferably native to the area.

iii) If required, previously vegetated areas and inactive portions of the construction site shall be seeded and watered until vegetation is grown.

iv) Any trees removed shall be replaced with the same or compatible species.

v) Revegetated areas shall be monitored annually for complete and successful ground cover, and revegetated (if required) to conform to the requirements of the County Grading Ordinance. Revegetation shall be continued, if determined by Solano County, for the life of the Project.

28. Mitigation Measure BIO-2a: Avoid Wetlands and Streams. The Permittee shall locate the turbines, aboveground substation, and switchyard outside and away from wetlands, drainages, streams, and other sensitive natural features.

a) Project components shall be constructed using the following recommended setbacks:

i) 100-foot setback from wetlands and streams based on guidance from the Corps and CDFG;

ii) 567-foot setback from vernal pools that provide habitat for special-status plants and wildlife protected by the USFWS; and

iii) 567-foot setback from ponds that may provide habitat for water birds protected by the CDFG.

b) A qualified wetland biologist shall identify and flag the boundaries of the wetlands prior to construction as "exclusion areas," so that construction crews may follow the recommended setbacks.

c) Support facilities such as underground cables shall be sited away from the sensitive natural resources to the extent feasible. In most instances, new overhead lines shall only be used to specifically avoid impacts to sensitive natural resources.

d) No foundations, utility poles, or other permanent facilities shall be located within waters of the U.S.

e) Ground disturbance during construction shall be sited at least 100 feet from the boundaries of wetlands to the extent feasible to minimize secondary effects to the identified wetlands.

f) All fueling and storage areas shall be located at least 100 feet from intermittent streams and wetlands to prevent spills of fuel or other hazardous materials from affecting wetlands and streams.

g) During construction, a "Qualified Wetland Biologist" (a person with at least an undergraduate degree in biology, ecology, or a related field, with a minimum of three years' professional field experience within the region or working under the direct supervision of a professional wetland biologist with at least six years of field experience in the region) shall hold tailgate environmental training sessions with construction personnel to inform them of the adjacent Suisun Marsh and wetlands and intermittent streams in the Project Area. The training sessions shall include information about the location of biological sensitive areas, resource avoidance, permit conditions, and possible fines for violations of State or Federal environmental laws.

29. Mitigation Measure BIO-2b: Horizontal Directional Drilling.

a) To minimize the potential effects from the use of horizontal directional drilling, the permittee shall comply with the following mitigation measures:

i) HDD drilling shall occur only during the season when the seasonal streams and wetlands in the project area do not have surface water present (i.e., typically June through October).

ii) On-site briefings shall be conducted for HDD workers so that they understand the location of sensitive resources and to ensure that all field personnel understand their responsibility for timely reporting of frac-outs.

iii) Barriers (e.g., straw bales, sedimentation fences, etc.) shall be erected between the bore site and nearby sensitive resources prior to drilling, as appropriate, to prevent any material from reaching sensitive resource areas.

iv) The necessary response equipment and/or supplied (e.g., vacuum truck, straw bales, sediment fencing, etc.) shall be kept on-site by the contractor during HDD operations so that it is readily available in the event of a frac-out.

b) To prevent or minimize potential effects in the event of a frac-out is detected, Permittee shall implement the following measures to reduce or minimize effects on sensitive resources:

i) All work shall stop until the frac-out has been contained and cleaned up.

ii) The frac-out area shall be isolated with straw bales, sand bags, or silt fencing to surround and contain the drilling mud.

30. Mitigation Measure BIO-4: Exclusion Flagging and Training.

a) Prior to commencing construction, a Qualified Botanist (a person with at least an undergraduate degree in botany, plant ecology, or a related field, with a minimum of three years' professional field experience within the region or working under the direct supervision of a professional botanist with at least six years of field experience in the region) shall identify and flag the boundaries of the Carquinez goldenbush and Gairdner's yampah populations, to prevent any indirect or inadvertent impacts to these special-status plants.

b) All construction activities shall be located outside the flagged areas, including clearing and grading, construction traffic, or any activities associated with the proposed power collection system routes.

c) If the final power collection system route crosses the location of these sensitive plants, horizontal boring techniques shall be used, after prior approval from the Solano County Department of Resource Management, in consultation with USFWS, and CDFG.

d) All fueling and storage areas shall be located at least 100 feet from the flagged areas, to prevent spills of fuel or other hazardous materials from affecting the special-status plants.

e) During construction, a Qualified Botanist shall hold tailgate environmental training sessions with construction personnel to inform them of the special-status plants in the Project Area. These training sessions shall include information about the locations of these plants, resource avoidance, permit conditions, and possible fines for violations of State or Federal environmental laws.

31. Mitigation Measure BIO-5: Habitat Avoidance - California tiger salamander. Permitte shall comply with the following mitigation measures:

a) Ground-disturbance activities with 0.5 mile of potential wet California tiger salamander habitat shall occur during the dry season (i.e., June 1st. through October 15th) only.

b) A worker-training program covering the California tiger salamander will be conducted before groundbreaking. The program shall provide workers with information on their responsibilities with regard to the species, and overview of the appearance of the species, and a description of the measures being taken to reduce the potential effects to the species during project construction.

c) A qualified biologist shall conduct a preconstruction survey to assess the potential for California tiger salamander appearance relative to the quality and status of wetland and upland habitats in the vicinity of project features and shall identify any key areas that would require avoidance. Qualified surveyors/monitors shall be onsite during construction to provide clearance

for all work activities in potential California tiger salamander habitat, including potential movement corridors and hibernation sites.

d) If a California tiger salamander is encountered during construction work, activities shall cease until the salamander is removed and relocated by a U.S. Fish and Wildlife Service-approved biologist. In the event of injury or mortality to a California tiger salamander, the U.S. Fish and Wildlife Service shall be notified immediately.

e) Signs that can be easily read from at least 20 feet away shall be placed to indicate potential California tiger salamander habitat that must be avoided by construction personnel. Prior to construction, a biologist shall determine the location and number of signs necessary.

f) To prevent inadvertent entrapment of California tiger salamanders during the Project, deep trenches that are within 2,000 feet of the vernal pools or stock ponds shall be completely covered using plywood or other appropriate materials at the close of each working day. Before the trench is filled, it shall be thoroughly inspected for trapped animals. If at any time a trapped California tiger salamander is discovered, the U.S. Fish and Wildlife Service-approved biologist shall carefully remove the animal by hand and place it at the entrance of a suitable rodent burrow within walking distance from the excavation site, but outside the area where the animal could be injured or killed by project activities. The rescued California tiger salamander shall be monitored until it enters the burrow. The U.S. Fish and Wildlife Service, California Department of Fish and Game, and Solano County Department of Resource Management shall be notified by telephone and letter within one (1) working day if a California tiger salamander is found in the project area.

g) To eliminate the attraction to predators of the California tiger salamander, all food-related trash items such as wrappers, cans, bottles, and food scraps that are within 2,000 feet of the vernal pools or stock ponds shall be disposed of in closed containers and removed from the project site at the end of each working day.

h) Best management practices (required as part of the SWPPP) shall be implemented to prevent sediment from entering suitable California tiger salamander habitat at the project site, but not limited to, silt fencing, sterile hay bales, and temporary sediment disposal.

32. Mitigation Measure BIO-5: Habitat Avoidance - Western Burrowing Owl. The following guidelines adapted from the CDFG Staff Report on Burrowing Owl Mitigation (CDFG 1995) shall be implemented by the Permittee:

a) Preconstruction burrowing owl surveys shall be conducted in all areas that may provide suitable nesting habitat according to CDFG (1995) guidelines. No more than 30 days before construction, a survey for burrows and burrowing owls shall be conducted by a qualified wildlife biologist within 500 feet of the construction corridor in areas suitable for burrowing owls. The survey shall conform to the protocol described by the California Burrowing Owl Consortium (1993), which includes up to four surveys on different dates if there are suitable burrows present.

b) The Permittee shall avoid disturbing active burrowing owl nests and implement standard CDFG mitigation guidelines during the non-breeding season.

i) If occupied owl burrows are found during preconstruction surveys, a determination shall be made by a qualified biologist in consultation with CDFG as to whether access road construction or other proposed construction activities would impact occupied burrows or disrupt reproductive behavior.

ii) If it is determined that construction activities would not adversely affect occupied burrows or disrupt breeding behavior, construction may proceed without any restriction or mitigation measures for burrowing owls.

iii) If it is determined that construction could adversely affect occupied burrows during the August 31 through February 1 non-breeding season, the subject owls may be passively relocated from the occupied burrow(s) using one-way doors. There shall be at least two unoccupied burrows suitable for burrowing within 300 feet of the occupied burrow before one-way doors are installed. The unoccupied burrows shall be located at least 160 feet from construction activities and can be natural burrows or artificial burrows constructed according to current design specifications. Artificial burrows shall be in place at least one-week before one-way doors are installed on occupied burrows. One-way doors must be in place for a minimum of 48 hours before burrows are excavated.

33. Mitigation Measure BIO-6: Avoidance of Nests.

a) A no-disturbance buffer zone shall be established around active nests during the breeding season. If construction activities (including removal of trees or shrubs) are scheduled to occur during the breeding season (February 1 through August 31), a qualified wildlife biologist shall conduct preconstruction surveys of all potential nesting habitat within 500 feet of construction activities. Surveys shall be conducted prior to construction activities, but no more than 30 days prior to construction activities.

b) If active nests are found, a 500-foot no disturbance buffer shall be created around active raptor nests during the breeding season or until it is determined that young have fledged. A 250-foot buffer zone shall be created around nests of other special-status birds.

c) If the nest(s) are found in an area where ground disturbance is to occur, the Permittee shall avoid the area, if feasible, by delaying ground disturbance in the area until the birds have fledged, or shall reroute the project component to avoid the area.

d) If surveys indicate that nests are inactive or potential habitat is unoccupied during the construction period, no further mitigation shall be required. Trees and shrubs that have been determined to be unoccupied by special-status birds or that are located more than 500 feet from active nests may be removed.

e) If construction is scheduled to occur during the non-nesting season, then no surveys shall be required.

34. Mitigation Measure BIO-7: Setback from the Suisun Marsh Management Area. The Permittee shall maintain a 1,000-foot setback from the boundary with the Suisun Marsh Secondary Management Area, to avoid any potential impacts to the migration or flight patterns of waterfowl or other birds using the Suisun Marsh.

35. Mitigation Measure BIO-8: Underground Lines and Design Specifications. Prior to Project operation, the Permittee shall implement the following design elements for the limited 50-foot high overhead collection lines:

a) All jumper wires shall be insulated (5-kV minimum rating and preferably 10-kV to 15-kV).

b) All exposed terminals (e.g., pot heads, lightning arresters, and transformer bushings) shall be covered by wildlife boots or other insulating materials.

c) Non-conductive materials (e.g., fiberglass, wood) shall be used instead of the straight, aluminum-type combination arms on riser poles.

d) Energized wires shall be placed a safe distance apart: 60 inches for crossarm configuration, 55 inches for armless configuration.

e) No cut-outs or riser poles shall be used.

f) Jumper leads shall be oriented in a vertical configuration to discourage bird perching.

g) Bonding of pole top devices mounted on non-conductive arms shall be done with insulated wire.

h) A minimum conductor wire size of 4/0 shall be used to increase the visibility of the wire.

i) Excepting angle poles of overhead lines, none of the installed facilities shall require the use of guy wires. All turbines and meteorological and microwave towers shall be free standing.

j) Bird diverters shall be installed on the overhead lines.

36. Mitigation Measure BIO-9: Turbine Locations. Turbine locations shall comply with the following standards:

a) Turbines shall be sited at least 500 feet from groves of mature trees, which could provide nesting habitat to raptors and other birds.

b) Facilities shall be set back at least 100 feet from wetlands and streams and 567 feet from vernal pools and ponds.

c) Turbines shall be setback at least 1,000- from Shiloh and Collinsville roads.

d) Facilities shall be set back at least 1,000 feet from the boundary of the Suisun Marsh Secondary Management Area.

e) All transmission lines and facilities shall be located to avoid crossing ridge tops to the extent feasible.

37. Mitigation Measure BIO-9: Bird Mortality Monitoring. The Permittee shall conduct annual monitoring of bird mortality in the Project Area, as follows:

a) Qualified ornithologists shall conduct annual bird mortality monitoring throughout the Project Area.

b) The species, number, location and distance from turbine, availability of raptor prey species, and cause of bird and bat mortalities shall be noted. All results shall be provided to the Wildlife Response and Reporting System ("WRRS") database.

c) The monitoring shall follow standardized guidelines outlined by the National Wind Coordinating Committee (Anderson et al. 1999) for a minimum of three years following the first delivery of power.

d) The Permittee shall contribute to the efforts of the Solano County Technical Advisory Committee (TAC) to develop mitigation measures to lessen potential impacts to raptors as a result of wind turbine generator operation.

e) The Permittee shall analyze the banding information obtained from the CDFG to assess the origin and population of red-tailed hawks, American kestrels, and other raptors.

38. Mitigation Measure BIO-9: On-site Mitigation. The Permittee shall provide on-site mitigation for bird and bat strikes, as outlined below:

a) Turbine locations shall avoid features of the landscape known to attract raptors such as cliff/rim edges.

b) The locations for Turbine Nos. A19 and B6 shall maintain a 500-foot buffer zone around the historical golden eagle nest identified in that area.

c) Prior to Project construction, a Raptor Mitigation Plan ("RMP") shall be developed. The Plan shall contain specific provisions for actions to minimize or offset impacts to golden eagles and other raptors, and shall include the following:

i) Move rock piles away from wind turbines.

ii) Construct tower pads to prevent under-burrowing by small mammals.

iii) Install bird flight diverters at the ends of strings and at the edges of clusters of turbines if determined necessary after three years of fatality data have been collected and based on recommendation of Solano County Technical Advisory Committee (TAC).

iv) Design turbines so the lowest reach of rotor planes is no lower than 26 meters off the ground.

39. Mitigation Measure BIO-9: Off-site Mitigation. The Permittee shall provide off-site mitigation for bird and bat strikes, as outlined below:

a) Within two years following the first delivery of power, the Permittee shall purchase and record an off-site conservation easement, at least 120 acres in size, for open space suitable as habitat for raptors such as the Golden Eagle and Red Tail Hawk. The County, in consultation with USFWS and the CDFG, shall approve the location of the easement, which approval shall not be unreasonably withheld. If the Permittee timely requests approval of the location of the easement and approval is not granted within the two year period, the Permittee shall purchase and record the conservation easement within a reasonable time after the County gives its approval. The conservation easement shall meet the following requirements:

i) The conservation easement shall be located within the regional area providing similar habitat as the Project area, but shall be outside the WRA.

ii) The easement site shall be dominated by natural vegetation, agricultural lands, or a combination of both. The primary purpose of this easement will be to provide conservation lands for a variety of bird species that could be potentially impacted by the Project.

iii) Conservation lands shall provide breeding opportunities in an effort to offset avian mortality associated with operation of the project. The main species anticipated to be impacted by the project are raptor species such as Golden Eagle, Red-tailed hawk, and American Kestrel, although the easement could also provide habitat for other species such as ground-nesting songbirds. Types of enhancement measures on the easement will be weighted according to the relative abundance of birds impacted by the project and the species specific needs of those species. A number of management measures and enhancements shall be provided (if such features are not already present) to provide suitable foraging and nesting habitat on the easement.

iv) The conservation easement shall be recorded, shall run with the land in perpetuity, and shall list and prohibit activities inconsistent with the purpose of supporting avian breeding opportunities.

b) The Permittee shall establish a non-wasting funding mechanism to fund the maintenance, management and monitoring of the conserved area. Estimated costs shall be established using a PAR-type analysis. The analysis and funding mechanism shall require approval by the County, in consultation with the resource agencies, prior to recordation of the conservation easement. Management activities or restrictions in the conservation easement shall include:

i) Providing suitable foraging habitat by maintaining or enhancing natural areas, particularly grasslands and seasonal wetlands; or by maintaining compatible agricultural crops and practices. Suitable crop types for foraging raptors include those with low-lying vegetation such as alfalfa and other hays, and various row and grain crops. Unsuitable crop types that would be restricted in the easement shall include those that do not provide sufficient accessibility or have low prey densities, such as orchards and vineyards;

ii) Maintaining or enhancing nesting opportunities by protecting trees or planting trees that are suitable for raptor nesting, including native valley oaks and cottonwood trees.

c) Within 3 years following the first delivery of power, the Permittee, in conjunction with a Qualified Wildlife Biologist, shall undertake breeding habitat enhancement measures on the conserved property, which shall include the following:

i) Prior to recording the conservation easement, the Permittee shall submit to the County an open space management plan for the conserved area, which shall be prepared by a qualified Wildlife Biologist. Approval of the Plan by the County, in consultation with the resource agencies, shall be required prior to recordation of the easement.

ii) Types of enhancement measures on the easement will be weighted according to the relative abundance of birds impacted by the project and the species specific needs of those species, but shall include the placement of nesting substrate for Golden Eagles, Red-tailed Hawks and American Kestrels (nesting boxes, trees, perches, and/or other natural features).

iii) A number of management measures and enhancements shall be provided (if such features are not already present) to provide suitable foraging and nesting habitat on the easement.

iv) Prior to recording the conservation easement, the Permittee shall designate, for the County's approval, a public agency or non-profit entity, or a designative representative to manage the conserved area.

d) Prior to the issuance of the first building permit, the Permittee shall establish an irrevocable letter of credit in favor of the County of Solano from a reputable bank in the amount of $500,000 to ensure compliance with the conservation easement provisions described above. The Director of Resource Management shall determine when the letter of credit may be cancelled due to the Permittee's compliance with the conservation easement provisions.

e) The Permittee shall be responsible for all mitigation costs including habitat enhancements, preparation and implementation of the open space management plan, and long-term management of the conservation area.

40. Mitigation Measure BIO-9: Post-construction Monitoring. The Permittee shall conduct post-construction avian and bat mortality monitoring, as follows:

a) Once the Project begins operation, the Permittee shall monitor the site to determine avian and bat mortality rates and the causes of mortality on the site itself for a period of three years. The monitoring shall be conducted by an independent biologist, and reports shall contain sufficient information (e.g. the location of dead birds relative to turbine location; the availability of raptor prey species) to allow evaluation of turbine design characteristics and location effects that contribute to mortality. This monitoring shall follow standardized guidelines outlined by the National Wind Coordinating Committee (Anderson et al. 1999).The Permittee shall prepare and provide reports from the monitoring to the County, USF&WS and CDFG, and shall also participate in the Solano County Technical Advisory Committee (TAC) for the term of the monitoring effort, and shall share the results of this research with the TAC.

b) After three years of post-construction monitoring data has been obtained, the County will review the permit and, in consultation with the California Department of Fish and Game and the USFWS, determine if any specific turbines should be relocated due to disproportionately high levels [e.g. more than at other turbines] of avian mortalities and no other mitigation measures are deemed appropriate. The County will determine whether turbines shall be relocated, based on consideration of the following factors:

i) Number of Annual Mortalities Per Turbine. Large comparative differences in the number of mortalities per turbine might indicate the need for relocation. In the absence of such large differences, however, this factor probably cannot be considered alone due to limited statistical basis upon which to estimate the number of avian mortalities at each turbine.

ii) Disproportionate Representation of a Particular Species. A large number of mortalities of a particular species must also be factored into the relocation decision due to enhanced concern for potential effects on that species population and further support for theories that something in that species' behavior, foraging strategy or flight mechanics make collision avoidance with that particular turbine configuration problematic.

iii) Comparison to other Windfarms in the Area. In light of the total body of knowledge accumulated about bird strikes on windfarms, an additional relocation factor is the number of mortalities at particular turbines or group of turbines which is substantially out of line in comparison with the experience of other windfarms in the Solano County Wind Resource Area.

41. Mitigation Measure BIO-9: Reimbursement. Once the Project operation begins, and for the three years thereafter, the Permittee shall provide reimbursement to the County for a senior staff planner for two weeks annually. This planner shall monitor the implementation of the mitigation measures and others included in this DEIR.

42. Mitigation Measure CUL-2: Cultural Resources.

a) The permittee shall notify the Solano County Resource Management Department immediately if any cultural resources are disturbed during excavation.

b) Prior to the issuance of any grading permits, the Permittee shall include specific wording in the construction and engineering specifications for Project stating that if evidence of cultural resources is identified during excavation all work shall stop in an area within 100 feet of the find until a qualified archaeologist can assess the significance of the find. Evidence of cultural resources includes chipped or ground stone, historic debris, building foundations, or human bone.

c) If necessary, the archaeologist shall develop appropriate treatment measures for the resource in consultation with Solano County, SHPO, and other appropriate agencies.

43. Mitigation Measure GEO-1: Seismic Resistant Design. Project facilities shall be designed to withstand substantial fault movement without rupture. The Permittee shall also complete final geotechnical studies, as outlined below.

44. Mitigation Measure GEO-2: Geotechnical Study.

a) Prior to commencing construction activities, the Permittee shall conduct a geotechnical study to evaluate soil conditions and geologic hazards in the Project Area. The geotechnical study must be signed by a California-registered geologist and approved by Solano County, and shall identify the following:

i) Location of fault traces and potential for surface rupture;

ii) Potential for seismically induced ground shaking, liquefaction, landslides, differential settlement, and mudflows;

iii) Stability of existing cut-and-fill slopes;

iv) Collapsible or expansive soils;

v) Foundation material type;

vi) Potential for wind erosion, water erosion, sedimentation, and flooding; and

vii) Location and description of unprotected drainage that could be impacted by the proposed development.

b) The Project shall, based on the results of this study, be designed to:

i) Follow safety and building codes, and other design requirements, as indicated by the site-specific geotechnical review, including the UBC;

ii) Use existing roads to the greatest extent feasible to minimize increased erosion;

iii) Design fill slopes for an adequate factor of safety, considering material type and compaction, identified during the site-specific geotechnical study;

iv) Cut slopes with a slope ratio compatible with the known geologic conditions, or be stabilized by a buttressed fill;

v) Avoid locating roads and structures near landslide and mudflow areas. Where avoidance of landslide areas is not feasible, relatively flat cut-and-fill slopes would be constructed (2 horizontal: 1 vertical, or 26 percent, or flatter). Roads would be constructed with slope buttressing consisting of excavation of the unstable materials, installation of subdrains, and reconstruction of the slopes to the designed grades using the excavated materials in properly compacted fills. Stabilization of soil, where required for tower foundations, will use the same methods;

vi) Utilize setback requirements from surrounding uses, including roads or utilities and/or diversion walls to mitigate impacts from mudflow-prone areas; and

vii) Avoid locating turbine locations, transmission lines, and associated structures astride faults, lineaments, or unstable areas.

viii) Where service lines or utilities cross the potentially active faults, they shall be designed to withstand vertical and horizontal displacement.

ix) In some cases, depending on the findings of the site-specific geotechnical study and where feasible, removal and replacement of shrink-swell soils with a non-expansive or non-collapsible soil material shall be done.

45. Mitigation Measure GEO-3: Increased Erosion and Expansive Soils. Prior to commencing construction activities, the Permittee shall develop a Project Stormwater Pollution Prevention Plan (SWPPP) in compliance with the State Water Resources Control Board Construction Storm Water Permit. Permittee shall also monitor all disturbed areas each spring for eroding or slump areas.

46. Mitigation Measure HAZ-1: Proper Use and Storage of Materials.

a) Prior to commencing construction activities, the Permittee shall prepare a Hazardous Materials Business Plan/ Spill Prevention, Control, and Countermeasure (SPCC) plan to avoid spills and minimize impacts in the event of a spill. The Plan shall include a discussion of hazardous materials management, including delineation of hazardous material and hazardous waste storage areas, access and egress routes, and notification procedures. The Plan shall be provided to all contractors working on the Project, and one copy shall be available on site at all times.

b) The Permittee shall store all paint, solvents, and any other hazardous materials in the manner specified by the manufacturer and in accordance with Federal regulations and nationally and internationally recognized codes and standards. Small spray cans of carburetor fluid and other hazardous materials shall be stored in an enclosed area in the Operation and Maintenance (O&M) building. A material safety data sheet shall be stored with each material, as well. In addition, all employees must be properly trained in the use and handling of these materials.

c) Prior to commencing construction activities, the Permittee shall prepare a Storm Water Pollution Prevention Plan (SWPPP). In addition to covering erosion control measures, the SWPPP shall include best management practices for construction material and equipment fluid spill prevention and control. Best management practices shall include the following:

i) No debris, soil, silt, bark, rubbish, cement or cement washing, oil or petroleum products, or any other construction materials are allowed to be placed where they may be washed by rainfall into wetlands or streams;

ii) Vehicles and equipment shall be well maintained and periodically inspected for leaks.

iii) No refueling or fuel storage shall occur within 100 feet of sensitive areas, including intermittent streams, wetlands, biological and cultural areas, or within 150 feet of wells.

iv) A drain pan, drop cloth, absorbent pads, or other secondary containment shall be placed beneath nozzle to catch spills/leaks while fueling.

v) Spill containment/cleanup equipment shall be kept on hand and maintained at all times during construction.

vi) Portable toilets shall be located in a convenient and level area; at least 100 feet from sensitive areas.

d) In the event of a hazardous material spill, the Solano County Department of Resource Management shall have jurisdiction over response and cleanup operations.

47. Mitigation Measure HAZ-2: Plan for Encountering Hazardous Materials. The Permittee shall prepare a written plan prior to commencing construction, specifying the proper handling, reporting, and disposal procedures for hazardous contaminants. If hazardous contaminants are unexpectedly encountered during construction, construction crews shall stop work and notify the Department of Resource Management. A licensed waste disposal contractor shall be used to remove the hazardous materials, once identified, from the site, according to Federal, State, and local requirements.

48. Mitigation Measure WQ-1: Avoid Wetlands and Streams. The Permittee shall locate the turbines, aboveground substation, and switchyard outside and away from wetlands, drainages, streams, and other sensitive natural features.

a) Project components shall be constructed using the following recommended setbacks:

i) 100-foot setback from wetlands and streams based on guidance from the U.S. Army Corps of Engineers and CDFG;

ii) 567-foot setback from vernal pools that provide habitat for special-status plants and wildlife protected by the USFWS; and

iii) 567-foot setback from ponds that may provide habitat for water birds and the tiger salamander protected by the CDFG.

iv) Support facilities such as underground cables shall also be sited away from these sensitive natural resources to the extent feasible. In most instances, new overhead lines shall only be used to specifically avoid impacts to sensitive natural resources. No foundations, utility poles, or other permanent facilities shall be located within waters of the U.S.

b) To minimize the potential effects from the use of horizontal directional drilling, the Permittee shall incorporate the following measures:

i) HDD drilling shall occur during the season when the seasonal streams and wetlands in the project area do not have surface water present (i.e., typically June through October).

ii) On-site briefings shall be conducted for HDD workers so that they understand the location of sensitive resources and to ensure that all field personnel understand their responsibility for timely reporting of frac-outs.

iii) Barriers (e.g., straw bales, sedimentation fences, etc.) will be erected between the bore site and nearby sensitive resources prior to drilling, as appropriate, to prevent any material from reaching sensitive resource areas.

iv) The necessary response equipment and/or supplied (e.g., vacuum truck, straw bales, sediment fencing, etc.) will be kept on-site by the contractor during HDD operations so that it is readily available in the event of a frac-out.

c) In the event a frac-out from Horizontal Directional Drilling is detected, the following measures shall be implemented to reduce or minimize effects on sensitive resources:

i) All work shall stop until the frac-out has been contained and cleaned up;

ii) The frac-out area shall be isolated with straw bales, sand bags, or silt fencing to surround and contain the drilling mud.

49. Mitigation Measure WQ-2: Stormwater Pollution Prevention Plan.

a) To minimize erosion potential and subsequent wash-down to low-lying wetland and stream areas, Permittee shall implement the following:

i) Prior to commencing construction activities, a Project SWPPP shall be developed in compliance with the SWRCB's Construction Storm Water Permit.

ii) Overhead transmission lines shall be located away from streams and wetlands to avoid runoff to these areas.

iii) Alignment and location of the proposed service roads shall follow the existing land contours and ridgelines. A minimum amount of earth shall be moved to allow for the required 35-foot access roads. Tower pads shall be similarly constructed.

iv) Graded areas and stockpiled soil shall be stabilized to prevent wind or water erosion.

v) Cut slopes shall have a slope ratio compatible with the known geologic conditions or be stabilized by a buttressed fill.

vi) Surface flows shall be collected and diverted away from cut and fill slopes into ditches discharging to natural drainages.

vii) Rock channel protection shall be employed at points where water concentrates in drainage channels.

viii) Drainage culverts shall be sized and located to minimize erosion and maximize storm runoff away from the Project site. Culverts placed in drainage ways along County roads shall be designed for 100-year storms.

ix) During construction, vegetation removal and grading shall be limited to the minimal area necessary and restricted to areas required for construction only.

x) Erosion control structures shall be placed between disturbed soil and drainage structures or areas prior to the start of the rainy season.

xi) The grading, construction, and drainage of roads shall be carried out to maintain any downstream water quality.

b) To further minimize the erosion potential, the Project Area shall be seeded with grasses and other vegetation as follows:

i) Revegetation of a cut and fill area shall be implemented in accordance with Solano County guidelines and the input of local farmers/farm residents.

ii) Disturbed or graded areas shall be planted with fast-growing and deep-rooted grasses or groundcover, preferably native to the area.

iii) If required, previously vegetated areas and inactive portions of the construction site shall be seeded and watered until vegetation is grown.

iv) Revegetated areas, if any, shall be monitored annually for complete and successful ground cover, and revegetated (if required) to conform to the requirements of the County Grading Ordinance. Revegetation shall be continued, if determined by Solano County, for the life of the Project.

50. Mitigation Measure LU-3: Guarantee Bond or Corporate Surety. Prior to issuance of building permits, the Permittee shall set aside decommissioning funds in the form of a bond or corporate surety as a specific Project budget item. The bond or corporate surety shall be executed on behalf of the Project in favor of the County with an independent administrator of such funds to cover all decommissioning costs. The bond shall be maintained for the life of the Project and through any

transfer of ownership.

51. Mitigation Measure NOI-1: Construction Noise.

a) MM NOI-1a: Care of Equipment- Equipment engines shall be covered and the Permittee shall ensure that mufflers are in good working condition.

b) MM NOI-1b: Restricted Work Hours- Work hours shall be restricted for all noise generating construction activities from 7:00 a.m. to 7:00 p.m. Monday through Friday, and from 8:00 a.m. to 6:00 p.m. on Saturdays and Sundays.

c) MM NOI-1c: Equipment Location- The Permittee shall locate stationary equipment, such as compressors and welding machines, away from noise receptors to the extent practicable.

d) MM NOI-1d: Pneumatic Tools- Pneumatic tools to be used within 1,500 feet of a residence shall have an exhaust muffler on the compressed air exhaust. This shall be included in the specifications for project construction.

e) MM NOI-1e: Noise Complaint Plan- Prior to issuance of any building permits for the Project, the Permittee shall submit a plan to the Solano County Resource Management Department that details how the Permittee will respond to noise complaints, keep the County apprised of the complaints, and document the resolution of those complaints. The plan must be approved by the County before the Project building permit is issued.

52. Mitigation Measure NOI-2: Operational Noise. Wind Turbine Operations could exceed the Solano County Zoning Ordinance-permitted noise levels.

a) MM NOI-2a: The Project shall be configured such that the operation of the selected wind turbines shall not exceed a CNEL of 50 dBA (or the equivalent 44 dBA) at nearby residences. This level shall be achieved by implementing one or more of the following:

i) Use all available sites more than 2,000 feet from residences and configure the turbines for sites within 2,000 feet of residences such that they would have the least practical effect on residents.

ii) Provide to the County, prior to obtaining a building permit, additional attenuation analyses, based on terrain effects, nighttime wind speed, or other considerations, demonstrating that the proposed configuration will not coincide with the 50 dBA CNEL area of influence at the nearby residences. A residence can be considered outside the CNEL influence area if, for all predicted wind speeds, either 1) the ambient noise exceeds the turbine noise, or 2) the turbine noise is less than the 50 dBA CNEL.

iii) If the Permittee receives a waiver from a landowner allowing construction of one or more turbines that would place his or her residence within the 50 dBA CNEL, the Permittee may use noise-insulating features such as double-paned windows and door seals to reduce noise impacts, particularly at night, to levels that would be achieved by relocating turbine sites. To be most effective, noise-insulating features should be constructed in connection with mechanical ventilation that would allow windows and doors to be closed for acoustical isolation.

iv) Provide to the County, prior to obtaining a building permit, a plan for committing to operational limitations or adjustments (such as partial "feathering" of the turbine blades) during nighttime hours or other provisions that would be implemented based upon noise complaints from nearby residents. Such limitations would provide a basis for reducing the CNEL penalty imposed for nighttime noise. The plan would not be implemented unless field measurements verify that noise from nearby turbines substantially influences noise levels at the residence and exceeds the 50 dBA CNEL criterion and the County has reviewed and approved these measures.

v) Relocation of proposed turbines pursuant to table 14.5-3 of the EIR, as may be determined necessary by the County, should the preceding mitigation prove not to be fully effective.

vi) Prior to the installation of the turbines, the Permittee shall provide a written study to the County Resource Management Department demonstrating how the Project, using a combination of the above measures, would achieve compliance with the 50 dBA CNEL (or 44 dBA equivalent) standard.

b) MM NOI-2b. Upon receipt of a reasonable complaint alleging that noise from the operation of the Project turbines is causing noise levels at the exterior of a residence to exceed the 50 dBA CNEL:

i) The Solano County Building Official or the County Sheriff shall report the matter to the Permittee and to the Solano County Department of Resource Management ("DRM").

ii) The Solano County DRM shall commission, at Permittee's expense, a qualified acoustical firm to conduct a site-specific study to verify whether noise levels routinely exceed the 50 dBA CNEL criterion at the residence and whether these levels can be attributed to the operation of specific Project turbines. All findings shall be consolidated into a single report. The acoustical firm shall be authorized to require that the Permittee cease operation of the specified turbines at such times as may be necessary for a period not to exceed 10 days to verify that the noise levels at the residence would be noticeably reduced (3 dBA decrease in sound levels) by modifications to, or restrictions on, the operation of the specified Shiloh I turbines. Upon Verification of the complaint, the qualified firm shall identify the circumstances and measures that could be undertaken to ensure conformance with the 50 dBA CNEL (or 44 dBA equivalent) standard.

iii) For 30 days after the receipt of the verification of the complaint and mitigation recommendations, the Permittee shall attempt in good faith to negotiate a resolution of this matter with the party making the allegation and shall report any such resolution to the DRM in a timely manner.

iv) If a resolution of the complaint is not achieved within 30 days, the DRM shall require the Permittee to implement one or more of the recommendations specified in the acoustical report to achieve conformance with the applicable standards, which may include turbine relocation.

53. Mitigation Measure PSU-1: Public Services. Permittee shall comply with the following:

a) Prior to commencing construction activities for the Project, the Permittee shall develop a Grass Fire Control Plan for use during construction and operation. The Plan shall include notification procedures and emergency fire precautions.

b) Permittee shall insure that the construction contractor develops a County Approved Health and Safety Plan.

c) Permittee shall notify the Solano Emergency Medical Services Cooperative and the affiliated Rio Vista Fire Department in advance of commencing construction activities for the Project.

54. Mitigation Measure PSU-3: Microwave Transmissions. Permittee shall comply with the following:

a) Permittee shall notify all microwave station owners within 2 miles of the Project Area to receive their clearance or, if necessary, negotiate alternative turbine locations or types of equipment, and shall provide such notification and the results to the Solano County Resource Management Department prior to issuance of building permits.

b) Wind turbine towers shall be sited outside the WCFZs identified for two pathways crossing the Project Area, and shall be sited an additional 40-meters from the WCFZs.

c) If any off-axis receiver interference occurs after installation of turbines, high-performance antennas shall be installed by Permittee at nearby microwave sites.

55. Mitigation Measure PSU-4: Television or Radio Interference. Permittee shall comply with the following:

a) Prior to issuance of building permits for the Project, Permittee shall notify all television and radio station owners within 2 miles of the Project Area of the Project.

b) All wind turbine towers shall be sited at least 1,000 feet (304.8 meters) from television/radio receivers or transmitters.

56. Mitigation Measure REC-2: Recreational Facilities. Setback from the Suisun Marsh Management Area. Turbines shall be set back a minimum of 1,000 feet from the boundary of the Suisun Marsh Secondary Management Area, as referenced in mitigation measure BIO-7.

57. Mitigation Measure SA-1: Grass Fire Control Plan.

a) Prior to commencing construction activities for the Project, the Permittee shall develop and implement a Grass Fire Control Plan ("Plan") for use during construction and operation and shall include notification procedures and emergency fire precautions.

b) During project construction, the Permittee shall comply with the following:

i) All internal combustion engines, stationary and mobile, shall be equipped with spark arresters.

ii) Spark arresters shall be in good working order.

iii) Light trucks and cars with factory-installed (type) mufflers, in good conditions, may be used on roads where the roadway is cleared of vegetation.

iv) Smoking sings and fire rules shall be posted on the project bulletin board at the contractor's field office and areas visible to employees during the fire season.

v) Equipment parking areas and small stationary engine sites shall be cleared of all extraneous flammable materials.

c) During project operation, the Permittee shall comply with the following:

i) Warning signs for high-voltage equipment

ii) Annual clearing of brush and other dried vegetation around pad-mount transformers, riser poles, and the Operation & Maintenance (O&M) building.

iii) Installation of fire extinguishers at the O&M building.

iv) Employee training in the use of extinguishers and communication with the Montezuma Hills Fire District.

v) Periodic inspections by the Montezuma Hills Fire District.

d) The Plan shall be submitted to the County for approval. Permittee shall not commence construction activities until the County has approved the Plan.

e) Permittee shall provide copies of the Plan, along with maps of the Project Area and roads, to the Montezuma Hills Fire District.

f) Permittee shall provide the Fire District access to its water storage tanks, if needed by the Fire District.

58. Mitigation Measure SA-2: Turbine Setbacks and Property Owner Waivers. Permittee shall comply with the following:

a) Prior to commencing Project operation, Permittee shall provide the County with manufacturer's specifications for the wind turbines, specifying that all turbines are equipped with a braking system, blade pitch control, and/or other mechanism for rotor control, and shall have both manual and automatic overspeed controls.

b) Where a turbine setback from a public road is less than three times (3x) the total turbine height, prior to turbine installation, Permittee shall provide the County Public Works Department certification that the base elevation of the turbine does not exceed 80 feet from the nearest public road, unless further study is provided to, and approved by, the County.

c) Prior to turbine installation, the Permittee shall provide to the County a waiver from adjacent property owners where a reduced turbine setback is proposed.

59. Mitigation Measure SA-3a: Equipment Shut-off Mechanisms.

a) All Project turbines and utility lines shall be equipped with automatic and manual-disconnect mechanisms.

b) Three circuit breakers that can be both manually and automatically operated shall be provided between each turbine and the connection to the electrical grid.

c) The electrical systems and substations shall be designed by California-registered electrical engineers, and shall meet national electrical safety codes and other national standards, including NEMA, ANSI, and Cal-OSHA standards. Grounding shall also be designed to the standards of the Institute of Electrical and Electronics Engineers.

d) The above mechanisms shall be installed and tested prior to interconnection.

e) Prior to commencing construction activities, the Permittee shall develop a project-specific Health and Safety Plan for implementation during construction and operation. The Health and Safety Plan shall include emergency contacts, location of nearest hospital, and proper emergency protocol.

60. Mitigation Measure SA-3b: Limited Site Access. The Permittee shall restrict access to the wind turbines and other Project facilities during Project operation by implementing the following measures:

a) The Project area shall be completely fenced;

b) All turbine towers shall be locked;

c) All turbines shall have at least 15 feet (4.6 m) between the ground and both the tips of the turbine blades and the access routes (e.g., ladders) unless enclosed by a 6-foot (1.8 m) high fence;

d) The substation and switchyard shall be fenced and locked;

e) The O&M building shall be kept locked;

f) Each down-tower electrical/communication cabinet shall be locked and have a sign with high-voltage warning;

g) Road access to Project sites shall be through locked gates;

h) Field maintenance crewmembers shall be on-site during the day, and a security service shall patrol the area at night.

i) Only properly trained personnel shall be provided entry to the site, to reduce the likelihood of accidents.

j) Signs shall be posted at entrance gates noting the existence of high-voltage and underground cable on the site and warning people of the hazards of electrocution.

k) Permittee shall also post signs at entrance gates noting the existence of high voltage and underground cable on the site and warning people of the hazards of electrocution.

61. Mitigation Measure TRA-1a: Traffic Control Plan.

a) The permittee shall develop and implement a traffic control plan based on the final engineering design, and prepared by a registered professional engineer. The Plan shall be submitted at least 45 days prior to construction to the Solano County Public Works Division (for affected County roads) and to CalTrans (for affected state Highways). The plan shall describe the location, schedule, and safety procedures for lane and road closures, as well as the hours, routes, and safety and management requirements. The plan shall contain the following measures:

i) Traffic safety measures, such as warning signs on approaches to areas with construction activity (i.e., "Construction Traffic Ahead" or equivalent);

ii) Scheduling of construction traffic to avoid peak traffic hours (also see Mitigation Measure TRA-1b);

iii) Ensure access for emergency vehicles at all times;

iv) Provide temporary access to businesses and/or residences during construction;

v) Open lanes as soon as possible to restore normal traffic patterns;

vi) During the design phase the Permittee shall coordinate with other utilities service providers to ensure conflicts with other utilities are minimized;

vii) New roads shall be designed and constructed to accommodate Project traffic and minimize the potential for accidents, in accordance with all applicable CalTrans and Solano County specifications, including appropriate slopes, sufficient turning radii, and appropriate roadway depth; and

viii) After construction, restore the routes to original conditions.

b) Prior to commencing construction activities, the Permittee shall provide to County Public Works – Engineering, a Transportation Plan that addresses the following issues:

i) Transport of all equipment to the site; (2) transport of all equipment during equipment removal;

ii) Transport of all building materials;

iii) Circulation, itemizing how many of each vehicle type will use which roads;

iv) Responsibilities;

v) Security bonding;

vi) Vehicular traffic types and amounts necessary for the project;

vii) Extra-legal loads;

viii) Signage;

ix) Road maintenance; and

x) Encroachment permits.

c) All of the Permittee's activities shall conform to the approved Transportation Plan.

d) As required by Solano County Public Works Division, grading and encroachment permits must also be obtained prior to construction.

62. Mitigation Measure TRA-1b: Notification, Scheduling and Carpooling. Prior to commencing construction activities, the Permittee shall implement notification, schedule shifts, carpooling, and other best management practices to minimize increases in traffic. Specific measures to minimize the impact of short-term increase in traffic from the construction workforce and truck deliveries shall include the following:

a) Coordinate with local jurisdictions to notify residents of alternate traffic routes;

b) Schedule shifts and material deliveries to avoid peak traffic congestion hours;

c) Promote carpooling among construction workforce;

d) Stage worker personal vehicles and some trucks at the O&M building staging area;

e) Deliver construction equipment, such as that used for grading, excavation, material delivery, and turbine assembly, directly to the construction location rather than the O&M building staging area to minimize trips on local public roads.

63. Mitigation Measure TRA-2: Temporary Disruption to Traffic Flow during Construction.

a) Temporary lane closures of public roads must be approved in advance by the County Public Works, and shall be allowed only during workdays.

b) No overnight lane closures shall be allowed.

64. Mitigation Measure TRA-3: Repairs to Roads.

a) Any damage to roads that occurs as a result of the Project shall be repaired to the original conditions.

b) Prior to commencing construction activities, the Permittee shall enter into a secured agreement with Solano County to ensure that any County roads that have been damaged by the project are promptly repaired and, if necessary, reconstructed. The agreement shall include posting of security bond to cover costs for road maintenance during construction.

c) Permittee shall obtain all appropriate hauling permits prior to construction.

65. Mitigation Measure TRA-6: Turbines Siting.

a) Permittee shall site all turbines within the outer horizontal plane on hills less than 222.5 feet (above sea level) for the 65-meter towers and 172.5 feet (above sea level) for the 80-meter towers.

b) Permittee shall submit FAA Form 7460-1, Notice of Proposed Construction or Alteration, to the FAA, requesting that the FAA issue a Determination of No Hazard to Air Navigation for all turbines and meteorological towers.