# APPENDIX A

## Scoping Report, Notice of Preparation

# APPENDIX A1
Scoping Report

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# TRES VAQUEROS WINDFARM PROJECT

## Scoping Report

Prepared for
Contra Costa County
Department of Conservation and Development

January 2010

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## Scoping Report

Prepared for
Contra Costa County
Department of Conservation and Development

January 2010

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# SCOPING REPORT

# Tres Vaqueros Windfarm Project Scoping Report

## 1. Introduction

This report provides an overview of the written and oral comments received by the Contra Costa County Department of Conservation and Development, Community Development Division (County) during the public scoping period for the Environmental Impact Report (EIR) that the County is preparing for Pattern Energy's Tres Vaqueros Windfarm Project (Project).[1]

CEQA Guidelines Section 15083 provides that a "Lead Agency may…consult directly with any person…it believes will be concerned with the environmental effects of the project." Scoping is the process of early consultation with affected agencies and the public prior to completion of a Draft EIR. Section 15083(a) states that scoping can be "helpful to agencies in identifying the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in depth in an EIR and in eliminating from detailed study issues found not to be important." Scoping is an effective way to bring together and consider the concerns of affected State, regional, and local agencies, the Project proponent, and other interested persons (CEQA Guidelines Section 15083(b)).

Scoping is not conducted to resolve differences concerning the merits of a project or to anticipate the ultimate decision on a proposal. Rather, the purpose of scoping is to help ensure that a comprehensive and focused EIR will be prepared that provides a firm basis for the decision-making process.

This report is intended for use by the public to have access to and understand the comments received during the scoping period. It includes oral and written comments received during the scoping period from March 23, 2009 to July 7, 2009. The County will use this report as a tool to ensure the preparation of a comprehensive and focused EIR. Pursuant to CEQA Guidelines Section 15082, all public comments *will be considered*[2] in the EIR process.

1 The Contra Costa County is the lead agency under the California Environmental Quality Act (CEQA) for the preparation of an EIR for the Project.

2 Comments not within the scope of CEQA will not be addressed through the CEQA Process.

# 2. Description of the Project

## Project Summary

The EIR will examine the potential environmental impacts associated with construction, operation and maintenance of the Project, develop mitigation measures to address potential environmental impacts, and identify and evaluate a reasonable range of alternatives to the Project. The objective of the Project is to replace approximately 90 existing older turbines with new higher capacity and efficiency turbines and to increase the overall output of the wind farm by almost 40 percent.

The Project includes the following elements:

- Removal of approximately 90 existing 60 kW and 330kW and one 750kW Howden wind turbines and associated civil/electrical infrastructure (except for one onsite substation). All above-ground facilities, foundations, and related systems would be removed to a depth of approximately two (2) feet. Surface soils will be prepared for planting and spread with native vegetation seed.

- Installation of new modern wind turbines and associated collection and communication systems. The wind turbines under consideration for the Project have a maximum tower height of 263 feet and a maximum rotor diameter of 271 feet. The Project would install either:

    - up to 42 Mitsubishi 1 MW capacity turbines; or
    - up to 28 GE 1.5 MW capacity turbines.

- Construction of approximately 70,000 feet (13.25 miles) of new access roads and reclamation or modification of existing site and turbine access roads. During construction new access roads leading to the turbine sites would be up to 32 feet wide with up to 4 feet of temporary shoulder. Following construction, permanent site access and turbine maintenance roads would be approximately 16 feet wide to accommodate maintenance vehicles.

## Project Location

The Project site consists of approximately 1,500 acres encompassing all or portions of 9 parcels in unincorporated southeastern Contra Costa County. The site is located roughly 3.5 miles southwest of the unincorporated community of Byron, approximately 6 miles north of the City of Livermore in Alameda County, approximately 2 miles west of the East County (Byron) Airport, and adjacent to Los Vaqueros Reservoir. Portions of the Los Vaqueros watershed and Vasco Caves Regional Park are located within the Project site. Vasco Road, which runs along the site's eastern edge, is the only public road providing access.

# 3. Opportunities for Public Comment

## Notification

On March 23, March 31, and June 5, 2009, the County published and distributed a Notice of Preparation (NOP) to advise interested local, regional, state, and federal agencies, as well as the public, that an EIR would be prepared for the Project. The NOPs solicited both oral and written comments that address potential environmental concerns resulting from implementation of the Project, during a 31-day comment period (later extended from April 22, 2009 to July 7, 2009). Additionally, the NOPs provided information on forthcoming public scoping meetings, and presented the description and location of the Project, potential issues to be addressed in the EIR, where to locate supporting documents, and the contact name for additional information regarding the Project. The NOPs are presented in Appendix A.

The public was encouraged to submit written comments pertaining to environmental concerns by mail or email to the County. No comments were received after the formal comment period ended.

## Public Scoping Meeting

The County conducted two public scoping meetings during Contra Costa County Zoning Administrator hearings. The first was held on April 20, 2009, at 1:30 pm in Room 107 of the McBrien Administration Building, 651 Pine Street, Martinez, California. Approximately 10-15 members of the public attended the scoping meeting, as well as William Nelson of Contra Costa County Department of Conservation. Public Speaker Cards from this scoping meeting are provided in Appendix B. At the meeting, public comments on the Project were taken and documented by a County secretary (Appendix C). All attendees were encouraged to submit written comments (Appendix D).

To ensure that federal agencies were given the opportunity to attend, a second scoping meeting was held on July 6, 2009, at 1:30 pm in Room 107 of the McBrien Administration Building, 651 Pine Street, Martinez, California. No comments were received at this meeting.

# 4. Summary of Scoping Comments

During the public scoping meeting held on April 20, 2009, participants commented on the scope of issues to be included in the EIR. Written comments were also collected throughout the public comment period, during which time six written letters were received. Appendix C presents a transcript of the oral comments received, and Appendix D contains copies of the submitted written comments.

## Commenting Parties

The following individuals and parties submitted comments on the scope of the EIR. These comments are organized alphabetically by organization; no comments were received after the formal comment period ended.

**TABLE 1**
**PARTIES SUBMITTING COMMENTS DURING**
**THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Name | Organization | Letter Number | Date |
|---|---|---|---|
| Oral Comments | | | |
| Joe Ciolek | Agricultural--Natural Resources Trust of Contra Costa County (Trust) | SM (Scoping Meeting) | April 20, 2009 |
| Laura Baker | California Native Plant Society (CNPS) East Bay Chapter | SM | April 20, 2009 |
| Troy Bristol | Save Mount Diablo | SM | April 20, 2009 |
| Jeff Welton | Northwind Energy, Inc. | SM | April 20, 2009 |
| Written Comments | | | |
| Julie Jones | Bingham McCutchen LLP, on behalf of Northwind Energy, Inc. | 1 | April 20, 2009 |
| Cindy Catalano for Charles Armor | California Department of Fish and Game (CDFG) | 2 | May 28, 2009 |
| Lisa Carboni | California Department of Transportation (Caltrans) | 3 | April 22, 2009 |
| Mark A. Seedall | Contra Costa Water District (CCWD) | 4 | April 22, 2009 |
| Brad Olson | East Bay Regional Parks District (EBRPD) | 5 | April 16, 2009 |
| Troy Bristol | Save Mount Diablo | 6 | April 28, 2009 |

## Comments Received During the Scoping Process

Table 2 summarizes both the oral and written comments received during the public scoping period. For more detailed information, please see Appendix C, which contains the scoping meeting transcript from April 20, 2009, and Appendix D, which contains written comments submitted during the scoping period.

Comments are categorized by topical areas to enable easier review of the comments. Table 2 also provides a description of where the comment is addressed in the Draft EIR.

## General Comments

The following two comments provided by the EBRPD were non-specific in nature to the scope or content of the EIR:

> **5-2:** As a potential Responsible Agency under CEQA EBRPD is required to prepare or adopt an environmental document as part of its consideration of the Project. EBRPD intends to utilize Contra Costa County's Final EIR in considering the Project and its potential effects to the Preserve. Therefore, EBRPD is submitting substantial scoping comments and information, including ongoing research on wind turbine impacts and excerpts from our 1997 Master Plan that are relevant to EBRPD's consideration of the Project.
>
> **5-3:** EBRPD anticipates that this project will be of substantial interest to the public and to other agencies. Prior to distribution of the DEIR for public review EBRPD requests that the County provide EBRPD with an administrative draft of the EIR so that EBRPD may review it to determine if it will be adequate for its CEQA compliance purposes.

These comments are noted and will be considered by the County in the preparation of the EIR.

**TABLE 2**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| PROJECT DESCRIPTION | | | | |
| 1 | 1-2 | Commenter requests that the EIR show the locations, sizes (including tower height, rotor diameter, and overall height), and potential manufacturers and models of all proposed wind turbines. Commenter also requests that the distances between the proposed turbines and the nearest existing Northwind turbines be stated clearly either in a table or on a plot plan, and that the impact analysis address the downwind effects of the Project's larger turbines on Northwind's smaller downwind turbines. Such effects would conflict with County Zoning Code section 88-3.418(b), which forbids wind energy conversion systems that "adversely affect the orderly conduct of existing or planned land uses in the vicinity." Also, if a project would cause a climatic change that would affect neighboring commercial uses of land, that change must be studied in an EIR. Galante Vineyards v. *Monterey Peninsula Water Management Dist*., 60 Cal. App. 4th 1109 (1997). (Bingham McCutchen LLP) | Project Description | Energy; Air Quality |
| 4 | 4-2 | Construction of 13.25 miles of new access roads and "reclamation or modification" of a similar amount of existing site and turbine access roads will have potentially significant impacts. The Project Description should fully describe the new and restored roads and turbine foundations, as well as restoration activities including recontouring the land and removal of drainage structures. (CCWD) | Project Description | |
| 5 | 5-8 | There is considerable infrastructure in place at the Vasco Caves Regional Preserve (Preserve) from the existing wind energy leases that would no longer be required should the Project be repowered or removed from the Preserve. This includes existing wind turbines, anemometers, pads, foundations, above and underground utilities, roads and drainage systems. The DEIR needs to describe the existing facilities that would be retained, replaced or removed as part of the proposed repowering Project. (EBRPD) | Project Description | |
| 5 | 5-21 | It is unclear why a 30-foot wide road is necessary to construct the Project. Typical roads in the Project area are 12 to 15 feet in width and appear adequate for the maintenance and replacement of existing wind turbines. To the extent feasible, the applicant should use existing roads and utilize helicopters and cranes in order to reduce the amount of road grading necessary for construction of the Project. (EBRPD) | Project Description | |
| 6 | 6-7 | The Notice of Preparation states that once the existing turbines are removed, their foundations will be covered with soil and seeded with native species. However, there is no discussion about whether the infrastructure associated with those turbines, such as roads, will be removed and whether those areas would be returned to a natural state. (Save Mt. Diablo) | Project Description | |
| AESTHETICS | | | | |
| 5 | 5-32a | The Project will directly affect the 617-acre Souza property at the Preserve. There are currently 48 turbines on the property that would be removed and potentially replaced with 10 larger turbines. EBRPD requests that visual impact simulations be conducted at three additional locations along Howden Road: one at the east end saddle looking west, one in the middle of the central valley looking northwest and one at the west end of the property (near the Enxco Facility) looking east. (EBRPD) | Aesthetics | |
| 5 | 5-33 | There has been much discussion in the past about the colors and patterns that have been applied to the wind turbines. While making the turbines blades more visible for birds may be an overriding consideration, perhaps other improvements to the turbine towers and bases would reduce the overall visual impacts. For example, are there other colors or patterns that might make visually prominent turbine towers less visible from the Preserve? (EBRPD) | Aesthetics | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| AESTHETICS (cont.) | | | | |
| 5 | 5-34 | Consideration should be given to reducing the visual prominence of existing and proposed support facilities, such as maintenance yards, buildings, substations, transformers, etc. Are there surface treatments or screens that could be employed to reduce the visibility of these structures from the Preserve? The Enxco facility just west of the Preserve and the North Wind facility to the northeast of the Preserve are two visually prominent examples where surface treatments could reduce visual impacts to the Preserve. Relocating and/or covering the surplus turbine parts would make them less visually prominent. (EBRPD) | Aesthetics | |
| 5 | 5-35 | The original 722-acre Preserve acquired in 1997 contains no wind turbine facilities. However, it is surrounded by properties that do contain turbines, including the 617 acre former Souza property that is now part of the Preserve. A quick scan of the hillsides surrounding the Preserve shows substantial amounts of debris from the past 25 years of wind energy generation, including derelict turbines, obsolete anemometers, unused electrical poles, broken turbine blades and abandoned roads. While these conditions have improved in recent years, the aesthetic environment surrounding the Preserve has been badly degraded. The Project provides the opportunity for the better management of these facilities. Regular inspection and enforcement of mitigation measures by the County would be one way to improve the degraded aesthetics of the areas surrounding the Preserve. (EBRPD) | Aesthetics | |
| 4 | 4-10 | Replacing the smaller wind turbines with fewer but larger turbines would alter the site's appearance and the natural setting of the watershed. CCWD needs to know the height and width of the wind towers as well as the size of the turbine blades and motor housing. A visual assessment needs to be performed that would evaluate the visual impacts of the wind turbine project on the following key views: (1) Walnut Blvd on the way into the watershed; (2) Views from various North side facilities including Walnut Staging Area, Watershed Office, Kellogg Staging Area, and the Interpretive Center; (3) Views from the reservoir; (4) Views from the marina; (5) Views from Morgan Territory Ridge, and (6) View from Vasco Road. (CCWD) | Aesthetics | |
| 5 | 5-30 | The visual environment at the Preserve includes a number of existing wind turbines to the south, east and north of the Preserve. The turbines to the south and north are older generation turbines ranging in heights of up to 100 feet. The new turbines to the east that are part of the Buena Vista Repowering Project are in excess of 200 feet. While the new turbines to the east are fewer, they are more visually prominent from the Preserve. They are also evident now in areas where the older turbines were hidden behind ridgelines. The net result of the Buena Vista Project was degradation in the visual environment at the Preserve. (EBRPD) | Aesthetics | |
| 5 | 5-31 | The EIR needs to consider the individual and cumulative visual impacts of the proposed turbines in conjunction with other repowering projects in the area. In EBRPD's comments for the Buena Vista EIR EBRPD provided a map of key locations (i.e. sensitive receptors) where it requested visual impact simulations. Views from the same locations (looking north) should be considered with before and after visual simulations conducted. (EBRPD) | Aesthetics | |
| 6 | 6-10 | The Notice of Preparation states that the total height of the proposed turbines is between 282 and 315 feet. However, the document does not indicate how much taller the proposed turbines would be than the existing turbines. The EIR should include these height differences. Furthermore, the EIR should include a description of the location of the new turbines related to topography. If the new turbines are located on the tops of hill, they would be more visible than if they were located on lower elevation. (Save Mt. Diablo) | Aesthetics | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| AESTHETICS (cont.) | | | | |
| 6 | 6-11 | Save Mount Diablo is concerned that the taller turbines may be more visible from greater distances and over ridge tops that hide the turbines currently present at the Project site. The Project area covers approximately 1,500 acres of land in southeast Contra Costa County which is dominated by rolling grasslands with high hills and ridgelines rising up above canyons and valleys. The current turbines are hidden from view from a number of locations throughout the area by tall ridgelines and hills. Would the increased height of the proposed turbines make the wind farm visible above some of the surrounding ridges and increase visibility from greater distances? (Save Mt. Diablo) | Aesthetics | |
| 6 | 6-12 | The Project area is located in close proximity to a number of preserved open spaces used for recreational purposes. The Project's impacts to the visual character of the area should be considered from a number of trails and view points within these parks and preserves. (Save Mt. Diablo) | Aesthetics | Recreation |
| 6 | 6-13 | The EIR should include significant visual analysis from distances expanding throughout the region, not just in the immediate vicinity. (Save Mt. Diablo) | Aesthetics | |
| AGRICULTURAL RESOURCES | | | | |
| 4 | 4-7 | The EIR should evaluate impacts on animal grazing, both short and long-term. (CCWD) | Agricultural Resources | |
| AIR QUALITY | | | | |
| 6 | 6-14 | The removal of the existing wind turbines and the installation of new ones will require a large amount of grading and use of machinery. Save Mount Diablo is concerned that the increased activity will have adverse affects to local air quality by increasing dust and exhaust output into the air. Residents, commuters, at risk populations, plant and some animal species are affected by adverse changes in the air quality. The EIR should consider how construction of the Project would impact air quality in the region. (Save Mt. Diablo) | Air Quality | |
| BIOLOGICAL RESOURCES | | | | |
| Scoping Meeting | SM-1 | Commenter would like to know what weed abatement practices will be employed along the roads. The Project area is adjacent to sensitive areas and includes sensitive sites. The commenter would like to see a weed management plan, particularly given that the construction of over 13 miles of roads will likely bring many weeds into the area. (CNPS) | Biological | |
| Scoping Meeting | SM-2 | The commenter notes that the Project site includes existing easements, and that two portions of the site seem to be recent acquisitions as part of the East Contra Costa County Habitat Conservation Plan. The commenter requests clarification as to whether these areas are mitigations for other projects and whether there will be mitigations considered for impacts off sites. The commenter also requests that the DEIR indicates who holds the easements (EBRPD or CCWD), and would like to see the ongoing management plan for the easements. (CNPS) | Biological | Land Use |
| Scoping Meeting | SM-3 | The commenter requests that the DEIR include the protocols described for the botanical surveys. The commenter understands, in speaking to Mr. Nelson (Contra Costa County), that there have been quite a few botanical surveys done in the Los Vaqueros area, which is immediately adjacent to the Project site. The commenter is concerned about listed plant species in the area, and would like to know whether the botanical surveys included locally rare plants, as well. (CNPS) | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| Scoping Meeting | SM-4 | The commenter would like the Project to be related to the creek pond and other wetlands in the vicinity of the project. On the maps available to the commenter it's hard to see exactly where everything occurs, and where the roads and turbines are with respect to those wetlands. Those areas are likely to contain plants of interest to the California Native Plant Society, and listed plant species. (CNPS) | Biological | |
| Scoping Meeting | SM-5 | There was mention in the description of the plant that they will be reseeding as they remove the old wind turbines. They will be reseeding the old site with native species. Because this site includes lands that are already sensitive, it's important that the local ecotypes be used for seeding and to not bring in seed from outside areas because they can cross pollinate with other species and that would be a negative impact. (CNPS) | Biological | |
| Scoping Meeting | SM-6 | The commenter is interested in the impacts to birds from the turbines and assumes that the issue will be addressed quite extensively in the EIR. (CNPS) | Biological | |
| 2 | 2-1 | The Altamont Pass Wind Resources Area supports high numbers of special-status terrestrial, avian, and bat species, with a particularly high concentration of raptors. Potential biological impacts identified during review of previous repowering projects should be considered in the preparation of the EIR for this Project. The EIR should consider not just the physical footprint of the Project, but also include information about factors that contribute to impacts to avian and bat species such as operating hours and schedules. (CDFG) | Biological | |
| 2 | 2-2 | Baseline conditions for the current operation of turbines at the Tres Vaqueros site are unknown in terms of impacts to avian and bat species. It is also unknown if repowering efforts will decrease or increase impacts to avian and bat species, or if a different suite of species will be affected. Differences in turbine heights and operation, including lower cut-in speeds (the amount of wind needed for the turbine to start operating), may affect the number and type of species that are impacted. Variation in these results will likely be site-specific. (CDFG) | Biological | |
| 2 | 2-3 | An accurate comparison of pre- and post-Project impacts, including mortality, cannot be based solely on results found for existing wind turbine operations throughout the APWRA including repowered projects. Specifically for avian and bat species, the EIR should require pre- and post-Project site-specific data be gathered and evaluated and that the Project be designed to minimize impacts to sensitive species based on this information. Use of site specific information on bird abundance and use, flight patterns, wind patterns, topography, and other factors as recommended in the "California Guidelines for Reducing Impacts to Bird and Bats from Wind Energy Development" produced by the California Energy Commission in cooperation with the Department of Fish and Game (CDFG) (October 2007) should be used to guide the design of the Project and to assess the change in impacts which can be attributed to this repowering Project. (CDFG) | Biological | |
| 2 | 2-4 | Based on this site-specific information, continuing unavoidable impacts should be evaluated in the EIR for their significance to each affected species. Even if a reduction in turbine strike mortality is achieved, other Project-related effects from the footprint and operation of these facilities and degradation of suitable habitat as a result of disturbance, proliferation of predators and avoidance by sensitive species should be considered when determining mitigation requirements and whether an impact has been reduced to a level of less-than-significant for each affected species. (CDFG) | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| 2 | 2-7 | The EIR should require that site disturbance be minimized during construction of the Project. CDFG supports the effort to restore previously disturbed sites to something closer to natural conditions; however, burying unused turbine pads by disturbing additional habitat is a significant impact that should be minimized and mitigated. Soil to cover the pads should not be scraped from the site, as has occurred for other projects in the area, or from off-site areas that provide habitat for sensitive native species such as California tiger salamander aestivation habitat. Alternatively, less destructive solutions should be implemented to meet Contra Costa County's remediation requirements such as buying suitable excess cut material available from other sites. (CDFG) | Biological | |
| 2 | 2-8 | Based on the limited amount of available information, careful siting and sizing of turbines appear to be some of the more effective ways to reduce impacts to biological resources. The EIR should include very specific siting and sizing requirements for turbines with the intent of reducing biological impacts. CDFG recommends that these siting and sizing conditions be made mandatory conditions of approvals when certifying the EIR. These requirements should be approved by CDFG and based on the best available science industry-wide as well as site-specific information about sensitive habitats and existing species use patterns. (CDFG) | Biological | |
| 2 | 2-9 | The EIR should require: (1) pre-project surveys, studies that are needed to fill data gaps, post-construction monitoring and compliance reports, adaptive management of biological resources and operation schedules, and site access for research and monitoring; (2) minimization and mitigation measures that consider impacts to species other than the focal raptor species since the changes in turbine type are anticipated to change the species which will be impacted; (3) various levels of shutdown or operational changes dependant on mortality rates; and (4) that CDFG and the County approve or formulate the shutdown plan based on monitoring results. (CDFG) | Biological | |
| 2 | 2-10 | The County should work with CDFG to develop specific and measurable mitigation requirements for unavoidable temporary, one-time, and ongoing impacts. Ongoing mitigation should be required to benefit the avian, bat and terrestrial species which continue to be affected. When monitoring shows a reduction/increase in impacts, mitigation requirements may be reduced/increased proportionally. Standard mitigation practices are appropriate for non-recurring impacts. (CDFG) | Biological | |
| 2 | 2-11 | In a CEQA context, the NOP compares the impacts from the repowering project to current impacts. Separately, CDFG will consider that although this is a repowering project, the siting, operation and impacts from the existing facilities were never reviewed, approved, or permitted by CDFG, U.S. Fish and Wildlife Service (USFWS) or any other resource agency. Take of State listed and federally listed, threatened, or endangered species is likely to occur during the construction and operation of this Project. CDFG's recommendations and permit requirements will require permanent conservation of habitat to mitigate for any take of State listed species and compensation to mitigate any for ongoing take. These CDFG recommendations and requirement for a permit should be included in the EIR as conditions of approval. (CDFG) | Biological | |
| 2 | 2-12 | The EIR should require that mitigation requirements for special-status species should be determined in coordination with CDFG and USFWS and fully disclosed in the EIR. Habitat mitigation for the kit fox, tiger salamander, red-legged frog, Swainson's hawk, Alameda whipsnake, and burrowing owl should be determined with consultation and approval from CDFG and USFWS. The EIR should require that all lands conserved for wildlife and habitat should be permanently protected under a conservation easement or fee title to the State of California with a management plan | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| 2 (cont.) | 2-12 (cont.) | and a management plan endowment. The management plan should be approved by CDFG and USFWS and guide management and monitoring of the mitigation habitat. The management plan may be modified as needed to adaptively manage for benefits to the wildlife habitat and associated species. A management plan template can be made available upon request. (CDFG) | | |
| 2 | 2-13 | The EIR should require the Applicant to provide notification of permitting efforts with CDFG and USFWS and a requirement that the Applicant submits to the County and technical advisors committee or scientific review committee, evidence that they have provided a description of the Project, including grading volumes, acreages and locations to the appropriate State and Federal agencies including CDFG and USFWS before site disturbance begins. The Applicant should provide the County a copy of any State or Federal permit for the Project's record. The EIR should require that the Applicant obtains final permits for the Project before selling or delivering power to Pacific Gas and Electric or the Independent Systems Operators, and that the Project monitoring efforts begin when site operations begin. (CDFG) | Biological | |
| 4 | 4-8 | The EIR should evaluate impacts on listed plant and animal species. (CCWD) | Biological | |
| 4 | 4-9 | Lack of proper and periodic maintenance of the existing windfarm (turbine blades and turbine housings littering the ground) represents a potential impact to plant and animal habitat and should be evaluated in the EIR. This impact also calls for the need for firm mitigation measures for the new windfarm to deal with this problem. The mitigation measure should also be made a condition of approval for the Project. (CCWD) | Biological | |
| 4 | 4-12 | The effect of operations on avian species as well as species requiring wildlife corridors needs to be fully documented. In addition, the impact on native grass species due to late season wildfires attributed to windfarm operations needs to be evaluated in the EIR. (CCWD) | Biological | |
| 5 | 5-5 | EBRPD has been conducting a number of restoration projects, habitat management changes and wildlife monitoring on the Souza property since 2004. This includes rehabilitation of two existing ponds, construction of seasonal wetlands, range management changes to promote native vegetation and to reduce the effects of wind turbines on raptors. In March of 2009 the California Energy Commission released a "Public Interest Energy Research Final Project Report" entitled "Range Management Practices to Reduce Wind Turbine Impacts on Burrowing Owls and Other Raptors in the Altamont Pass Wind Resource Area, California." The report contains substantial information about the effects of wind turbines on raptors in the Preserve and the greater Altamont Wind Resource Area. (A copy of this report is enclosed with this scoping letter.) EBRPD requests that this information be considered during preparation of the DEIR for the Project. (EBRPD) | Biological | |
| 5 | 5-6 | Concurrent with EBRPD's research at the Preserve, the Contra Costa County Public Works Department has been conducting monitoring on wildlife impacts along a portion of Vasco Road, just east of the Preserve. A March 30, 2009 report entitled "Vasco Road Wildlife Movement Study Report" documents a substantial mortality of wildlife along just a 2.5 mile stretch of Vasco Road adjacent to the Preserve. Approximately 1,339 individuals, including 50 California tiger salamander and 120 red-legged frogs, were killed on Vasco Road in a fifteen month period. This report should be considered when evaluating the construction and use of roads for the Project and in evaluating the cumulative effects to these and other species in the region. (EBRPD) | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| 5 | 5-10 | East Contra Costa Habitat Conservation Plan: In response to significant development and loss of wildlife habitat in eastern Contra Costa County, the cities of Brentwood, Oakley, Pittsburg and Clayton, Contra Costa County, CCWD and the EBRPD prepared a Habitat Conservation Plan for a 172,000 acre portion of Contra Costa County, including the Project area. Incidental take permits for impacts to endangered species were issued to these agencies (except CCWD who did not request a permit) for development within their jurisdictions. One notable exception is wind turbines; they are not permitted through the HCP. The Project applicant will need to obtain its regulatory permits through a separate process, unless there is agreement to amend the HCP to make wind turbines a permitted activity. (EBRPD) | Biological | Land Use |
| 5 | 5-11 | Currently a regional Natural Communities Conservation Plan (NCCP) is being prepared for the Altamont Wind Resource Area of Alameda County. When complete, the NCCP may provide some of the necessary permitting for wind turbine projects in the participating jurisdictions. (EBRPD) | Biological | Land Use |
| 5 | 5-12 | Some of the existing turbines in the Preserve have been in operation for more than twenty years. When these initial facilities were installed, little was known about the potential effects of these facilities on wildlife, plants and special-status species. Since that time there have been a number of significant changes in project circumstances that must be addressed in the DEIR. One area of particular significance is project impacts to special-status species. In the past fifteen years, the Alameda whipsnake, California red-legged frog, California tiger salamander and long-horn fairy shrimp have been listed as threatened or endangered under the California and/or federal endangered species acts. Whipsnake, red-legged frog and tiger salamander are present at the Preserve. It also contains a very substantial population of Western burrowing owl, a special-status species, in close proximity to the existing wind turbines. The endangered San Joaquin kit fox was observed at the Preserve in 2004. (EBRPD) | Biological | |
| 5 | 5-13 | The commenter poses a series of questions pertaining to avian impacts, including: (1) What has the monitoring data for the repowered Buena Vista Project of 2004 actually shown about avian mortality rates? Has overall mortality been reduced? Are the actual numbers consistent with the projected numbers? (2) How are the individual species affected by the repowering project? In particular, how are golden eagles, burrowing owls and bats affected by the repowered Buena Vista Project? (3) How will the County use the monitoring, operation, citing and design information from the Buena Vista Project (and other relevant projects) to determine the potential effects and mitigate the impacts resulting from the Project? (4) EBRPD understands that golden eagles are being killed at a rate that may well exceed sustainable levels in the region. If such rates continue, might the individual or cumulative impacts to this species result in localized extinction of the species? How would the Project mitigate for its cumulative contribution to this impact? (5) How will the operation of fewer larger turbines affect the various birds and bats that use habitats in the Project area? The repowered turbines "sweep" a larger diameter of air as it passes over the Altamont Hills. The blades on new turbines may move at a different speed than existing turbines. How will these changes affect different species? For example, the new larger turbines are killing more bats than the existing turbines. (EBRPD) | Biological | |
| 5 | 5-14 | The EIR should examine the potential effects of removing the old facilities on numerous terrestrial wildlife species, including American badger, San Joaquin kit fox, ground squirrels, California tiger salamander and red-legged frog. These terrestrial species, along with the ground-nesting Western burrowing owl, make use of the habitats created by the original turbine projects. For example, the areas around existing turbine foundations can be riddled with ground squirrel burrows. These burrows may also be used by badger, kit fox, coyote, tiger salamander, red-legged frog and burrowing owl. Biological surveys should be conducted within the disturbed areas to determine if it might be more appropriate to leave certain facilities. (EBRPD) | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| 5 | 5-15 | Construction of new roads, pads, foundations, underground utilities, above ground utilities and turbines will all result in potentially significant impacts to terrestrial species. Excavation and grading may affect all of the above described species. Preconstruction surveys must be conducted to determine the extent and location of potentially affected terrestrial species, and measures must be implemented to avoid potential impacts and to relocate terrestrial animals away from the Project impact area. In some cases, such as for breeding burrowing owls it would be necessary to wait until chicks have fledged before burrows could be destroyed. (EBRPD) | Biological | |
| 5 | 5-16 | The applicant should establish procedures for securing the site during project construction to reduce the potential for impacts to biological resources. This would include site security on a 24/7 basis, setting and enforcing speed limits, and closure of certain roads to prevent contractors from unnecessarily entering areas where there may be sensitive resources. (EBRPD) | Biological | |
| 5 | 5-17 | The Preserve has a very rich assemblage of ecological communities, including perennial grassland, annual grassland, rock outcrop, sandstone basins, stock ponds, alkali seeps and meadows, perennial freshwater marsh, riparian scrub and woodland, and valley oak savannah. With the exception of valley oaks, all of these communities are present in the Project area. The DEIR needs to address potential impacts to each of these community types and to the special-status plants and animals that they contain. (EBRPD) | Biological | |
| 5 | 5-18 | EBRPD has made a number of changes in the Preserve, including restoration of ecological communities and range management practices to improve both wildlife habitat values and to reduce avian mortality. EBRPD will continue to monitor these improvements and make adaptive management changes when necessary. Similar monitoring and management changes should also be implemented throughout tarea to reduce on going impacts and to minimize the effects of a repowering project. (EBRPD) | Biological | |
| 5 | 5-20 | Abandoned roads should be recontoured and restored with native perennial grasses. The restoration will need maintenance and monitoring for several years until successfully established. The applicant should be required to create an endowment, a management and monitoring plan, and to establish specific restoration objectives, proposed improvements, and long-term maintenance and monitoring of restored areas. (EBRPD) | Biological | |
| 6 | 6-1 | Avian mortality is an issue of particular concern in Eastern Contra Costa and Alameda Counties because the region contains wind farms with large numbers of turbines. These turbines have significant impacts on birds and bats in the area which collide with the turbines while soaring on wind currents and foraging for prey in the area's open grasslands. How would the addition of larger, taller wind turbines to the area affect avian mortality? Are there any studies which show that the larger turbines result in either an increase or decrease in avian mortality? How many wind turbines are currently present in the vicinity of the project? (Save Mt. Diablo) | Biological | |
| 6 | 6-2 | Different avian species fly at different heights. Constructing taller wind turbines would likely result in impacts to a different set of species than those that are currently impacted with the existing turbines. For example, many bat species fly at an altitude higher than the existing turbines. Would the addition of taller wind turbines have impacts on any special status bat species that fly at higher elevations? (Save Mt. Diablo) | Biological | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| BIOLOGICAL RESOURCES (cont.) | | | | |
| 6 | 6-3 | The EIR should analyze how the construction of 13.25 miles of roads and 42 new wind turbines will impacts the habitat and movement of San Joaquin kit fox, the American, California red legged frog, California tiger salamander, and Western burrowing owl, among other species. (Save Mt. Diablo) | Biological | |
| 6 | 6-4 | According to the Notice of Preparation, the Project would include the construction of 13.25 miles of roads up to 30 feet wide, which would result in the conversion of more than 48 acres of open grassland to roads. The EIR should include figures indicating the amount of soil which will be graded to complete the construction of 13.25 miles of road covering 48 acres of land. For example, the Buchanan Road Bypass project currently being considered by the City of Pittsburg proposes the construction of 1.98 miles of road, which will require the grading of 2.7 million cubic yards. Regardless of the exact number, it seems likely that a significant amount of soil will be graded for the construction of the access roads. How would the grading of such a large amount of soil impact ground squirrel burrows which provide habitat for the San Joaquin kit fix, the Western burrowing owl, the California red-legged frog, the California tiger salamander, and other wildlife? (Save Mt. Diablo) | Biological | |
| 6 | 6-6 | The removal of the existing wind turbines and the installation of new ones would substantially increase the amount of traffic accessing the property and travelling along the 13.25 miles of new roads. Each additional vehicle driving on the Project site poses a threat to special status species moving through the area. A recent report analyzing Vasco Road's impacts to wildlife was published by the Contra Costa Public Works Department which details the death of a substantial number of special status species resulting from vehicle traffic along the road. How would the increased traffic on roads within the Project area add to the impacts resulting from the vehicular traffic of Vasco Road on wildlife habitat and movement in the area? (Save Mt. Diablo) | Biological | Traffic |
| 6 | 6-9 | The EIR should include full analysis of rare plants that may be found in the area which would be impacted by the removal of 86 turbines, the grading and construction 42 turbines and 13.25 miles of roads, and the burial of the current above ground transmission lines. (Save Mt. Diablo) | Biological | |
| 6 | 6-15 | The EIR should consider land uses throughout the area in analyzing how this project will add to cumulative impacts on wildlife habitat and open space resources. (Save Mt. Diablo) | Biological | Cumulative |
| 6 | 6-16 | CCWD is currently considering a project which would expand the Los Vaqueros reservoir, resulting in the flooding of up to 1,000 acres of land. The land that would be flooded offers habitat and movement corridors for a number of special status species in the area. The Tres Vaqueros wind farm project site is located on lands directly to the east of the Los Vaqueros Reservoir. As special status species habitat within the watershed is flooded, habitat suitable for those species within the Tres Vaqueros area will become even more valuable. Most notably, the Los Vaqueros project would flood a San Joaquin kit fox corridor on the western side of the reservoir. As a result, the only grassland corridor connecting the preserved open spaces in East Contra Costa County to the core of the kit fox habitat in the Altamont Hills and San Joaquin Valley would be the grasslands to the east of the reservoir. In other words, if a reservoir expansion is approved the 1,500 acre project site for the Tres Vaqueros wind farm would be part of the only remaining connection for kit fox dispersal. The significance of each kit fox den affected by grading and each kit fox potentially struck by a construction vehicle on the Project site is greater when considering the loss of the kit fox corridor on the western side of Los Vaqueros. (Save Mt. Diablo) | Biological | Cumulative |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| CULTURAL RESOURCES | | | | |
| 5 | 5-26 | The Preserve has tremendous and regionally significant cultural resources from a long habitation by Native Americans. There are many artifacts from this history throughout the Preserve. As a result, the Preserve is closed to general public access and there is ongoing monitoring and police enforcement to protect these sensitive cultural artifacts. It is very likely that similar cultural artifacts may be encountered throughout the Project area. This could include surface artifacts and burials that could be disturbed or destroyed during project construction. (EBRPD) | Cultural | |
| 5 | 5-27 | There should be a thorough investigation of the Project area to locate, document, avoid and protect cultural resources that may be affected by the Project. A specific mitigation plan should be developed that provides for construction monitoring by a qualified archeologist throughout the construction period. The plan should also include contingencies should something be encountered during project construction. Information about the specific cultural resources of the area must be kept confidential and provided only on a need to know basis. Employees should be trained on procedures for identifying and protecting cultural artifacts that may be encountered during Project construction. (EBRPD) | Cultural | |
| 5 | 5-28 | The applicant should establish procedures for securing the site during project construction to reduce the potential for vandalism and theft of cultural artifacts. This would include site security on a 24/7 basis and closure of certain roads to prevent contractors from unnecessarily entering areas where there may be cultural artifacts. (EBRPD) | Cultural | |
| 6 | 6-19 | The proposed Tres Vaqueros project would be located partially in the EBRPD's Preserve which was protected as mitigation for the 1997 Los Vaqueros Reservoir Project. The purpose of the Preserve is to protect the sensitive biological, cultural, and visual resources of the area. The EIR should evaluate how the Project would affect the preservation efforts of the EBRPD at the Preserve. (Save Mt. Diablo) | Cultural | Recreation |
| ENERGY | | | | |
| 1 | 1-1 | Northwind Energy, Inc. (Northwind) currently operates wind turbines downwind of the Project. Commenter request that the EIR analyze the Project's potential to cause downwind effects that would diminish the clean energy generated by Northwind's existing turbines. Commenter specifically requests that the EIR: (1) show the locations of all existing Northwind Turbines, (2) show the locations of all existing Howden turbines that the Project would replace, and (3) not count non-operational Howden turbines in the baseline for analysis. (Bingham McCutchen LLP) | Energy | Cumulative |
| HAZARDS | | | | |
| 5 | 5-24 | Consideration should be given to the potential release of hazardous materials from construction of the project. There are two buried petroleum pipelines that cross through the Project area. Access roads to the existing turbines cross these pipes at three locations. Construction would need to be closely coordinated with the owners of these pipelines to assure that there is no damage or potential release of petroleum products. (EBRPD) | Hazards | |
| 5 | 5-25 | Construction and maintenance of the Project also have the potential to release hazardous materials into the environment. This would include concrete, fuels, oils, solvents, paints, etc. Of particular concern are hazardous materials that might be discharged into wetlands and drainages in the Project area. (EBRPD) | Hazards | |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| HYDROLOGY | | | | |
| 4 | 4-1 | A portion of the Project is within CCWD's general district boundary adjacent to the Los Vaqueros Reservoir. CCWD's concerns are mainly focused on the potential impact of the windfarm project on the Los Vaqueros Watershed. The Draft EIR needs to ensure that the windfarm project conforms to the requirements of the following three documents: (1) the September 3, 1993 U.S. Fish and Wildlife Biological Opinion (BO) on the construction and operation of the Los Vaqueros Reservoir within the Los Vaqueros Watershed, which describes land management objectives and practices for the watershed lands; (2) the February 17, 1994 CDFG Memorandum of Understanding (MOD) on the Los Vaqueros Project, Attachment B of which is a Plan for Habitat Management which describes the management practices of the MOU; and (3) the Conservation Easement granted by CCWD to the CDFG which contains various property management provisions related to the Los Vaqueros Project. (CCWD) | Hydrology | |
| 4 | 4-6 | The EIR should evaluate construction on existing watershed fences and gates, on existing streams and water courses, and on the Los Vaqueros Reservoir. (CCWD) | Hydrology | |
| 5 | 5-9 | Mitigation measures should be adopted and implemented for removal and/or replacement of wind energy facilities. For example, many of the existing roadways have caused significant water quality impacts from substantial erosion from an inadequate drainage system. Regardless of whether specific roads are retained or removed, these drainage and erosion problems must be corrected to mitigate for this on going significant effect to water quality. (EBRPD) | Hydrology | |
| 5 | 5-19 | To the extent feasible, the Project should remove unneeded roads and associated drainage facilities. Many of the roads are in poor condition, some have failed and others are highly erosive, causing substantial downslope erosion and sedimentation in wetlands and riparian areas, impacting the species that depend upon these habitats, including tiger salamander and red-legged frog. (EBRPD) | Hydrology | Alternatives |
| 5 | 5-23 | New access roads should be designed to minimize the potential for slope failure and erosion. Drainage should be contained and discharged in a manner that does not concentrate flows that scour hillsides or deposit sediments and other pollutants into wetlands and drainages. (EBRPD) | Hydrology | |
| 6 | 6-5 | In reviewing Contra Costa County mapping information, it appears the Project site includes several streams and drainages with wetlands characteristics. Intense grading can cause a significant increase in soil erosion in the area. Potential erosion of soil near wetlands would have impacts on wetlands habitats. The construction of new roads will increase impermeable surfaces in the area. This change has the potential to increase runoff and impact drainage into the creeks. Wetlands delineation and impacts on riparian habitat from the Project should be assessed in the EIR. The EIR should include a map showing the exact location of all of the grading proposed for road construction in relation to the streams, drainages and other wetlands on the property. (Save Mt. Diablo) | Hydrology | Biological |
| 6 | 6-8 | Although they would no longer be in use, existing roads and other infrastructure may impact wildlife and their habitat. For example, roads contribute to run off and affect water quality and habitat of the wetlands in the area. The EIR should include mitigations which require the identification and removal all of the existing facilities and infrastructure on the Project site which will no longer be in use. (Save Mt. Diablo) | Hydrology | Biological |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| LAND USE | | | | |
| 5 | 5-1 | The Project is partially located on property owned by EBRPD and managed as part of the Preserve. (EBRPD) | Land Use | Recreation |
| 5 | 5-4 | Commenter provides background information regarding the establishment and expansion of EBRPD's Preserve. (EBRPD) | Land Use | |
| 5 | 5-7 | If EBRPD agrees to a repowering project at the Preserve, the applicant must obtain a lease or license to operate the new turbines and an Encroachment Permit from EBRPD, to construct the new turbines and related infrastructure. (EBRPD) | Land Use | |
| 6 | 6-18 | The East Contra Costa Habitat Conservation Plan Acquisition Priorities Map shows the portions of the Tres Vaqueros project area outside of the Los Vaqueros Watershed as Medium Acquisition Priority lands. The HCP has already begun to fund acquisition projects located in the Project area to preserve and protect the area's resources. The EIR should evaluate the compatibility of the Tres Vaqueros project with the goals and policies of the HCP and the lands being acquired with HCP funds in the area. (Save Mt. Diablo) | Land Use | Biological |
| PUBLIC SERVICES | | | | |
| 5 | 5-36 | Howden Road (from Vasco Road) is the primary means of access to the Preserve and to the southern end of the Project area. This road should remain accessible at all times for EBRPD emergency and maintenance vehicles to reach the Preserve. Should there be a need for temporary closure of the road then an alternative means of access to the Preserve should be provided. The EIR should evaluate how alternative access can be provided and address any potential safety concerns regarding access to the Preserve from Vasco Road. (EBRPD) | Public Services | Traffic |
| 5 | 5-29 | Site security at the Preserve has been an on-going concern. On numerous occasions gates are left open or unlocked. Unauthorized individuals have entered the Preserve and adjacent areas as a result of these breaches in security. The DEIR should identify mitigation measures to be implemented to improve site security, including new gates that open and close properly, new fencing where needed, regular inspections by the site supervisor and employee training about the sensitive cultural resources in the Preserve and adjacent areas. (EBRPD) | Public Services | |
| RECREATION | | | | |
| 5 | 5-38 | The Preserve currently has no public access, except by EBRPD-led tours on a reservation-only basis. These trips are limited to hikers. EBRPD will want to provide for these trips during the Project construction period. These trips are typically limited to weekends. (EBRPD) | Recreation | |
| 5 | 5-39 | EBRPD may, in the future, choose to allow public access to newly acquired lands to the north of the Preserve. EBRPD is concerned about the potential public access restrictions that may be imposed in order to protect public safety from the repowered turbines. For example, the EIR should establish reasonable set-back requirements between turbines and roads that might be useable as future trails. (EBRPD) | Recreation | Hazards |
| 5 | 5-40 | In Alameda County there is a set back requirement between turbines and public access. EBRPD understands the standard is three times the length of the turbine blade. This is considered the "blade throw" distance where the public might be in danger of being struck by a broken turbine blade. EBRPD would like to work with the County to establish reasonable standards that protect public safety, wind turbine facilities and allow for establishment of future trails, as depicted in our Master Plan Map of 2007. (EBRPD) | Recreation | Hazards |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| TRAFFIC | | | | |
| 3 | 3-1 | As the lead agency, Contra Costa County is responsible for all project mitigation, including any needed improvements to State highways. The project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures. This information should also be presented in the Mitigation Monitoring and Reporting Plan of the environmental document. Required roadway improvements should be completed prior to issuance of the Certificate of Occupancy. Since an encroachment permit is required for work in the state right of way (ROW), and Caltrans will not issue a permit until our concerns are adequately addressed, the Department strongly recommends that the Contra Costa County work with both the applicant and the Department to ensure that our concerns are resolved during the CEQA process, and prior to submittal of a permit application. (Caltrans) | Traffic | |
| 3 | 3-2 | Caltrans is primarily concerned with impacts to the State Highway System. Please ensure that the environmental analysis evaluates the traffic impacts on State faculties by applying the following criteria to determine if a Traffic Impact Study (TIS) is warranted: (1) The Project will generate over 100 peak hour trips assigned to a State highway facility; (2) the Project will generate between 50 to 100 peak hour trips assigned to a State highway facility, and the affected highway facilities are experiencing noticeable delay, approaching unstable traffic flow (level of service (LOS) "en or "D") conditions; and (3) the Project will generate between 1 to 49 peak hour trips assigned to a State highway facility, and the affected highway facilities are experiencing significant delay, unstable or forced traffic flow (LOS "E" or "P") conditions. (Caltrans) | Traffic | |
| 3 | 3-3 | The commenter recommends using the Department of Transportation's Guide for the Preparation of Traffic Impact Studies for determining which scenarios and methodologies to use in the analysis. It is available at the following website address: http://www.dot.ca.gov/hq/traffops/developserv/operationalsystems/reports/tisguide.pdf (Caltrans) | Traffic | |
| 3 | 3-4 | Any work or traffic control that encroaches onto the state ROW requires an encroachment permit that is issued by Caltrans. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating state ROW must be submitted to the address below. Traffic-related mitigation measures should be incorporated into the construction plans during the encroachment permit process. See the following website for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits/ (Caltrans) | Traffic | |
| 4 | 4-4 | Transportation and other pertinent sections of the EIR should evaluate the impacts resulting from construction of 13.25 miles of new access roads and "reclamation or modification" of a similar amount of existing site and turbine access roads, as well as restored roads and turbine foundations, and recontouring the land and removal of drainage structures. (CCWD) | Traffic | Biological Resources; Hydrology |
| 4 | 4-11 | Permanent site access roads 16 to 20 feet wide to accommodate maintenance vehicles represent a continuing circulation impact. CCWD needs to know the type and size of vehicles that would use the roads and at what frequency. In addition, any trail development needs to observe the Contra Costa County Ordinance which requires that visitors come no closer to the windmills than 3 times the height of the wind tower. (CCWD) | Traffic | Hazards |

**TABLE 2 (Continued)**
**COMMENTS RECEIVED DURING THE TRES VAQUEROS WINDFARM PROJECT EIR SCOPING PROCESS**

| Letter | Comment Number | Comment Summary | Response to Comment, or Draft EIR section in which comment is addressed | Comment also addressed in Section |
|---|---|---|---|---|
| ALTERNATIVES | | | | |
| 5 | 5-37 | As previously noted, the applicant is proposing 30 foot wide roads in some areas for construction of the new turbines. Howden Road is considerably narrower than 30 feet. Widening of this road to 30 feet would result in a number of significant impacts to water quality, wetlands, special-status species, aesthetics, etc. The EIR should address these specific impacts and identify alternative means of access that do not require widening this road. (EBRPD) | Alternatives | Hydrology |
| 2 | 2-5 | The EIR should analyze the full range of alternatives including permitting wind development on the site at a level that will maintain current power output, permitting wind development on the site at a level that will maintain current installed capacity and permitting the proposal as presented in the NOP, which increases both current output and current installed capacity. The EIR should acknowledge that any reduction in avian and bat mortality anticipated as a result of the replacement of the old generation turbines would be diminished by the increase in the current level of installed and production capacity on the site as described in the NOP. (CDFG) | Alternatives | Biological |
| 2 | 2-6 | An effective avoidance and minimization measure would be to maintain the current power output on the site instead of maintaining or increasing the current installed capacity and power output as proposed. This, combined with siting to avoid high risk areas such as saddles and canyons, sizing to avoid flight patterns of birds and bats, and operation of fewer more efficient turbines, could result in an effective effort to avoid and minimize impacts to biological resources. (CDFG) | Alternatives | Biological |
| 4 | 4-3 | Access alternatives, including the possible construction of a smaller amount of new roadways need to be evaluated in the EIR. (CCWD) | Alternatives | |
| 4 | 4-5 | Construction Equipment, Materials & Staging Area: The construction laydown area(s) needs to be evaluated in the alternatives section of the EIR with respect to the least amount of land take possible. (CCWD) | Alternatives | |
| 5 | 5-22 | Aerial construction methods are frequently employed by PG&E and other utilities to construct large electrical transmission towers in remote areas that are inaccessible from roads or where there are sensitive ecological habitats that cannot be disturbed. A recent example occurred in the Gateway Valley of Orinda where PG&E relocated about one mile of 500 KV electrical towers. PG&E used a monopole tower that was assembled in sections using helicopters. This method eliminated the need for construction of roads in some areas. (EBRPD) | Alternatives | |
| GROWTH | | | | |
| 6 | 6-17 | The approval of this project would likely result in similar applications being submitted to the County and have growth inducing impacts. There are a large number of turbines located in the area and many of them are either outdated or soon to be outdated. Larger turbines which produce more energy capacity are becoming the preferred option. Each of these projects will include a variety of infrastructure that will have impacts on sensitive resources. (Save Mt. Diablo) | Growth | |

## Issues Not Analyzed under CEQA

One comment from the EBRPD, number 5-32b states:

> "We would like to see views of the existing turbines (existing condition), views with the existing turbines removed (future no-project condition) and views of the new repowered turbines in place (future with-project condition)."

This comment requests visual simulations be prepared of a future no project case, i.e, a view of the future project site without turbines. This type of analysis, while appropriate for a National Environmental Policy Act (NEPA) analysis, is not required or needed for a CEQA analysis. Although the CEQA "no project alternative" is not fully known at this early point in the CEQA process, the "no project alternative" would most likely be the existing conditions continuing on site with the existing turbines operating. Consequently, these requested simulations will not be analyzed in this CEQA document.

# 5. Consideration of Issues Raised in Scoping Process

A primary purpose of this Scoping Report is to document the process of soliciting and identifying comments from interested agencies and the public. The Scoping Process provides the means by which the County can determine those issues that interested participants consider to be the principal areas for study and analysis. Every issue that has been raised that falls within the scope of CEQA during scoping will be addressed in the EIR.

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# APPENDIX A

## Notices of Preparation

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Department of Conservation & Development

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Contra Costa County

**Catherine O. Kutsuris**
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**Aruna Bhat**
Deputy Director
Community Development Division

FILED
MAR 23 2009
S.L. WEIR, COUNTY CLERK
CONTRA COSTA COUNTY
BY _____ DEPUTY

March 23, 2009

**NOTICE OF PREPARATION / NOTICE OF SCOPING MEETING FOR A DRAFT ENVIRONMENTAL IMPACT REPORT ON THE PROPOSED TRES VAQUEROS WINDFARM REPOWERING PROJECT**

**TO:** RESPONSIBLE AND TRUSTEE AGENCIES, AND OTHERWISE INTERESTED AGENCIES, ORGANIZATIONS, AND INDIVIDUALS

The Contra Costa County Department of Conservation & Development (DCD) has received an application for a Land Use Permit (County File Number LP09-2005) to allow "repowering" of a first-generation windfarm constructed in the mid-1980s. The DCD is the lead agency for preparation of the environmental impact report (EIR) for this project and is issuing this Notice of Preparation pursuant to Section 15082 of the California Environmental Quality Act (CEQA) Guidelines.

PROJECT DESCRIPTION

The project applicant, Tres Vaqueros Windfarms, LLC, proposes the following:

- Removal of 85 330kW and 1 750kW Howden wind turbines with a combined generating capacity of approximately 28.3 megawatts. Existing foundations would be covered with at least 1.5 feet of soil and seeded with native species. Reclaimed turbine areas would be returned to annual grassland habitat for agricultural use.
- Installation of up to 42 1-megawatt, or similar size, wind turbines. The total height of the model currently proposed is between 282 and 315 feet - the range resulting from different tower height options. The final model and height would be determined based on the conclusions of the EIR and considerations relating to model availability.
- Construction of approximately 70,000 feet (13.25 miles) of new access roads and reclamation or modification of a similar amount of existing site and turbine access roads. During construction, new access roads leading to the turbine sites would be up to 30 feet wide depending upon specific turns and required turning radii. Following

construction, permanent site access and turbine maintenance roads would be 16 to 20 feet wide to accommodate maintenance vehicles.

- Replacement of all existing above-ground electrical collection systems with below-ground lines. The underground transmission system would terminate at the existing substation, which connects the windfarm to a 230kV PG&E transmission line running adjacent to the project area.

The "repowered" facility's energy production capability would be 3 to 4 times greater than the output capability of the existing facility.

The actual "footprint" of turbine pads, foundations, underground collection facilities, the maintenance facility, and the substation would be about 44 acres, representing a 3-acre reduction from the existing facility.

PROJECT LOCATION

The project site consists of approximately 1,500 acres encompassing all or portions of 9 parcels in unincorporated southeastern Contra Costa County. The site is located roughly 3.5 miles southwest of the unincorporated community of Byron, approximately 6 miles north of the city of Livermore in Alameda County, approximately 2 miles west of the East County (Byron) Airport, and adjacent to Los Vaqueros Reservoir. Portions of the Los Vaqueros watershed and Vasco Caves Regional Park are located within the site. Vasco Road, which runs along the site's eastern edge, is the only public road providing access.

Latitude / Longitude: 37° 49' 12" / -121° 41' 48"
Section: 25, 30
Township: 1S
Range: 2E, 3E
Base: Mt. Diablo

ANTICIPATED IMPACTS

Pursuant to CEQA Guidelines Section 15060(d), the DCD will not prepare an initial study prior to commencing work on the EIR. Based on knowledge of other windfarm projects in the vicinity of the project site, we anticipate that the project may result in potentially significant impacts in the following CEQA topic areas:

- Aesthetics: replacing smaller, more numerous wind turbines with fewer, but significantly larger turbines would alter the site's appearance.
- Air Quality: construction activities would cause a temporary increase in emissions of criteria pollutants and greenhouse gases.
- Biological Resources: construction activities and turbine operation may result in significant impacts to a variety of protected plant and animal species and their habitats. Of special concern are potential impacts to avian species.
- Cultural Resources: construction activities may disturb undiscovered cultural sites.

- Geology & Soils: the new turbines would eventually be exposed to seismic shaking and it is unclear whether existing soil conditions are suitable for the project.
- Hydrology & Water Quality: local drainage patterns may be altered in a way that causes erosion.
- Noise: ambient noise levels may increase temporarily during construction and may increase permanently during operation.
- Transportation & Traffic: transportation of construction materials and equipment may necessitate temporary closures of Vasco Road and may temporarily disrupt traffic along State highways.

PUBLIC COMMENTS

All responsible and trustee agencies, and interested agencies, organizations, and individuals are invited to submit comments which address environmental concerns resulting from the implementation of the proposed project.

**Responses to this Notice of Preparation must be received at the following address by 5:00 p.m. on Wednesday, April 22, 2009:**

**Contra Costa County**
**Department of Conservation & Development**
**Community Development Division**
**651 Pine Street, 4th Floor - North Wing**
**Martinez, California 94553**
**Attention: Will Nelson**

The County File Number stated above should be included in all correspondence.

SCOPING MEETING

A scoping meeting will be held on **Monday, April 20, 2009, at 1:30 p.m.** in Room 107 of the McBrien Administration Building, 651 Pine Street, Martinez, California. At this meeting, interested agencies, organizations, and individuals may submit oral and written comments pertaining to environmental concerns related to the proposed project.

SUPPORTING DOCUMENTS

The Land Use Permit application and supporting documents are available for review at the Department of Conservation & Development, Community Development Division. If you wish to obtain a copy of any documents related to this project, please contact me at (925) 335-1208 or wnels@cd.cccounty.us.

Signature: _____

William R. Nelson, Senior Planner
Contra Costa County
Department of Conservation & Development

Department of Conservation & Development

**Community Development Division**

County Administration Building
651 Pine Street
North Wing, Fourth Floor
Martinez, CA 94553-1229

Phone: (925) 335-1210

Contra Costa County

**Catherine O. Kutsuris**
Director

**Aruna Bhat**
Deputy Director
Community Development Division

FILED
MAR 31 2009
S.L. WEIR, COUNTY CLERK
CONTRA COSTA COUNTY
BY _____ DEPUTY

March 31, 2009

**NOTICE OF PREPARATION / NOTICE OF SCOPING MEETING FOR A DRAFT ENVIRONMENTAL IMPACT REPORT ON THE PROPOSED TRES VAQUEROS WINDFARM REPOWERING PROJECT**

**TO:** RESPONSIBLE AND TRUSTEE AGENCIES, AND OTHERWISE INTERESTED AGENCIES, ORGANIZATIONS, AND INDIVIDUALS

The Contra Costa County Department of Conservation & Development (DCD) has received an application for a Land Use Permit (County File Number LP09-2005) to allow "repowering" of a first-generation windfarm constructed in the mid-1980s. The DCD is the lead agency for preparation of the environmental impact report (EIR) for this project and is issuing this Notice of Preparation pursuant to Section 15082 of the California Environmental Quality Act (CEQA) Guidelines.

PROJECT DESCRIPTION

The project applicant, Tres Vaqueros Windfarms, LLC, proposes the following:

- Removal of 85 330kW and 1 750kW Howden wind turbines with a combined generating capacity of approximately 28.3 megawatts. Existing foundations would be covered with at least 1.5 feet of soil and seeded with native species. Reclaimed turbine areas would be returned to annual grassland habitat for agricultural use.
- Installation of up to 42 1-megawatt, or similar size, wind turbines. The total height of the model currently proposed is between 282 and 315 feet - the range resulting from different tower height options. The final model and height would be determined based on the conclusions of the EIR and considerations relating to model availability.
- Construction of approximately 70,000 feet (13.25 miles) of new access roads and reclamation or modification of a similar amount of existing site and turbine access roads. During construction, new access roads leading to the turbine sites would be up to 30 feet wide depending upon specific turns and required turning radii. Following

construction, permanent site access and turbine maintenance roads would be 16 to 20 feet wide to accommodate maintenance vehicles.

- Replacement of all existing above-ground electrical collection systems with below-ground lines. The underground transmission system would terminate at the existing substation, which connects the windfarm to a 230kV PG&E transmission line running adjacent to the project area.

The "repowered" facility's energy production capability would be 3 to 4 times greater than the output capability of the existing facility.

The actual "footprint" of turbine pads, foundations, underground collection facilities, the maintenance facility, and the substation would be about 44 acres, representing a 3-acre reduction from the existing facility.

PROJECT LOCATION

The project site consists of approximately 1,500 acres encompassing all or portions of 9 parcels in unincorporated southeastern Contra Costa County. The site is located roughly 3.5 miles southwest of the unincorporated community of Byron, approximately 6 miles north of the city of Livermore in Alameda County, approximately 2 miles west of the East County (Byron) Airport, and adjacent to Los Vaqueros Reservoir. Portions of the Los Vaqueros watershed and Vasco Caves Regional Park are located within the site. Vasco Road, which runs along the site's eastern edge, is the only public road providing access.

Latitude / Longitude: 37° 49' 12" / -121° 41' 48"
Section: 25, 30
Township: 1S
Range: 2E, 3E
Base: Mt. Diablo

ANTICIPATED IMPACTS

Pursuant to CEQA Guidelines Section 15060(d), the DCD will not prepare an initial study prior to commencing work on the EIR. Based on knowledge of other windfarm projects in the vicinity of the project site, we anticipate that the project may result in potentially significant impacts in the following CEQA topic areas:

- Aesthetics: replacing smaller, more numerous wind turbines with fewer, but significantly larger turbines would alter the site's appearance.
- Air Quality: construction activities would cause a temporary increase in emissions of criteria pollutants and greenhouse gases.
- Biological Resources: construction activities and turbine operation may result in significant impacts to a variety of protected plant and animal species and their habitats. Of special concern are potential impacts to avian species.
- Cultural Resources: construction activities may disturb undiscovered cultural sites.

- Geology & Soils: the new turbines would eventually be exposed to seismic shaking and it is unclear whether existing soil conditions are suitable for the project.
- Hydrology & Water Quality: local drainage patterns may be altered in a way that causes erosion.
- Noise: ambient noise levels may increase temporarily during construction and may increase permanently during operation.
- Transportation & Traffic: transportation of construction materials and equipment may necessitate temporary closures of Vasco Road and may temporarily disrupt traffic along State highways.

PUBLIC COMMENTS

All responsible and trustee agencies, and interested agencies, organizations, and individuals are invited to submit comments which address environmental concerns resulting from the implementation of the proposed project.

**Responses to this Notice of Preparation must be received at the following address by 5:00 p.m. on Thursday, April 30, 2009:**

**Contra Costa County**
**Department of Conservation & Development**
**Community Development Division**
**651 Pine Street, 4th Floor - North Wing**
**Martinez, California 94553**
**Attention: Will Nelson**

The County File Number stated above should be included in all correspondence.

SCOPING MEETING

A scoping meeting will be held on **Monday, April 20, 2009, at 1:30 p.m.** in Room 107 of the McBrien Administration Building, 651 Pine Street, Martinez, California. At this meeting, interested agencies, organizations, and individuals may submit oral and written comments pertaining to environmental concerns related to the proposed project.

SUPPORTING DOCUMENTS

The Land Use Permit application and supporting documents are available for review at the Department of Conservation & Development, Community Development Division. If you wish to obtain a copy of any documents related to this project, please contact me at (925) 335-1208 or wnels@cd.cccounty.us.

Signature: _____

William R. Nelson, Senior Planner
Contra Costa County
Department of Conservation & Development

Department of
Conservation &
Development

**Community Development Division**

County Administration Building
651 Pine Street
North Wing, Fourth Floor
Martinez, CA 94553-1229

Phone: (925) 335-1210

Contra
Costa
County

**Catherine O. Kutsuris**
Director

**Aruna Bhat**
Deputy Director
Community Development Division

FILE COPY

FILED
JUN 05 2009
S.L. WEIR, COUNTY CLERK
CONTRA COSTA COUNTY
BY Moliver DEPUTY

June 5, 2009

**NOTICE OF PREPARATION / NOTICE OF SCOPING MEETING
FOR A DRAFT ENVIRONMENTAL IMPACT REPORT
ON THE PROPOSED TRES VAQUEROS WIND FARM REPOWERING PROJECT**

**TO:** RESPONSIBLE AND TRUSTEE AGENCIES, AND OTHERWISE INTERESTED AGENCIES, ORGANIZATIONS, AND INDIVIDUALS

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- Installation of up to 42 1-megawatt, or similar size, wind turbines. The total height of the model currently proposed is between 282 and 315 feet - the range resulting from different tower height options. The final model and height would be determined based on the conclusions of the EIR and considerations relating to model availability.
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construction, permanent site access and turbine maintenance roads would be 16 to 20 feet wide to accommodate maintenance vehicles.

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PROJECT LOCATION

The project site consists of approximately 1,500 acres encompassing all or portions of 9 parcels in unincorporated southeastern Contra Costa County. The site is located roughly 3.5 miles southwest of the unincorporated community of Byron, approximately 6 miles north of the city of Livermore in Alameda County, approximately 2 miles west of the East County (Byron) Airport, and adjacent to Los Vaqueros Reservoir. Portions of the Los Vaqueros watershed and Vasco Caves Regional Park are located within the site. Vasco Road, which runs along the site's eastern edge, is the only public road providing access.

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Section: 25, 30
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Range: 2E, 3E
Base: Mt. Diablo

ANTICIPATED IMPACTS

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- Noise: ambient noise levels may increase temporarily during construction and may increase permanently during operation.
- Transportation & Traffic: transportation of construction materials and equipment may necessitate temporary closures of Vasco Road and may temporarily disrupt traffic along State highways.

PUBLIC COMMENTS

All responsible and trustee agencies, and interested agencies, organizations, and individuals are invited to submit comments which address environmental concerns resulting from the implementation of the proposed project.

**Responses to this Notice of Preparation must be received at the following address by 5:00 p.m. on Tuesday, July 7, 2009:**

**Contra Costa County**
**Department of Conservation & Development**
**Community Development Division**
**651 Pine Street, 4th Floor - North Wing**
**Martinez, California 94553**
**Attention: Will Nelson**

The County File Number stated above should be included in all correspondence.

SCOPING MEETING

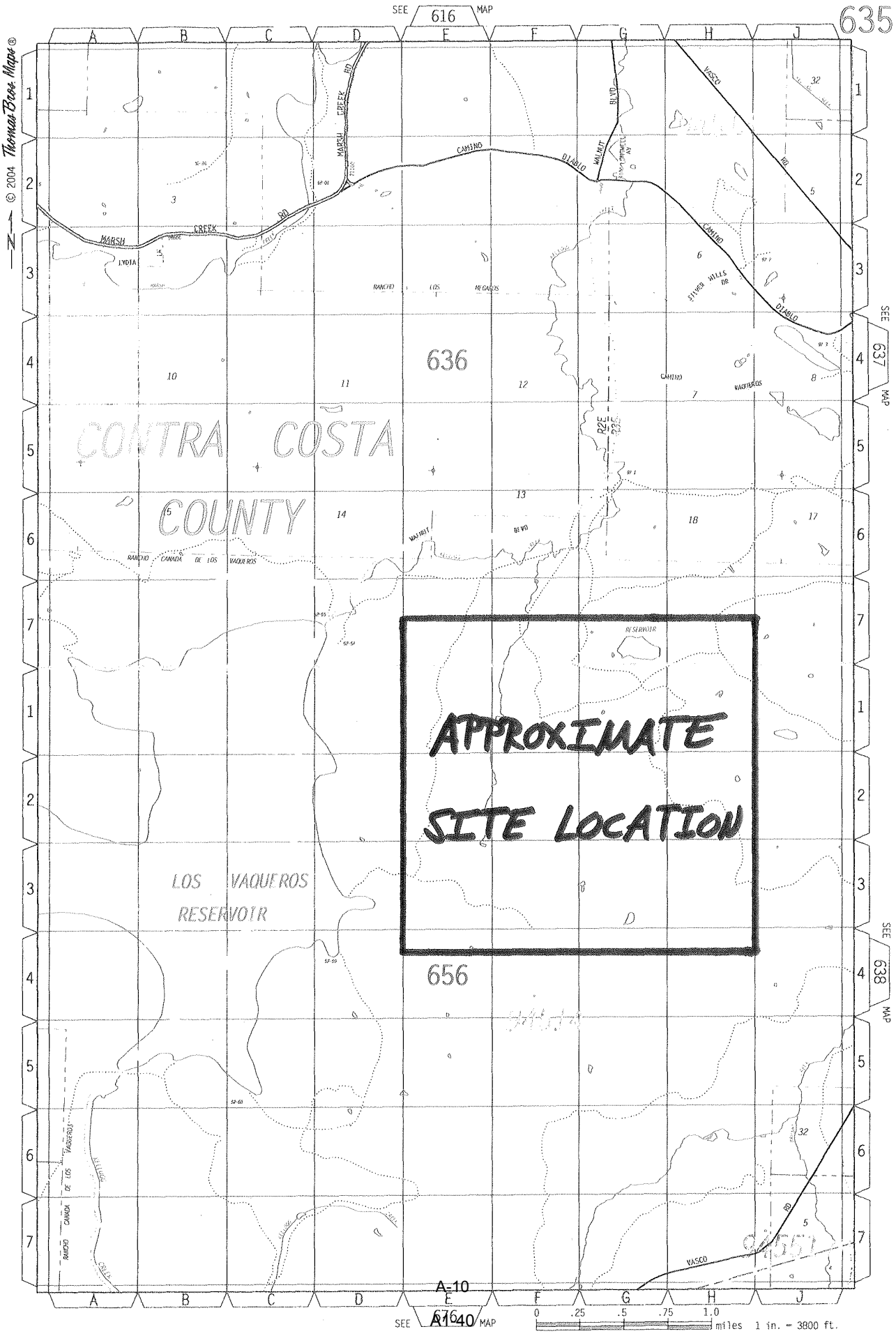
A scoping meeting will be held on **Monday, July 6, 2009, at 1:30 p.m.** in Room 107 of the McBrien Administration Building, 651 Pine Street, Martinez, California. At this meeting, interested agencies, organizations, and individuals may submit oral and written comments pertaining to environmental concerns related to the proposed project.

SUPPORTING DOCUMENTS

The Land Use Permit application and supporting documents are available for review at the Department of Conservation & Development, Community Development Division. If you wish to obtain a copy of any documents related to this project, please contact me at (925) 335-1208 or wnels@cd.cccounty.us.

Signature: _____

William R. Nelson, Senior Planner
Contra Costa County
Department of Conservation & Development

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CONTRA COSTA

# APPENDIX B

## Scoping Meeting Speaker Cards

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Contra Costa County
Community Development Department

IF YOU ARE INTERESTED IN SPEAKING IN FAVOR OF OR OBJECTING TO THE GRANTING OF ANY OF THE APPLICATIONS LISTED, PLEASE SIGN YOUR NAME AND ADDRESS AND LIST THE ITEM NUMBER TO WHICH YOU ARE GOING TO SPEAK AND LEAVE THIS AT THE LECTERN.

Item Number on Agenda: 5 Check One: Scoping Session

Date: Apr. 20 - 09 Support:____ Oppose:____

Name: Laura Baker / California Native Plant Society

Address: 79 Roble Rd.

City: Berkeley State: CA Zip Code: 94705

Telephone Number: (510) 849-1409 (Optional)

Contra Costa County
Community Development Department

IF YOU ARE INTERESTED IN SPEAKING IN FAVOR OF OR OBJECTING TO THE GRANTING OF ANY OF THE APPLICATIONS LISTED, PLEASE SIGN YOUR NAME AND ADDRESS AND LIST THE ITEM NUMBER TO WHICH YOU ARE GOING TO SPEAK AND LEAVE THIS AT THE LECTERN.

Item Number on Agenda: 5 Check One:

Date: 4/20/09 Support: ✓ Oppose:____

Name: JOE CIOLEK, AGRICULTURAL - NATURAL RESOURCES TRUST OF CCC

Address: P.O. BOX 6224

City: CONCORD State: CA Zip Code: 94520

Telephone Number: (925) 588-5351 (Optional)

Contra Costa County
Community Development Department

IF YOU ARE INTERESTED IN SPEAKING IN FAVOR OF OR OBJECTING TO THE GRANTING OF ANY OF THE APPLICATIONS LISTED, PLEASE SIGN YOUR NAME AND ADDRESS AND LIST THE ITEM NUMBER TO WHICH YOU ARE GOING TO SPEAK AND LEAVE THIS AT THE LECTERN.

Item Number on Agenda: 5 Check One:

Date: 04/20/2009 Support: ____ Oppose: ✓

Name: Jeff Welton, Northwind Energy, Inc.

Address: 1090 N. Palm Canyon Dr. Suite A

City: Palm Springs State: CA Zip Code: 92262

Telephone Number: (760) 323-9490 ext. 122 (Optional)

Contra Costa County
Community Development Department

IF YOU ARE INTERESTED IN SPEAKING IN FAVOR OF OR OBJECTING TO THE GRANTING OF ANY OF THE APPLICATIONS LISTED, PLEASE SIGN YOUR NAME AND ADDRESS AND LIST THE ITEM NUMBER TO WHICH YOU ARE GOING TO SPEAK AND LEAVE THIS AT THE LECTERN.

Item Number on Agenda: 5 Check One:

Date: 4-20-2009 Support: ____ Oppose: ____

Name: ~~SETH~~ TROY BRISTOL, LAND CONSERVATION ASSOC. SAVE MOUNT DIABLO

Address: 1901 Olympic Blvd. Suite 220

City: Walnut Creek State: CA Zip Code: 94596

Telephone Number: (925) 947.3535 (Optional)

# APPENDIX C

## Scoping Meeting Transcript

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**ZA MTG 4-20-09 13:30**
**TRES VAQUEROS WINDFARMS, LLC**
**TRANSCRIPT**

Item 5
Public Comments

*Environmental Impact comments only [requested by Aruna]*

**(#880) Laura Baker, Representative of the East Bay Chapter of California Native Plant Society, 79 Roble Road, Berkeley, CA 94705, 510-849-1409**

"We will probably be submitting written comments as well.

The areas we would like to see covered in the EIR:

Interested in what type of weed abatement will be on fracticed along the road b/c the project area is adjacent to sensitive and includes sensitive plant sites and the construction of over 13 miles of road is, as a source of disturbance, is likely to bring quite a bit of weeds into the area; and we would like to see a weed management plan. SM-1

We note that the project site includes easements already there and that two of the portions of the site seem to be recent acquisitions as part of the East Contra Costa County Habitat Conservation Plan. I think there needs to be some clarification as to whether those are mitigations for other projects and whether there will be mitigations considered for impacts off site. In other words, the mitigations would be off site. I'm sure the document will reveal who holds the easements, whether it's the East Bay Regional Park District or the Water District, I'm not sure. SM-2

But, we would also like to see as part of those documents the ongoing management plan that are part of the easement documentation b/c that may reveal a lot about what is there and how it's being managed in terms of the natural resources.

We would like to see the protocols described for the botanical surveys. I understand, in speaking to Mr. Nelson, that there have been quite a few botanical surveys done in the Los Vaqueros area, which is immediately SM-3

adjacent so there are likely to be fairly good surveys, but we'd like to see that because there are a couple of plant species that are likely to occur there that are listed plant species.

We'd also like to know whether the botanical surveys included locally rare plants, as well. There is a database that can be consulted for those purposes. SM-3

We'd like the project to be related to the creek pond and other wetlands that are apparently on the project; all I have are the maps so it's hard to see exactly where everything occurs, where the roads are and where the turbines, with respect to those wetlands; but, those are likely to contain plants of interest to us possibly listed plant species, as well. SM-4

There was mention in the description of the plant that they will be reseeding as they remove the old wind turbines, they will be reseeding the old site with native species. Again, because this site includes lands that are already sensitive, it's important that the local ecotypes be used for seeding and not bring in seed from outside areas b/c they can cross pollinate with other species and that would be a negative impact. SM-5

I don't know if anyone is here from Audubon; but, we certainly are interested in the impacts to birds of the turbines there and assuming that will be addressed quite extensively in the EIR. SM-6

Thank you."

---

**(#943) Joe Ciolek, Executive Director, Agricultural – Natural Resources Trust of CCC**

"We hold the conservation easement on 936 acres of the proposed 1500-acre site. Note that we have not been in communication of any kind with the property owners or the project proponent. Although the easement document pretty clearly stipulates that work of this nature needs to include communication with us.

We are not in opposition to the plan; but, because we don't know very much about it at this time, we can't say much more there. So my purpose in coming is to ask that it be in the record our interest in working closely on the project. There is a management plan for the 936 acres. We're happy to share

what we know and what our responsibilities are under that and certainly looking forward to working closely with the project proponents in this matter.

I don't know what other questions to ask or to raise at this time. Health issues have complicated our schedule for the last several months so we're behind and have not seen the draft of the EIR at this point.

We'll catch up as quickly as we can in that matter and any assistance you can give to direct us to the right people, we'd appreciate."

[Aruna introduced Joe to Will Nelson, the project planner, and gave him Will's phone number.]

Joe will make it a point to meet with him.

---

**(#963) Jeff Welton, Northwind Energy, Inc., 1090 N. Palm Canyon Drive, Suite A, Palm Springs, CA 92262, 760-323-9490**

"We own the wind energy project, which is immediately adjacent to the Tres Vaqueros Windfarms. We'd like to submit our written comments that were prepared by our representing offer."

---

**(#912) Mr. Adams**

"Save Mt. Diablo is working on our comments and I don't have any specific comments right now and I was just filling out the speaker's card. But, we wanted to go on record that we have strong concerns. A lot of our comments mirror those of the East Bay Regional Park District, which has already submitted extensive scoping comments and we'll be providing scoping comments before the deadline. Thanks."

---

Deadline for comments: Thursday, April 30th by 5:00pm.Contact Will Nelson

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# APPENDIX D

## Scoping Period Written Comments

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BINGHAM

Julie Jones
Direct Phone: 415.393.2580
Direct Fax: 415.262.9239
julie.jones@bingham.com

CONTRA COSTA

2009 APR 21 P 12: 09

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

April 20, 2009

**By Hand and First Class Mail**

William R. Nelson
Senior Planner
Contra Costa County Department of Conservation and Development
651 Pine Street, 4th Floor - North Wing
Martinez, California 94553

**Re: Draft Environmental Impact Report on the Proposed Tres Vaqueros Windfarm Repowering Project**

Dear Mr. Nelson:

This firm represents Northwind Energy, Inc. ("Northwind"). We are writing on behalf of Northwind in response to the County's Notice of Preparation of an Environmental Impact Report for the proposed Tres Vaqueros Windfarm Repowering Project ("Project"). As the County is aware, Northwind currently operates wind turbines downwind of the Project. In addition to the other environmental impacts the EIR must address, Northwind requests that the EIR analyze the Project's potential to cause downwind effects that would diminish the clean energy generated by Northwind's existing turbines. Specifically, Northwind requests that the EIR for the Project address the following issues:

1. In its existing setting discussion, the EIR should show the locations of all of the existing Northwind turbines. We believe the County has this information, but if it does not, please contact me and a map will be provided. The existing setting discussion should also show the locations of all of the existing Howden turbines that the Project would replace, and should state which of those turbines were and were not operational as of March 23, 2009, the NOP date. Northwind understands that the applicant's Howden wind turbines have been failing for some years and that many of them are not operational. Because the baseline for analysis of the environmental impacts of the Project is physical conditions as of the NOP date, non-operational Howden turbines cannot be treated as operational for the purposes of CEQA analysis. 1-1

2. In its project description, the EIR should show the locations, sizes (including tower height, rotor diameter, and overall height), and potential manufacturers and models of all of the proposed wind turbines. The distances between the proposed turbines and the nearest existing Northwind turbines should be stated clearly either in a table or on a plot plan. The specifications of the turbines would be relevant to both effects on downwind turbines and to impacts on birds, so determination of these turbine specifics cannot, as the NOP suggests, await "the conclusions of the EIR and considerations relating to model availability." 1-2

Boston
Hartford
Hong Kong
London
Los Angeles
New York
Orange County
San Francisco
Santa Monica
Silicon Valley
Tokyo
Walnut Creek
Washington

Bingham McCutchen LLP
Three Embarcadero Center
San Francisco, CA
94111-4067

T 415.393.2000
F 415.393.2286
bingham.com

3. The EIR's impact analysis must address the downwind effects of the Project's very large turbines on Northwind's smaller downwind turbines. In Northwind's experience, the placement of large 1-megawatt wind turbines upwind of smaller turbines--even at substantial distances--has significant effects on the energy generated by the downwind turbines, both due to decreased wind reaching the downwind turbines and due to increased turbulence that harms the downwind turbines and shortens their useful lives. If the Project would cause such effects, it would conflict with County Zoning Code section 88-3.148(b), which forbids wind energy conversion systems that "adversely affect the orderly conduct of existing or planned land uses in the vicinity."

In addition, significant downwind effects would constitute significant CEQA impacts. CEQA defines "environment" to mean "the physical conditions which exist within the area which will be affected by the proposed project, including . . . air." Pub. Res. Code § 21060.5. To determine the significance of an environmental effect of a project, the lead agency *shall* consider direct physical changes in the environment which may be caused by the project. CEQA Guidelines § 15064(d). If a project would cause a climatic change that would affect neighboring commercial uses of land, that change must be studied in an EIR. *Galante Vineyards v. Monterey Peninsula Water Management Dist.,* 60 Cal. App. 4th 1109 (1997) (EIR for reservoir project held inadequate where reservoir could slightly change the humidity and temperature of the air in the immediate vicinity, but EIR did not analyze the potential effects of those climatic changes on the commercial viability of nearby vineyards and rose nurseries). The wind effect of the Project is not a "mere" economic effect; it is a physical change whose significance may be measured in part by its economic consequences. *See* CEQA Guidelines sections 15131(b); 15064(e); *Marin Mun. Water Dist. v. KG Land California Corp.,* 235 Cal. App. 3d 1652, 1662 (1991) (EIR may use "economic effects to determine the importance of physical changes"). Here, the tangible effects downwind of the new turbines could be the loss of wind energy production, deterioration of physical facilities, and the loss of commercial viability of Northwind's turbines. 1-2

Thank you for the opportunity to comment on the proper scope of the EIR for this Project. Please do not hesitate to contact me if you have any questions or require further information.

Sincerely yours,

Julie Jones

Julie Jones

cc: Jeff Welton, Northwind Energy, Inc.
Fred Noble, Northwind Energy, Inc.

A/73016411.1

California Natural Resources Agency
DEPARTMENT OF FISH AND GAME
Bay Delta Region
Post Office Box 47
Yountville, California 94599
(707) 944-5500
http://www.dfg.ca.gov

ARNOLD SCHWARZENEGGER, Governor
DONALD KOCH, Director

May 28, 2009

Mr. Will Nelson
Contra Costa County
Department of Conservation and Development
651 Pine Street, 4th Floor-North Wing
Martinez, CA 94553
Via Fax (925) 335-1222

Dear Mr. Nelson:

Subject: Tres Vaqueros Windfarm Repowering Project, Notice of Preparation of a Draft Environmental Impact Report, SCH #2009032077, Contra Costa County

This letter responds to the Notice of Preparation (NOP) for the draft Environmental Impact Report (EIR) for the Tres Vaqueros Windfarm Repowering Project (Project), Contra Costa County dated March 2009. The Project is for the installation of up to 42 one-megawatt or similar size turbines. The height range for the turbines is between 282 and 315 feet. The Project is located in the Altamont Pass Wind Resources Area (APWRA). This area supports high numbers of special-status terrestrial, avian, and bat species, with a particularly high concentration of raptors in the area.

Potential biological impacts identified during review of previous repowering projects should be considered in the preparation of the EIR for this Project. The summary of information presented in the NOP states that the footprint of the "new" project will ultimately be 44 acres, which represents a 3-acre reduction from the existing facility; that the power output will increase; and that the number of turbines will be reduced from 84 to 42. The information as presented is accurate but only considers physical footprint. To do a fair and balanced analysis of the impacts that will continue as a result of the repowering as proposed, it is necessary to include information about factors that contribute to impacts to avian and bat species such as operating hours and schedules. 2-1

Although we understand that a California Environmental Quality Act (CEQA) analysis relies on existing conditions to establish baseline for comparison, the baseline conditions for the current operation of turbines at the Tres Vaqueros site is unknown in terms of impacts to avian and bat species. It is also unknown if repowering efforts will decrease or increase impacts to avian and bat species, or if a different suite of species will be affected. Differences in turbine heights and operation, including lower cut-in speeds (the amount of wind needed for the turbine to start operating), may affect the number and type of species that are impacted. We do know that variation in these results will likely be site-specific. 2-2

*Conserving California's Wildlife Since 1870*

An accurate comparison of pre- and post-Project impacts, including mortality cannot be based solely on results found for existing wind turbine operations throughout the APWRA including repowered projects. Specifically for avian and bat species, the EIR should require pre- and post-Project site-specific data be gathered and evaluated and that the Project be designed to minimize impacts to sensitive species based on this information. Use of site-specific information on bird abundance and use, flight patterns, wind patterns, topography, and other factors as recommended in the "California Guidelines for Reducing Impacts to Bird and Bats from Wind Energy Development" produced by the California Energy Commission in cooperation with the Department of Fish and Game (DFG), dated October 2007, should be used to guide the design of the Project and to assess the change in impacts which can be attributed to this repowering Project. 2-3

In addition, based on this site-specific information, continuing unavoidable impacts should be evaluated in the EIR for their significance to each affected species. Even if a reduction in turbine strike mortality is achieved, other Project-related effects from the footprint and operation of these facilities and degradation of suitable habitat as a result of disturbance, proliferation of predators and avoidance by sensitive species should be considered when determining mitigation requirements and whether an impact has been reduced to a level of less-than-significant for each affected species. 2-4

The EIR should analyze the full range of alternatives including permitting wind development on the site at a level that will maintain current power output, permitting wind development on the site at a level that will maintain current installed capacity and permitting the proposal as presented in the NOP, which increases both current output and current installed capacity. The EIR should acknowledge that any reduction in avian and bat mortality anticipated as a result of the replacement of the old generation turbines would be diminished by the increase in the current level of installed and production capacity on the site as described in the NOP. It is not known if this repowering Project will reduce or increase avian and bat mortality unless pre- and post-repowering data are developed and analyzed. 2-5

An effective avoidance and minimization measure would be to maintain the current power output on the site instead of maintaining or increasing the current installed capacity and power output as proposed. This, combined with siting to avoid high risk areas such as saddles and canyons, sizing to avoid flight patterns of birds and bats, and operation of fewer more efficient turbines, could result in an effective effort to avoid and minimize impacts to biological resources. 2-6

The EIR should require that site disturbance be minimized during construction of the Project. DFG supports the effort to restore previously disturbed sites to something closer to natural conditions; however, burying unused turbine pads by disturbing additional habitat is a significant impact that should be minimized and mitigated. Soil to cover the pads should not be scraped from the site, as has occurred for other projects in the area, or from off-site areas that provide habitat for sensitive native species such as California tiger salamander 2-7

estivation habitat. Alternatively, less destructive solutions should be implemented to meet Contra Costa County's (County) remediation requirements such as buying suitable excess cut material available from other sites. 2-7

Based on the limited amount of available information, careful siting and sizing of turbines appear to be some of the more effective ways to reduce impacts to biological resources. The EIR should include very specific siting and sizing requirements for turbines with the intent of reducing biological impacts. DFG recommends that these siting and sizing conditions be made mandatory conditions of approvals when certifying the EIR. These requirements should be approved by DFG and based on the best available science industry-wide as well as site-specific information about sensitive habitats and existing species use patterns. 2-8

The EIR should require pre-project surveys, studies that are needed to fill data gaps, post-construction monitoring and compliance reports, adaptive management of biological resources and operation schedules, and site access for research and monitoring.

The EIR should require minimization and mitigation measures that consider impacts to species other than the focal raptor species since the changes in turbine type are anticipated to change the species which will be impacted. 2-9

The EIR should include requirements for various levels of shutdown or operational changes dependant on mortality rates. The EIR should require that DFG and the County approve or formulate the shutdown plan based on monitoring results.

The EIR should identify mitigation requirements. The County should work with DFG to develop specific and measurable mitigation requirements for unavoidable temporary, one-time, and ongoing impacts. Ongoing mitigation to benefit the avian, bat and terrestrial species which continue to be affected should be required. Ongoing mitigation should be required for ongoing impacts and should be linked to impact trend. When monitoring shows a reduction/increase in impacts, mitigation requirements may be reduced/increased proportionally. Standard mitigation practices are appropriate for non-recurring impacts. 2-10

In a CEQA context, the NOP compares the impacts from the repowering project to current impacts. Separately, DFG will consider that although this is a repowering project, the siting, operation and impacts from the existing facilities were never reviewed, approved, or permitted by DFG, U.S. Fish and Wildlife Service (USFWS) or any other resource agency. Take of State listed and federally listed, threatened, or endangered species is likely to occur during the construction and operation of this Project. DFG's recommendations and permit requirements will require permanent conservation of habitat to mitigate for any take of State listed species and compensation to mitigate any for ongoing take. These DFG recommendations and requirement for a permit should be included in the EIR as conditions of approval. 2-11

The EIR should require that mitigation requirements for special-status species should be determined in coordination with DFG and USFWS and fully disclosed in the EIR. Habitat mitigation for the kit fox, tiger salamander, red-legged frog, Swainson's hawk, Alameda whipsnake, and burrowing owl should be determined with consultation and approval from DFG and USFWS. Many biological factors are evaluated when determining appropriate mitigation to adequately reduce the level of significant project impacts. These factors include evaluating the Project's biological value and resulting impact to listed species, as well as the quality of the proposed mitigation lands. Project design modifications that minimize impacts to species are also evaluated. 2-12

The EIR should require that all lands conserved for wildlife and habitat should be permanently protected under a conservation easement or fee title to the State of California with a management plan and a management plan endowment. The management plan should be approved by DFG and USFWS and guide management and monitoring of the mitigation habitat. The management plan may be modified as needed to adaptively manage for benefits to the wildlife habitat and associated species. A management plan template can be made available upon request.

The EIR should require the Applicant to provide notification of permitting efforts with DFG and USFWS and a requirement that the Applicant submits to the County and technical advisors committee or scientific review committee, evidence that they have provided a description of the proposed Project, including grading volumes, acreages and locations to the appropriate State and Federal agencies including DFG and USFWS before site disturbance begins. The Applicant should provide the County a copy of any State or Federal permit for the Project's record. 2-13

The EIR should require that the Applicant obtains final permits for the project before selling or delivering power to Pacific Gas and Electric or the Independent Systems Operators, and that the project monitoring efforts begin when site operations begin.

We appreciate this opportunity to comment on the NOP for this EIR. We are available to provide input during the development of the EIR to ensure that concerns for public trust resource are fully disclosed during this process. If you have any further questions, please call or Ms. Janice Gan, Staff Environmental Scientist, at (209) 835-6910; or Mr. Scott Wilson, Environmental Program Manager, at (707) 944-5584.

Sincerely,

Cindy Catalano

Charles Armor
Regional Manager
Bay Delta Region

cc: See next page

cc: State Clearinghouse

Mr. Ryan Olah
U.S. Fish and Wildlife Service
2800 Cottage Way, W-2605
Sacramento, CA 95825

Mr. Neal Fujita
Ms. Nancy Wenninger
East Bay Regional Parks District
2950 Peralta Oaks Court
Oakland, CA 94605-0381
Fx# 510-569-1417

Ms. Melinda Dorn
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY ARNOLD SCHWARZENEGGER, Governor

**DEPARTMENT OF TRANSPORTATION**
111 GRAND AVENUE
P. O. BOX 23660
OAKLAND, CA 94623-0660
PHONE (510) 622-5491
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TTY 711

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*Be energy efficient!*

April 22, 2009

CC004032
SCH#2009032077

Mr. William Nelson
Contra Costa County
Department of Conservation and Development
651 Pine Street, 4th Floor, North Wing
Martinez, CA 94553

Dear Mr. Nelson:

**Tres Vaqueros Windfarm Repowering Project – Notice of Preparation (NOP)**

Thank you for including the California Department of Transportation (Department) in the early stages of the environmental review process for the Tres Vaqueros Windfarm Repowering Project. The following comments are based on the Notice of Preparation (NOP). As the lead agency, the County of Contra Costa is responsible for all project mitigation, including any needed improvements to State highways. The project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures. This information should also be presented in the Mitigation Monitoring and Reporting Plan of the environmental document. Required roadway improvements should be completed prior to issuance of the Certificate of Occupancy. Since an encroachment permit is required for work in the state right of way (ROW), and the Department will not issue a permit until our concerns are adequately addressed, we strongly recommend that the County of Contra Costa work with both the applicant and the Department to ensure that our concerns are resolved during the CEQA process, and in any case prior to submittal of a permit application. Further comments will be provided during the encroachment permit process; see the end of this letter for more information regarding encroachment permits. 3-1

***Traffic Impact Study (TIS)***
The Department is primarily concerned with impacts to the State Highway System. Please ensure that the environmental analysis evaluates the traffic impacts on State faculties by applying the following criteria to determine if a TIS is warranted: 3-2

1. The project will generate over 100 peak hour trips assigned to a State highway facility.

*"Caltrans improves mobility across California"*

2. The project will generate between 50 to 100 peak hour trips assigned to a State highway facility, and the affected highway facilities are experiencing noticeable delay; approaching unstable traffic flow (level of service (LOS) "C" or "D") conditions. 3-2

3. The project will generate between 1 to 49 peak hour trips assigned to a State highway facility, and the affected highway facilities are experiencing significant delay; unstable or forced traffic flow (LOS "E" or "F") conditions.

We recommend using the Department's Guide for the Preparation of Traffic Impact Studies for determining which scenarios and methodologies to use in the analysis. It is available at the following website address: 3-3
http://www.dot.ca.gov/hq/traffops/developserv/operationalsystems/reports/tisguide.pdf

***Encroachment Permit***

Please be advised that any work or traffic control that encroaches onto the state ROW requires an encroachment permit that is issued by the Department. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating state ROW must be submitted to the address below. Traffic-related mitigation measures should be incorporated into the construction plans during the encroachment permit process. See the website link below for more information. http://www.dot.ca.gov/hq/traffops/developserv/permits/ 3-4

Michael Condie, District Office Chief
Office of Permits
California DOT, District 4
P.O. Box 23660
Oakland, CA 94623-0660

Please feel free to call or email Luis Melendez of my staff at (510) 286-5606 or Luis_Melendez@dot.ca.gov with any questions regarding this letter.

Sincerely,

for LISA CARBONI
District Branch Chief
Local Development – Intergovernmental Review

c: State Clearinghouse

*"Caltrans improves mobility across California"*

CONTRA COSTA
WATER DISTRICT

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*General Manager*

April 22, 2009

***VIA FACSIMILE (925) 335-1222***
***Hard Copy to Follow***

Mr. William Nelson, Project Planner
Community Development Department
Contra Costa County
County Administration Building
651 Pine Street, North Wing, 4th Floor
Martinez, CA 94553-0095

**Subject: Receipt of Request for Comments on a Notice of Preparation for a Draft EIR on the Proposed Tres Vaqueros Windfarm Repowering Project (File No. LP09-2005)**

Dear Mr. Nelson:

The Contra Costa Water District (CCWD) is in receipt of request for comments on a Notice of Preparation for a Draft Environmental Impact Report (EIR) on the Proposed Tres Vaqueros Windfarm Repowering Project. A portion of the project is within the CCWD general district boundary adjacent to the Los Vaqueros Reservoir.

CCWD's concerns are mainly focused on the potential impact of the windfarm project on the Los Vaqueros Watershed. Pertinent to this concern is the September 3, 1993 U.S. Fish and Wildlife Biological Opinion (BO) on the construction and operation of the Los Vaqueros Reservoir within the Los Vaqueros Watershed. The BO describes land management objectives and practices for the watershed lands. A second pertinent document is the February 17, 1994 California Department of Fish (DFG) and Game Memorandum of Understanding (MOU) on the Los Vaqueros Project. Attachment B of the MOU is a Plan for Habitat Management which describes the management practices of the MOU. Lastly, a third pertinent document is the Conservation Easement granted by CCWD to the DFG which contains various property management provisions related to the Los Vaqueros Project. 4-1

The Draft EIR needs to ensure that the windfarm project conforms to the requirements of the above three documents.

In addition, the Draft EIR should also include an assessment of construction and operation and maintenance activities by topic as follows:

Construction Activities

- Access: Construction of 13.25 miles of new access roads and "reclamation or modification" of a similar amount of existing site and turbine access roads will have potentially significant impacts. The new and restored roads and turbine foundations need to be fully described in the project description. Restoration activities including recontouring the land and removal of drainage structures needs to be described as well in the project description and evaluated in the transportation and other pertinent sections of the EIR. Access alternatives, including the possible construction of a smaller amount of new roadways need to be evaluated in the EIR. 4-2 4-4 4-3

- Construction Equipment, Materials & Staging Area: The construction laydown area (s) needs to be evaluated in the alternatives section of the EIR with respect to the least amount of land take possible. 4-5

- Fences and Gates: The construction impact of the project on existing watershed fences and gates needs to be evaluated in the EIR. 4-6

- Grazing: The impact of the project (both short term and long term) on animal grazing needs to be evaluated in the EIR. 4-7

- Biological Resources: The effect of the Project on plant and animal listed species needs to be fully evaluated in the EIR. 4-8

- Hydrology & Water Quality: The effect of the Project on existing streams and water courses as well as the Los Vaqueros Reservoir needs to be fully documented in the EIR. 4-6

Operation & Maintenance Activities

- Maintenance: Lack of proper and periodic maintenance of the existing windfarm (turbine blades and turbine housings littering the ground) represents a potential impact to plant and animal habitat and should be evaluated in the EIR. This impact also calls for the need for firm mitigation measures for the new windfarm to deal with this problem. The mitigation measure should also be made a condition of approval for the project. 4-9

- Aesthetics: Replacing the smaller wind turbines with fewer but larger turbines would alter the site's appearance and the natural setting of the watershed. CCWD needs to know the height and width of the wind towers as well as the size of the turbine blades and motor housing. A visual assessment needs to be done that would evaluate the visual impacts of the wind turbine project on the following key views: 4-10

  - Walnut Blvd. on the way into the watershed
  - Views from various North side facilities[1]
  - Views from the reservoir
  - Views from the marina
  - Views from Morgan Territory Ridge
  - View from Vasco Road

- Access: Permanent site access roads 16 to 20 feet wide to accommodate maintenance vehicles represent a continuing circulation impact. CCWD needs to know the type and size of vehicles that would use the roads and at what frequency. In addition, any trail development needs to observe the Contra Costa County Ordinance which requires that visitors come no closer to the windmills than 3 times the height of the wind tower. 4-11

- Biological Resources: The effect of operations on avian species as well as species requiring wildlife corridors needs to be fully documented. In addition, the impact on native grass species due to late season wildfires attributed to windfarm operations needs to be evaluated in the EIR. 4-12

Please contact me at CCWD (925) 688-8119 should you have further questions.

Sincerely,

Mark A. Seedall

Mark A. Seedall
Senior Planner

MAS/jmt/rlr

[1] Walnut Staging Area, Watershed Office, Kellogg Staging Area, Interpretive Center`

East Bay Regional Park District

2950 PERALTA OAKS COURT P.O. BOX 5381 OAKLAND CALIFORNIA 94605-0381 T. 1 888 EBPARKS F. 510 569 4319 TDD. 510 633 0460 WWW.EBPARKS.ORG

April 16, 2009

Will Nelson
Department of Conservation & Development
Contra Costa County
651 Pine Street, 4th floor, north wing
Martinez, CA 94533-0095

CONTRA COSTA
2009 APR 17 P 12:
DEPARTMENT OF CONSERVATION AND DEVELOPMENT

Subject: Scoping Comments for Tres Vaqueros Windfarm Repowering Project

Dear Mr. Nelson,

Thank you for providing the East Bay Regional Park District ("District") with a copy of the Notice of Preparation (NOP) for a draft Environmental Impact Report (DEIR) for the proposed Tres Vaqueros Windfarm Repowering Project ("Project") in eastern Contra Costa County. As you are aware, the proposed Project is partially located on property owned by the District and managed as part of Vasco Caves Regional Preserve ("Preserve"). 5-1

As a potential Responsible Agency under the California Environmental Quality Act (CEQA) the District is required to prepare or adopt an environmental document as part of its consideration of the proposed Project. We intend to utilize Contra Costa County's Final EIR in considering the proposed Project and its potential effects to the Preserve. Therefore, the District is submitting substantial scoping comments and information, including ongoing research on wind turbine impacts and excerpts from our 1997 Master Plan that are relevant to the District's consideration of the proposed Project. Also enclosed are copies of recent studies conducted on wind turbine avian impacts at Vasco Caves and road kill impacts on Vasco Road. 5-2

We anticipate that this project will be of substantial interest to the public and to other agencies. Prior to distribution of the DEIR for public review we request that the County provide the District with an administrative draft of the EIR so that we may review it to determine if it will be adequate for our CEQA compliance purposes. 5-3

Please call me at (510) 544-2622 should you have any questions regarding our scoping comments and the attached supporting information.

Sincerely,

Brad Olson
Environmental Programs Manager

Enclosures (4)

cc. George Hardie, Babcock and Brown

Board of Directors

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**Scoping Comments**
# Tres Vaqueros Windfarm Repowering Project
**East Bay Regional Park District**
April 16, 2009

## 1. Project Background Information

The proposed Project will be located within and adjacent to Vasco Caves Regional Preserve in eastern Contra Costa County. The 1,339 acre Preserve has substantial natural, cultural and scenic resources of regional significance. The Preserve was established in 1997 as part of the mitigation for the original Los Vaqueros Reservoir Project. It is jointly owned by Contra Costa Water District (CCWD) and East Bay Regional Park District ("District"). It is operated and managed by the District. The Preserve is closed to general access by the public, but can be accessed by special interpretive trips that are conducted several times per year.

In 2004 the District acquired the 617-acre Souza property to expand the Preserve (to its current 1,339 acres). At that time, the property included three wind energy leases, known as the Buena Vista, North Wind and Tres Vaqueros windfarms. Buena Vista no longer has any turbines on the property. North Wind still operates 20 existing turbines through a lease that expires in 2014. Tres Vaqueros recently applied to Contra Costa County for a repowering project (the subject Project) that would remove all 48 of their existing turbines from the Souza property and replace them with approximately ten much larger turbines. The existing Tres Vaqueros lease also expires in 2014. 5-4

The District has been conducting a number of restoration projects, habitat management changes and wildlife monitoring on the Souza property since 2004. This includes rehabilitation of two existing ponds, construction of seasonal wetlands, range management changes to promote native vegetation and to reduce the effects of wind turbines on raptors. In March of 2009 the California Energy Commission released a "Public Interest Energy Research Final Project Report" entitled "Range Management Practices to Reduce Wind Turbine Impacts on Burrowing Owls and Other Raptors in the Altamont Pass Wind Resource Area, California." The report contains substantial information about the effects of wind turbines on raptors in the Preserve and the greater Altamont Wind Resource Area. A copy of this report is enclosed with this scoping letter. We request that this information be considered during preparation of the DEIR for the subject Project. 5-5

Concurrent with the District's research at the Preserve, the Contra Costa County Public Works Department has been conducting monitoring on wildlife impacts along a portion of Vasco Road, just east of The Preserve. A March 30, 2009 report entitled "Vasco Road Wildlife Movement Study Report" documents a substantial mortality of wildlife along just a 2.5 mile stretch of Vasco Road adjacent to the Preserve. Approximately 1,339 individuals, including 50 California tiger salamander and 120 red-legged frogs, were killed on Vasco Road in a fifteen month period. This report should be considered when evaluating the construction and use of roads for the proposed Project and in evaluating the cumulative effects to these and other species in the region. 5-6

Should the District agree to a repowering project at the Preserve the applicant will be required to obtain from the District a lease or license to operate the new turbines and an Encroachment Permit to construct the new turbines and related infrastructure. 5-7 There is also considerable infrastructure in place at the Preserve from the existing wind energy leases that would no longer be required should the Project be repowered or removed from The Preserve. This includes existing wind turbines, anemometers, pads, foundations, above and underground utilities, roads and drainage systems. The DEIR needs to describe the existing facilities that would be retained, replaced or removed as part of the proposed repowering Project. 5-8

Mitigation measures should also be adopted and implemented for removal and/or replacement of wind energy facilities. For example, many of the existing roadways have caused significant water quality impacts from substantial erosion from an inadequate drainage system. Regardless of whether specific roads are retained or removed, these drainage and erosion problems must be corrected to mitigate for this on going significant effect to water quality. 5-9

2. East Contra Costa Habitat Conservation Plan

In response to significant development and loss of wildlife habitat in eastern Contra Costa County, the cities of Brentwood, Oakley, Pittsburg and Clayton, Contra Costa County, CCWD and the District prepared a Habitat Conservation Plan for a 172,000 acre portion of Contra Costa County, including the proposed Project area. Incidental take permits for impacts to endangered species were issued to these agencies (except CCWD who did not request a permit) for development within their jurisdictions. One notable exception is wind turbines; they are not permitted through the HCP. The project applicant will need to obtain its regulatory permits through a separate process, unless there is agreement to amend the HCP to make wind turbines a permitted activity. 5-10

Currently a regional Natural Communities Conservation Plan (NCCP) is being prepared for the Altamont Wind Resource Area of Alameda County. When complete, the NCCP may provide some of the necessary permitting for wind turbine projects in the participating jurisdictions. 5-11

Some of the existing turbines in the Preserve have been in operation for more than twenty years. When these initial facilities were installed, little was known about the potential effects of these facilities on wildlife, plants and special-status species. Since that time there have been a number of significant changes in project circumstances that must be addressed in the DEIR. One area of particular significance is project impacts to special-status species. In the past fifteen years, the Alameda whipsnake, California red-legged frog, California tiger salamander and long-horn fairy shrimp have been listed as threatened or endangered under the California and/or federal endangered species acts. 5-12

Whipsnake, red-legged frog and tiger salamander are present at the Preserve. It also contains a very substantial population of Western burrowing owl, a special-status species, in close proximity to the existing wind turbines. The endangered San Joaquin kit fox was observed at the Preserve in 2004. The Preserve is very rich in special-status species that may be affected by the proposed Project.

3. Biological Resource Impacts

A. Avian Impacts

1) What has the monitoring data for the repowered Buena Vista Project of 2004 actually shown about avian mortality rates? Has overall mortality been reduced? Are the actual numbers consistent with the projected numbers?

2) How are the individual species affected by the repowering project? In particular, how are golden eagles, burrowing owls and bats affected by the repowered Buena Vista Project?

3) How will the County use the monitoring, operation, citing and design information from the Buena Vista Project (and other relevant projects) to determine the potential effects and mitigate the impacts resulting from the proposed Project?

4) We understand that golden eagles are being killed at a rate that may well exceed sustainable levels in the region. If such rates continue, might the individual or cumulative impacts to this species result in localized extinction of the species? How would the project mitigate for its cumulative contribution to this impact? 5-13

5) How will the operation of fewer larger turbines affect the various birds and bats that use habitats in the project area? The repowered turbines "sweep" a larger diameter of air as it passes over the Altamont Hills. The blades on new turbines may move at a different speed than existing turbines. How will these changes affect different species? For example, we understand that the new larger turbines are killing more bats than the existing turbines.

B. Terrestrial Wildlife Impacts

1) The proposed Project calls for installation of up to 42 new larger turbines to replace the existing 85 turbines in the entire Project area. This will require removing turbines, foundations, pads and supporting utility connections. The EIR should examine the potential effects of removing the old facilities on numerous terrestrial wildlife species, including American badger, San Joaquin kit fox, ground squirrels, California tiger salamander and red-legged frog. These terrestrial species, along with the ground-nesting Western burrowing owl, make use of the habitats created by the original turbine projects. For example, the areas around existing turbine foundations can be riddled with ground squirrel burrows. These burrows may also be used by badger, kit fox, coyote, tiger salamander, red-legged frog and burrowing owl. Biological surveys should be conducted within the disturbed areas to determine if it might be more appropriate to leave certain facilities. 5-14

2) Similar to the comments above, the EIR should also consider the impacts of constructing new roads and wind energy facilities in the project area. Construction of new roads, pads, foundations, underground utilities, above ground utilities and 5-15

turbines will all result in potentially significant impacts to terrestrial species. Excavation and grading may affect all of the above described species. Preconstruction surveys must be conducted to determine the extent and location of potentially affected terrestrial species, and measures must be implemented to avoid potential impacts and to relocate terrestrial animals away from the project impact area. In some cases, such as for breeding burrowing owls it would be necessary to wait until chicks have fledged before burrows could be destroyed. 5-15

3) The applicant should also establish procedures for securing the site during project construction to reduce the potential for impacts to biological resources. This would include site security on a 24/7 basis, setting and enforcing speed limits, and closure of certain roads to prevent contractors from unnecessarily entering areas where there may be sensitive resources. 5-16

C. Ecological Community Impacts

1) The Preserve has a very rich assemblage of ecological communities, including perennial grassland, annual grassland, rock outcrop, sandstone basins, stock ponds, alkali seeps and meadows, perennial freshwater marsh, riparian scrub and woodland, and valley oak savannah. With the exception of valley oaks, all of these communities are present in the project area. The DEIR needs to address potential impacts to each of these community types and to the special-status plants and animals that they contain. 5-17

2) As previously described, the District has also made a number of changes in the Preserve, including restoration of ecological communities and range management practices to improve both wildlife habitat values and to reduce avian mortality. The District will continue to monitor these improvements and make adaptive management changes when necessary. Similar monitoring and management changes should also be implemented throughout the project area to reduce on going impacts and to minimize the effects of a repowering project. 5-18

4. Water Quality

A. Road and Drainage Impacts

1) To the extent feasible, the proposed project should remove unneeded roads and associated drainage facilities. Many of the roads are in poor condition, some have failed and others are highly erosive, causing substantial downslope erosion and sedimentation in wetlands and riparian areas, impacting the species that depend upon these habitats, including tiger salamander and red-legged frog. 5-19

2) Abandoned roads should be recontoured and restored with native perennial grasses. The restoration will need maintenance and monitoring for several years until successfully established. The applicant should be required to create an endowment, a management and monitoring plan, and to establish specific restoration objectives, 5-20

proposed improvements, and long-term maintenance and monitoring of restored areas. 5-20

3) It is unclear why a 30-foot wide road is necessary to construct the proposed project. Typical roads in the project area are 12 to 15 feet in width and appear adequate for the maintenance and replacement of existing wind turbines. To the extent feasible, the applicant should use existing roads and utilize helicopters and cranes in order to reduce the amount of road grading necessary for construction of the proposed project. 5-21

Aerial construction methods are frequently employed by PG&E and other utilities to construct large electrical transmission towers in remote areas that are inaccessible from roads or where there are sensitive ecological habitats that cannot be disturbed. A recent example occurred in the Gateway Valley of Orinda where PG&E relocated about one mile of 500 KV electrical towers. PG&E used a monopole tower that was assembled in sections using helicopters. This method eliminated the need for construction of roads in some areas. 5-22

4) New access roads should be designed to minimize the potential for slope failure and erosion. Drainage should be contained and discharged in a manner that does not concentrate flows that scour hillsides or deposit sediments and other pollutants into wetlands and drainages. 5-23

B. Hazardous Materials

1) Consideration should be given to the potential release of hazardous materials from construction of the project. There are two buried petroleum pipelines that cross through the project area. Access roads to the existing turbines cross these pipes at three locations. Construction would need to be closely coordinated with the owners of these pipelines to assure that there is no damage or potential release of petroleum products. 5-24

2) Construction and maintenance of the proposed Project also have the potential to release hazardous materials into the environment. This would include concrete, fuels, oils, solvents, paints, etc. Of particular concern are hazardous materials that might be discharged into wetlands and drainages in the project area. 5-25

5. Cultural Resources

A. Construction Impacts

1) The Preserve has tremendous and regionally significant cultural resources from a long habitation by Native Americans. There are many artifacts from this history throughout the Preserve. As a result, the Preserve is closed to general public access and there is ongoing monitoring and police enforcement to protect these sensitive cultural artifacts. It is very likely that similar cultural artifacts may be encountered 5-26

throughout the Project area. This could include surface artifacts and burials that could be disturbed or destroyed during project construction. 5-26

2) There should be a thorough investigation of the Project area to locate, document, avoid and protect cultural resources that may be affected by the proposed Project. A specific mitigation plan should be developed that provides for construction monitoring by a qualified archeologist throughout the construction period. The plan should also include contingencies should something be encountered during project construction. Information about the specific cultural resources of the area must be kept confidential and provided only on a need to know basis. Employees should be trained on procedures for identifying and protecting cultural artifacts that may be encountered during Project construction. 5-27

3) The applicant should also establish procedures for securing the site during project construction to reduce the potential for vandalism and theft of cultural artifacts. This would include site security on a 24/7 basis and closure of certain roads to prevent contractors from unnecessarily entering areas where there may be cultural artifacts. 5-28

B. Operation and Maintenance Impacts

1) Site security at the Preserve has been an on-going concern. On numerous occasions gates are left open or unlocked. Unauthorized individuals have entered the Preserve and adjacent areas as a result of these breaches in security. The DEIR should identify mitigation measures to be implemented to improve site security, including new gates that open and close properly, new fencing where needed, regular inspections by the site supervisor and employee training about the sensitive cultural resources in the Preserve and adjacent areas. 5-29

6. Visual Impacts and Aesthetics

A. Visual Impacts

1) The visual environmental at the Preserve includes a number of existing wind turbines to the south, east and north of the Preserve. The turbines to the south and north are older generation turbines ranging in heights of up to 100 feet. The new turbines to the east that are part of the Buena Vista Repowering Project are in excess of 200 feet. While the new turbines to the east are fewer, they are more visually prominent from the Preserve. They are also evident now in areas where the older turbines were hidden behind ridgelines. The net result of the Buena Vista Project was degradation in the visual environment at The Preserve. 5-30

2) The EIR needs to consider the individual and cumulative visual impacts of the proposed turbines in conjunction with other repowering projects in the area. In our comments for the Buena Vista EIR the District provided a map of key locations (i.e. sensitive receptors) where we requested visual impact simulations. Views from the 5-31

same locations (looking north) should be considered with before and after visual simulations conducted. 5-31

3) The proposed Project will directly affect the 617-acre Souza property at the Preserve. There are currently 48 turbines on the property that would be removed and potentially replaced with 10 larger turbines. We request that visual impact simulations be conducted at three additional locations along Howden Road. One at the east end saddle looking west, one in the middle of the central valley looking northwest and one at the west end of the property (near the Enxco Facility) looking east. We would like to see views of the existing turbines (existing condition), views with the existing turbines removed (future no-project condition) and views of the new repowered turbines in place (future with-project condition). 5-33a 5-33b

4) There has been much discussion in the past about the colors and patterns that have been applied to the wind turbines. While making the turbines blades more visible for birds may be an overriding consideration, perhaps other improvements to the turbine towers and bases would reduce the overall visual impacts. For example, are there other colors or patterns that might make visually prominent turbine towers less visible from the Preserve? 5-33

5) Consideration should also be given to reducing the visual prominence of existing and proposed support facilities, such as maintenance yards, buildings, substations, transformers, etc. Are there surface treatments or screens that could be employed to reduce the visibility of these structures from the Preserve? The Enxco facility just west of the Preserve and the North Wind facility to the northeast of the Preserve are two visually prominent examples where surface treatments could reduce visual impacts to the Preserve. Relocating and/or covering the surplus turbine parts would make them less visually prominent. 5-34

B. Aesthetic Impacts

1) The original 722-acre Preserve acquired in 1997 contains no wind turbine facilities. However, it is surrounded by properties that do contain turbines, including the 617-acre former Souza property that is now part of the Preserve. A quick scan of the hillsides surrounding the Preserve shows substantial amounts of debris from the past 25 years of wind energy generation, including derelict turbines, obsolete anemometers, unused electrical poles, broken turbine blades and abandoned roads. While these conditions have improved in recent years, the aesthetic environment surrounding the Preserve has been badly degraded. The proposed Project provides the opportunity for the better management of these facilities. Regular inspection and enforcement of mitigation measures by the County would be one way to improve the degraded aesthetics of the areas surrounding the Preserve. 5-35

7. Emergency, Maintenance and Public Access

1) Howden Road (from Vasco Road) is the primary means of access to the Preserve and to the southern end of the project area. This road should remain accessible at all times for District emergency and maintenance vehicles to reach the preserve. Should there be a need for temporary closure of the road then an alternative means of access to the Preserve should be provided. The EIR should evaluate how alternative access can be provided and address any potential safety concerns regarding access to the Preserve from Vasco Road. 5-36

2) As previously noted, the applicant is proposing 30 foot wide roads in some areas for construction of the new turbines. Howden Road is considerably narrower than 30 feet. Widening of this road to 30 feet would result in a number of significant impacts to water quality, wetlands, special-status species, aesthetics, etc. The EIR should address these specific impacts and identify alternative means of access that do not require widening this road. 5-37

3) The Preserve currently has no public access, except by District-led tours on a reservation-only basis. These trips are limited to hikers. The District will want to provide for these trips during the Project construction period. The EIR will also need to consider this need as well. These trips are typically limited to weekends. 5-38

4) The District may, in the future, choose to allow public access to newly acquired lands to the north of the Preserve. We are concerned about the potential public access restrictions that may be imposed in order to protect public safety from the repowered turbines. For example, the EIR should establish reasonable set-back requirements between turbines and roads that might be useable as future trails. 5-39

5) In Alameda County there is a set back requirement between turbines and public access. We understand the standard is three times the length of the turbine blade. This is considered the "blade throw" distance where the public might be in danger of being struck by a broken turbine blade. We would like to work with the County to establish reasonable standards that protect public safety, wind turbine facilities and allow for establishment of future trails, as depicted in our Master Plan Map of 2007. 5-40

save MOUNT DIABLO

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April 28, 2009

Mr. Will Nelson
Contra Costa County
Department of Conservation & Development
Community Development Division
651 Pine Street, 4th Floor – North Wing
Martinez, CA 94553

Re: comments, Tres Vaqueros Windfarm Repowering Project
Notice of Preparation of Draft EIR

Dear Mr. Nelson,

Save Mount Diablo appreciates the opportunity to make scoping comments on the proposed Tres Vaqueros Repowering project in Eastern Contra Costa County.

The applicant proposes to remove 85 330kW wind turbines and 1 750kW wind turbine and replace them with 42 larger 1 megawatt wind turbines. Additionally, the project would include the construction of 13.25 miles of new roads which will be used to access the wind turbines for construction and maintenance. The project would also replace all of the existing above-ground electrical collection systems with below-ground lines.

Save Mount Diablo does not yet have a position on the proposed Tres Vaqueros Repowering project but we have a number of concerns and believe the project has the potential to have significant impacts on a number of sensitive resources in the area.

**Biological Resources**

1) *Avian Wildlife* - Avian mortality is an issue of particular concern in Eastern Contra Costa and Alameda Counties because the region contains wind farms with large numbers of turbines. These turbines have significant impacts on birds and bats in the area which collide with the turbines while soaring on wind currents and foraging for prey in the area's open grasslands. 6-1

How would the addition of larger, taller wind turbines to the area affect avian mortality? Are there any studies which show that the larger turbines result in either an increase or decrease in avian mortality? How many wind turbines are currently present in the vicinity of the project?

Different avian species fly at different heights. Constructing taller wind turbines would likely result in impacts to a different set of species than those that are currently impacted with the existing turbines. For example, many bat species fly at an altitude 6-2

higher than the existing turbines. Would the addition of taller wind turbines have impacts on any special status bat species that fly at higher elevations? 6-2

The EIR should analyze whether the taller, larger wind turbines would impact an additional set of special status species and whether the impacts the turbines currently have on avian species would remain.

2) *Terrestrial Wildlife* – The Tres Vaqueros project includes a substantial amount of infrastructure removal and construction which would have significant impacts on a number of special status terrestrial species.

The EIR should analyze how the construction of 13.25 miles of roads and 42 new wind turbines will impacts the habitat and movement of San Joaquin kit fox, the American, California red-legged frog, California tiger salamander, Western burrowing owl, among other species. 6-3

a) Roads – According to the Notice of Preparation, the project would include the construction of 13.25 miles of roads up to 30 feet wide, which would result in the conversion of more than 48 acres of open grassland to roads.

The EIR should include figures indicating the amount of soil which will be graded to complete the construction of 13.25 miles of road covering 48 acres of land. For example, the Buchanan Road Bypass project currently being considered by the City of Pittsburg proposes the construction of 1.98 miles of road, which will require the grading of 2.7 million cubic yards. Regardless of the exact number, it seems likely that a significant amount of soil will be graded for the construction of the access roads. 6-4

How would the grading of such a large amount of soil impact ground squirrel burrows which provide habitat for the San Joaquin kit fix, the Western burrowing own, the California red-legged frog, the California tiger salamander, and other wildlife?

In reviewing Contra Costa County mapping information, it appears the project site includes several streams and drainages with wetlands characteristics.
Intense grading can cause a significant increase in soil erosion in the area. Potential erosion of soil near wetlands would have impacts on wetlands habitats. The construction of new roads will increase impermeable surfaces in the area. This change has the potential to increase runoff and impact drainage into the creeks. 6-5

Wetlands delineation and impacts on riparian habitat from the project should be assessed in the EIR.

The EIR should include a map showing the exact location of all of the grading proposed for road construction in relation to the streams, drainages and other wetlands on the property.

b) Removal and Construction of Wind Turbines – The construction of 42 new 1-megawatt wind turbines would require additional grading and excavating which would also potentially impact the burrows and wetlands used as habitat by special-status species. 6-6

Furthermore, the removal of the existing wind turbines and the installation of new ones would substantially increase the amount of traffic accessing the property and

travelling along the 13.25 miles of new roads. Each additional vehicle driving on the project site poses a threat to special status species moving through the area. A recent report analyzing Vasco Road's impacts to wildlife was published by the Contra Costa Public Works Department which details the death of a substantial number of special status species resulting from vehicle traffic along the road. It is our understanding that East Bay Regional Park District included a copy of this report with their comments. 6-6

How would the increased traffic on roads within the project area add to the impacts resulting from the vehicular traffic of Vasco Road on wildlife habitat and movement in the area?

The Notice of Preparation states that once the existing turbines are removed, their foundations will be covered with soil and seeded with native species. However, there is no discussion about whether the infrastructure associated with those turbines, such as roads, will be removed and whether those areas would be returned to a natural state. 6-7

Although they would no longer be in use, existing roads and other infrastructure may impact wildlife and their habitat. For example, roads contribute to run off and affect water quality and habitat of the wetlands in the area. The EIR should include mitigations which require the identification and removal all of the existing facilities and infrastructure on the project site which will no longer be in use. 6-8

3) *Rare Plant Species* – The EIR should include full analysis of rare plants that may be found in the area which would be impacted by the removal of 86 turbines, the grading and construction 42 turbines and 13.25 miles of roads, and the burial of the current above ground transmission lines. 6-9

**Aesthetic Resources**

The Notice of Preparation states that the total height of the proposed turbines is between 282 and 315 feet. However, the document does not indicate how much taller the proposed turbines would be than the existing turbines. The EIR should include theses height differences. Furthermore, the EIR should include a description of the location of the new turbines related to topography. If the new turbines are located on the tops of hill, they would be more visible than if they were located on lower elevation. 6-10

Save Mount Diablo is concerned that the taller turbines may be more visible from greater distances and over ridge tops that hide the turbines currently present at the project site. The project area covers approximately 1,500 acres of land in southeast Contra Costa County which is dominated by rolling grasslands with high hills and ridgelines rising up above canyons and valleys. The current turbines are hidden from view from a number of locations throughout the area by tall ridgelines and hills. Would the increased height of the proposed turbines make the wind farm visible above some of the surrounding ridges and increase visibility from greater distances? 6-11

The project area is located in close proximity to a number of preserved open spaces used for recreational purposes. The project's impacts to the visual character of the area should be considered from a number of trails and view points within these parks and preserves. 6-12

The EIR should include significant visual analysis from distances expanding throughout the region, not just in the immediate vicinity. 6-13

**Air Quality**

The removal of the existing wind turbines and the installation of new ones will require a large amount of grading and use of machinery. We are concerned that the increased activity will have adverse affects to local air quality by increasing dust and exhaust output into the air. Residents, commuters, at risk populations, plant and some animal species are affected by adverse changes in the air quality. The EIR should consider how construction of the project would impact air quality in the region. 6-14

**Cumulative Impacts**

The EIR should consider land uses throughout the area in analyzing how this project will add to cumulative impacts on wildlife habitat and open space resources. 6-15

Contra Costa Water District is currently considering a project which would expand the Los Vaqueros reservoir, resulting in the flooding of up to 1,000 acres of land. The land that would be flooded offers habitat and movement corridors for a number of special status species in the area. The Tres Vaqueros wind farm project site is located on lands directly to the east of the Los Vaqueros Reservoir. As special status species habitat within the watershed is flooded, habitat suitable for those species within the Tres Vaqueros area will become even more valuable.

Most notably, the Los Vaqueros project would flood a San Joaquin kit fox corridor on the western side of the reservoir. As a result, the only grassland corridor connecting the preserved open spaces in East Contra Costa County to the core of the kit fox habitat in the Altamont Hills and San Joaquin Valley would be the grasslands to the east of the reservoir. In other words, if a reservoir expansion is approved the 1,500 acre project site for the Tres Vaqueros wind farm would be part of the only remaining connection for kit fox dispersal. The significance of each kit fox den affected by grading and each kit fox potentially struck by a construction vehicle on the project site is greater when considering the loss of the kit fox corridor on the western side of Los Vaqueros. 6-16

The EIR should consider the cumulative impacts of the Tres Vaqueros project along with the proposed Los Vaqueros project and other proposed or potential projects in the area.

**Growth Inducing Impacts**

The approval of this project would likely result in similar applications being submitted to the County and have growth inducing impacts. There are a large number of turbines located in the area and many of them are either outdated or soon to be outdated. Larger turbines which produce more energy capacity are becoming the preferred option. 6-17

Each of these projects will include a variety of infrastructure that will have impacts on sensitive resources.

The EIR should consider the growth inducing impacts of the Tres vaqueros project.

**Land Use Issues**

East Contra Costa County Habitat Conservation Plan - The East Contra Costa Habitat Conservation Plan Acquisition Priorities Map shows the portions of the Tres Vaqueros project area outside of the Los Vaqueros Watershed as Medium Acquisition Priority lands. The HCP has already begun to fund acquisition projects located in the project area to preserve and protect the area's resources. 6-18

The EIR should evaluate the compatibility of the Tres Vaqueros project with the goals and policies of the HCP and the lands being acquired with HCP funds in the area.

Vasco Caves Regional Preserve – The proposed Tres Vaqueros project would be located partially in East Bay Regional Park District's Vasco Caves Regional Preserve which was protected as mitigation for the 1997 Los Vaqueros reservoir project. The purpose of Vasco Caves Preserve is to protect the sensitive biological, cultural, and visual resources of the area.

The EIR should evaluate how the proposed project would affect the preservation efforts of East Bay Regional Park District at Vasco Caves Regional Preserve. 6-19

Thank you for the opportunity to make comments on this project. SMD requests to receive notice of any further filings and will provide additional comments and questions at that time.

Sincerely,

Troy Bristol
Land Conservation Associate
Save Mount Diablo

# APPENDIX A2
Notice of Preparation

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STATE OF CALIFORNIA

# GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH

STATE CLEARINGHOUSE AND PLANNING UNIT

ARNOLD SCHWARZENEGGER
GOVERNOR

CYNTHIA BRYANT
DIRECTOR

**Notice of Preparation**

CONTRA COSTA
2009 MAR 26 P 12:57
DEPARTMENT OF CONSERVATION AND DEVELOPMENT

March 24, 2009

To: Reviewing Agencies

Re: Tres Vaqueros Windfarm Repowering Project
SCH# 2009032077

Attached for your review and comment is the Notice of Preparation (NOP) for the Tres Vaqueros Windfarm Repowering Project draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

**William Nelson**
**Contra Costa County Dpt of Conservation & Development**
**651 Pine Street, 4th Floor, North Wing**
**Martinez, CA 94553**

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

for: Scott Morgan
Assistant Deputy Director & Senior Planner, State Clearinghouse

Attachments
cc: Lead Agency

1400 10th Street P.O. Box 3044 Sacramento, California 95812-3044
(916) 445-0613 FAX (916) 323-3018 www.opr.ca.gov

# Document Details Report
## State Clearinghouse Data Base

**SCH#** 2009032077
**Project Title** Tres Vaqueros Windfarm Repowering Project
**Lead Agency** Contra Costa County

**Type** **NOP** Notice of Preparation

**Description** The project applicant, Tres Vaqueros Windfarms, LLC, proposes the following:

" Removal of 85 330kW ad 1,750kW Howden wind turbines with a combined generating capacity of approximately 28.3 megawatts. Existing foundations would be covered with at least 1.5 feet of soil and seeded with native species. Reclaimed turbine areas would be returned to annual grassland habitat for agricultural use.

" Installation of up to 42 megawatt, or similar size, wind turbines. The total height of the model currently proposed is between 282 and 315 feet - the range resulting from different tower height options. The final model and height would be determined based on the conclusions of the EIR and considerations relating to model availability.

" Construction of approximately 70,000 feet (13.25 miles) of new access roads and reclamation or modification of a similar amount of existing site and turbine access roads. During construction, new access roads leading to the turbine sites would be up to 30 feet wide depending upon specific turns and required turning radii. Following construction, permanent site access and turbine maintenance roads would be 16 to 20 feet wide to accommodate maintenance vehicles.

" Replacement of all existing above-ground electrical collection systems with below-ground lines. The underground transmission system would terminate at the existing substation, which connects the windfarms to a 230kV PG&E transmission line running adjacent to the project area.,

The "repowered" facility's energy production capability would be 3 to 4 times greater than the output capability of the existing facility. The actual "footprint" of turbine pads, foundations, underground collection facilities, the maintenance facility, and the substation would be about 44 acres, representing a 3-acre reduction from the existing facility.

Note: Blanks in data fields result from insufficient information provided by lead agency.

# Document Details Report
## State Clearinghouse Data Bas

### Lead Agency Contact

| | |
|---|---|
| *Name* | William Nelson |
| *Agency* | Contra Costa County Dpt of Conservation & Development |
| *Phone* | (925) 335-1208 *Fax* |
| *email* | |
| *Address* | 651 Pine Street, 4th Floor, North Wing |
| *City* | Martinez *State* CA *Zip* 94553 |

### Project Location

| | |
|---|---|
| *County* | Contra Costa |
| *City* | Byron |
| *Region* | |
| *Cross Streets* | Vasco Road |
| *Lat / Long* | 37° 49' 12" N / -121° 41' 48" W |
| *Parcel No.* | 005-160-001 and several others |
| *Township* | 1S *Range* 2, 3E *Section* 25, 30 *Base* MDB&M |

### Proximity to:

| | |
|---|---|
| *Highways* | None |
| *Airports* | East County (Byron) |
| *Railways* | None |
| *Waterways* | Los Vaqueros Reservoir, Fish Creek, Brushy Creek |
| *Schools* | None |
| *Land Use* | The project site is approximately 1,500 acres, portions of which lie within Los Vaqueros Watershed owned by Contra Costa Water District and Vasco Caves Regional Preserve owned by East Bay Regional Park District. Development consists solely of the existing windfarm. The site is made up of rolling hills that could be used as grazing land. |

*Project Issues* Aesthetic/Visual; Agricultural Land; Air Quality; Archaeologic-Historic; Biological Resources; Drainage/Absorption; Flood Plain/Flooding; Forest Land/Fire Hazard; Geologic/Seismic; Minerals; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Schools/Universities; Septic System; Sewer Capacity; Soil Erosion/Compaction/Grading; Solid Waste; Toxic/Hazardous; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wetland/Riparian; Growth Inducing; Landuse; Cumulative Effects; Other Issues

*Reviewing Agencies* Resources Agency; California Energy Commission; Department of Parks and Recreation; Department of Water Resources; Department of Fish and Game, Region 3; Native American Heritage Commission; Public Utilities Commission; California Highway Patrol; Caltrans, District 4; Department of Toxic Substances Control; Regional Water Quality Control Bd., Region 5 (Sacramento)

*Date Received* 03/24/2009 *Start of Review* 03/24/2009 *End of Review* 04/22/2009

Note: Blanks in data fields result from insufficient information provided by lead agency.

County: Contra Costa

SCH# 2009092077

## Resources Agency

- ■ **Resources Agency**
  Nadell Gayou
- ☐ **Dept. of Boating & Waterways**
  Mike Sotelo
- ☐ **California Coastal Commission**
  Elizabeth A. Fuchs
- ☐ **Colorado River Board**
  Gerald R. Zimmerman
- ☐ **Dept. of Conservation**
  Rebecca Salazar
- ■ **California Energy Commission**
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- ☐ **Cal Fire**
  Allen Robertson
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  Wayne Donaldson
- ■ **Dept of Parks & Recreation**
  Environmental Stewardship Section
- ☐ **Central Valley Flood Protection Board**
  Jon Yego
- ☐ **S.F. Bay Conservation & Dev't. Comm.**
  Steve McAdam
- ■ **Dept. of Water Resources**
  Resources Agency
  Nadell Gayou
- ☐ _____
  Conservancy

## Fish and Game

- ☐ **Depart. of Fish & Game**
  Scott Flint
  Environmental Services Division
- ☐ **Fish & Game Region 1**
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- ☐ **Fish & Game Region 1E**
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- ☐ **Fish & Game Region 2**
  Jeff Drongesen
- ■ **Fish & Game Region 3**
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- ☐ **Fish & Game Region 5**
  Don Chadwick
  Habitat Conservation Program
- ☐ **Fish & Game Region 6**
  Gabrina Gatchel
  Habitat Conservation Program
- ☐ **Fish & Game Region 6 I/M**
  Gabrina Getchel
  Inyo/Mono, Habitat Conservation Program
- ☐ **Dept. of Fish & Game M**
  George Isaac
  Marine Region

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  Dept. of Food and Agriculture
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  CEQA Coordinator

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- ☐ **RWQCB 2**
  Environmental Document Coordinator
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- ☐ **RWQCB 3**
  Central Coast Region (3)
- ☐ **RWQCB 4**
  Teresa Rodgers
  Los Angeles Region (4)
- ■ **RWQCB 5S**
  Central Valley Region (5)
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    Fresno Branch Office
  - ☐ **RWQCB 5R**
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- ☐ **RWQCB 9**
  San Diego Region (9)

☐ **Other** _____

Last Updated on 01/07/2009

# APPENDIX B

## Example Wind Turbine Brochures

# APPENDIX B1
# Gamesa G90-2.0 MW Wind Turbine Brochure

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# Gamesa
# G90-2.0 MW

Gamesa

# Benefits

## Maximum output at minimum cost per kWh for low wind sites

- Class IIIA/WZII.
- Pitch and variable speed technology to maximize energy production.
- Production of lighter blades using fiberglass, carbon fiber and prepreg method.
- Compliance with the main international Grid Codes.
- Aerodynamic design and Gamesa NRS® control system to minimize noise emissions.
- Gamesa WindNet®: Remote monitoring and control system with Web access.

# G90-2.0 MW

## Rotor

| | |
|---|---|
| **Diameter** | 90 m |
| **Swept area** | 6,362 $m^2$ |
| **Rotational speed** | 9.0 - 19.0 rpm |
| **Rotational direction** | Clock Wise (front view) |
| **Weight** (incl. Hub) | Approx. 36 T |
| **Top head mass** | Approx. 106 T |

## Blades

| | |
|---|---|
| **Number of blades** | 3 |
| **Length** | 44 m |
| **Airfoils** | DU (Delft University) + FFA-W3 |
| **Material** | Preimpregnated epoxy glass fiber + carbon fiber |
| **Total blade weight** | 5,800 kg |

## Tubular Tower

| **Modular type** | Height | Weight |
|---|---|---|
| **4 sections** | 78 m | 203 T |
| **5 sections** | 100 m | 255 T |

## Gearbox

| | |
|---|---|
| **Type** | 1 planetary stage / 2 parallel stages |
| **Ratio** | 1:100.5 (50 Hz)<br>1:120.5 (60 Hz) |
| **Cooling** | Oil pump with oil cooler |
| **Oil heater** | 2.2 kW |

## Generator 2.0 MW

| | |
|---|---|
| **Type** | Doubly-fed machine |
| **Rated power** | 2.0 MW |
| **Voltage** | 690 V ac |
| **Frequency** | 50 Hz / 60 Hz |
| **Protection class** | IP 54 |
| **Number of poles** | 4 |
| **Rotational speed** | 900:1,900 rpm (rated 1,680 rpm) (50 Hz)<br>1,080:2,280 rpm (rated 2,016 rpm) (60 Hz) |
| **Rated Stator Current** | 1,500 A @ 690 V |
| **Power factor** (standard) | 0.98 CAP - 0.96 IND at partial loads and 1 at nominal power.* |
| **Power factor** (optional) | 0.95 CAP - 0.95 IND throughout the power range.* |

* Power factor at generator output terminals, on low voltage side before transformer input terminals.

## Mechanical design

Drive train with main shaft supported by two spherical bearings that transmit the side loads directly to the frame by means of the bearing housing. This prevents the gearbox from receiving additional loads, reducing malfunctions and facilitating its service.

## Brake

Aerodynamic primary brake by means of full-feathering blades. In addition, a hydraulically-activated mechanical disc brake for emergencies is mounted on the gearbox high speed shaft.

## Lightning protection

The Gamesa G90 -2.0 MW wind turbine generator uses the "total lightning protection" system, in accordance with standard IEC 61024-1. This system conducts the lightning from both sides of the blade tip down to the root joint and from there across the nacelle and tower structure to the grounding system located in the foundations. As a result, the blade and sensitive electrical components are protected from damage.

## Control System

The Generator is a doubly fed machine (DFM), whose speed and power is controlled through IGBT converters and PWM (Pulse Width Modulation) electronic control.

**Benefits:**

- Active and reactive power control.
- Low harmonic content and minimal losses.
- Increased efficiency and production.
- Prolonged working life of the turbine.

## Gamesa WindNet®

The new generation SCADA System (a wind farm control system) entirely developed by Gamesa allows realtime operation and remote control of wind turbines, meteorological mast and the electrical substation. This innovative modular design based on TCP/IP architecture has tools for controlling active and reactive energy, voltage and frequency. It also contains environmental options to optimize the production to perfectly comply with regulations currently in force. The intuitive remote web client employs a very friendly user interface. The system includes analytical tools for decision-making, Report Generator and Information Manager and TrendViewer, to give a sharp, clear view of trends.

## SMP Predictive Maintenance System

Predictive Maintenance System for the early detection of potential deterioration or malfunctions in the wind turbine's main components.

**Benefits:**

- Reduction in major corrective measures.
- Increase in the machine's availability and working life.
- Preferential terms in negotiations with insurance companies
- Integration within the control system.

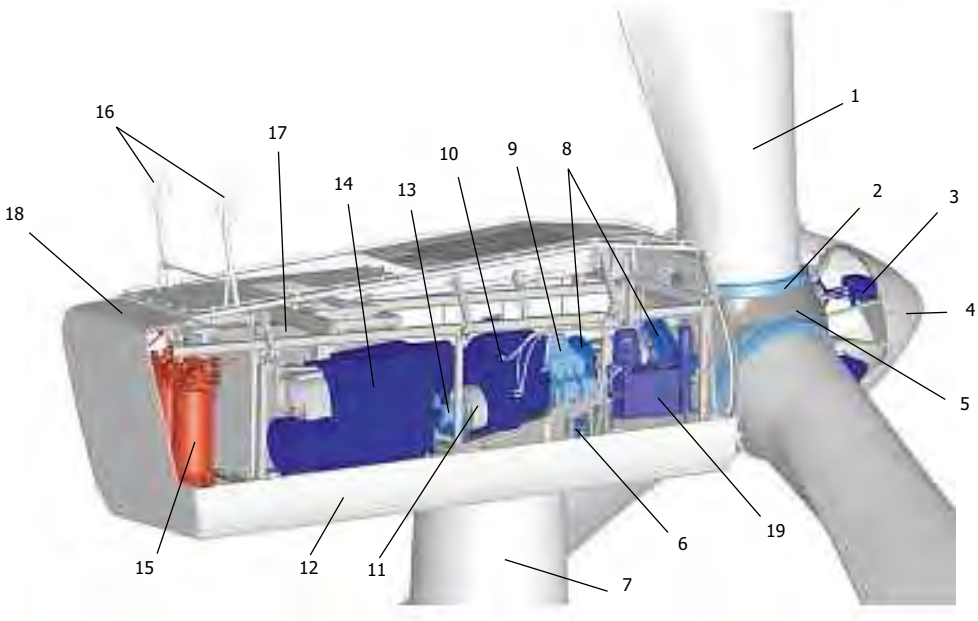
## Noise control

Aerodynamic blade tip and mechanical component design minimize noise emissions. In addition, Gamesa has developed the Gamesa NRS® noise control system, which permits programming the noise emissions according to criteria such as date, time or wind direction. This achieves the goals of local regulation compliance as well as maximum production.

## Grid connection

Gamesa's doubly-fed wind turbines and Active Crowbar and over sized converter technologies ensure compliance with the most demanding grid connection requirements.
Low voltage ride-through capability and dynamic regulation of active and reactive power.

1. Blade
2. Blade bearing
3. Hydraulic pitch actuator
4. Hub cover
5. Hub
6. Active yaw control
7. Tower
8. Main shaft with two bearing houses
9. Shock absorbers
10. Gearbox
11. Main disc brake
12. Nacelle support frame
13. Transmission: High speed shaft
14. Doubly-fed generator
15. Transformer
16. Anemometer and wind vane
17. Top controller
18. Nacelle cover
19. Hydraulic unit

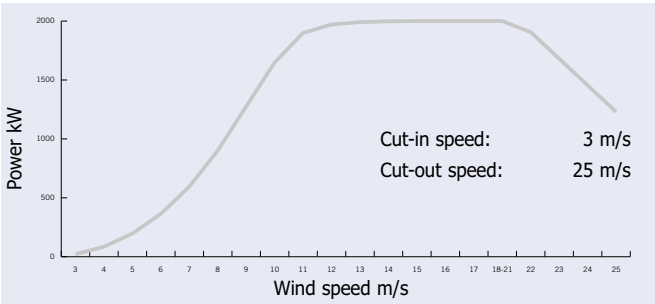



## Power Curve Gamesa G90-2.0 MW

(for an air density of 1.225 kg/m³)

Power curve calculation based on DU (Delft University) and FFAW3 airfoils.

Calculation parameters: 50 Hz grid frequency; tip angle pitch regulated; 10% turbulence intensity and a variable rotor speed ranging from 9.0-19.0 rpm.



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Printed date: December 2009

# APPENDIX B2
## Siemens Wind Turbine SWT-2.3-101 Brochure

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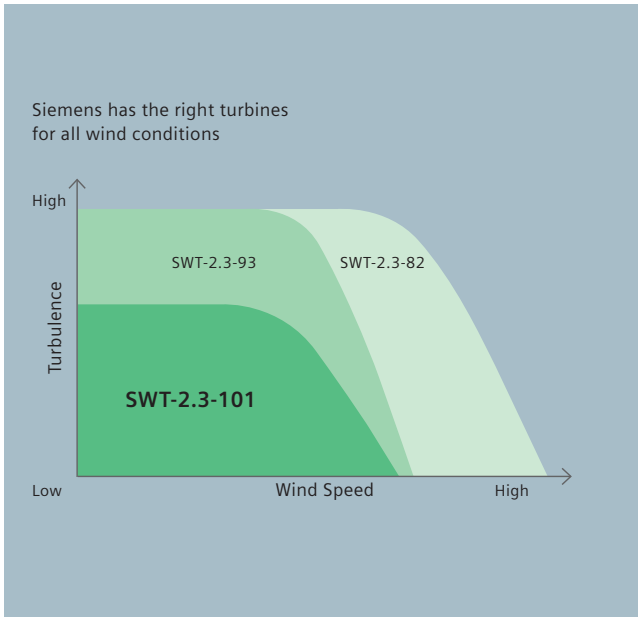
# The new standard for moderate wind conditions

**Siemens Wind Turbine SWT-2.3-101**

Answers for energy.

SIEMENS




# Your trusted partner

**Siemens has been a major driver of innovation in the wind power industry since the early 1980s when wind turbine technology was still in its infancy.**

Technology has changed with the times, but Siemens' commitment to providing its customers with proven wind turbine solutions remains the same.

The combination of robust and reliable turbines, highly efficient solutions for power transmission and distribution and a deep understanding of the entire energy market ensures that Siemens will continue to be a leading supplier.

Siemens' record, when it comes to on-time delivery, is impeccable. Long-lasting customer relationships, based on the successful installation of wind turbines, provide for a sound, sustainable and profitable investment.

Drawing on 140 years of experience in the energy sector, a strong focus on renewables and a global network of highly skilled and trained employees, Siemens has proven itself to be a trustworthy and reliable business partner. And will continue to be in the future.

# Harvest more energy from sites with moderate wind conditions

**The Siemens SWT-2.3-101 turbine is designed to deliver unparalleled performance and reliability, making it especially suited to areas with moderate wind conditions.**

The SWT-2.3-101 turbine offers low energy production costs and joins Siemens' 2.3-MW product family, which has proven availabilitity that is among the highest in the industry. The 101-meter rotor is specifically designed to optimize the energy output in areas with moderate wind conditions. The turbine is also ideal for all types of grid connections in most major markets.

The SWT-2.3-101 is designed to last. The robust and reliable design offers a high yield with low maintenance costs. The turbine is backed by advanced condition monitoring and diagnostics, which constantly examine the turbine. Any change in a turbine's performance is promptly addressed by an experienced after-sales service team either remotely or in the field.

If you desire a better return on investment and superior availability, take a closer look at the SWT-2.3-101 turbine.

# Superior performance gives higher yields

## Optimum energy at moderate wind conditions

### Harvesting more energy

The SWT-2.3-101 wind turbine is designed to increase the energy returns from sites with moderate wind conditions. Advanced blade technology also allows for quieter operation. The B49 blade with a rotor diameter of 101 meters and pitch regulation optimizes power output and increases control over the energy output.

### High availability

Currently, the Siemens fleet of 2.3-MW wind turbines sets the industry standard for availability. The SWT-2.3-101 will build on the reputation for reliability that the market has come to expect from a Siemens Wind turbine.

### High yield with minimal maintenance

Siemens optimizes the return on investment in its wind turbines through intelligent maintenance that ensures the turbine to deliver high yield with low operational costs.

The rugged structural design, combined with an automatic lubrication system, internal climate control and a generator system without slip rings contributes to exceptional reliability. The innovative design of the SWT-2.3-101 allows for longer service intervals.

### Superior grid compliance

The Siemens NetConverter® system is designed for maximum flexibility in the turbine's response to voltage and frequency variations, fault ride-through capability and output adjustment. The advanced wind farm control system provides state-of-the-art fleet management.

### Proven track record

Siemens has a proven track record of providing reliable turbines that last. The world's first offshore wind farm in Vindeby, Denmark, was installed in 1991 and is still fully operational. In California, Siemens installed over 1,100 turbines between 1983 and 1990, with 97% still in operation today. Siemens takes its commitment to reliability seriously and prides itself on the long lifespan that its turbines have demonstrated.

# No compromise on reliability

### SWT-2.3-101: Newest member of the extremely reliable product family

**Designed for life**

Siemens turbines are designed to last. The robust design of the SWT-2.3-101 allows for trouble-free output throughout the complete lifecycle of the turbine.

The blades are made of fiberglass-reinforced epoxy in Siemens' proprietary IntegralBlade® manufacturing process. The blades are cast in one piece in a closed process, which eliminates the traditional weaknesses found at glue joints in other manufacturers' blades. Like the turbine itself, the blades are designed to last.

Climate control within the turbine protects vital equipment from the outside environment. The turbine also offers controlled-wear strategies for critical components, which results in a further reduction of maintenance costs.

**Safety first**

Safety is at the heart of all Siemens operations. From production to installation, operation and service, Siemens strives to set the standard in safety.

The fail-to-safe capabilities within a turbine, combined with Siemens' superior lightning protection system, are designed to enhance security for the turbine.

**Advanced operations support**

Given the logistical challenges associated with servicing wind farms, Siemens has equipped its turbines with a Turbine Condition Monitoring (TCM) system that reduces the need for on-site servicing.

Continuous monitoring of turbines allows for the discovery of small faults before they become major problems.

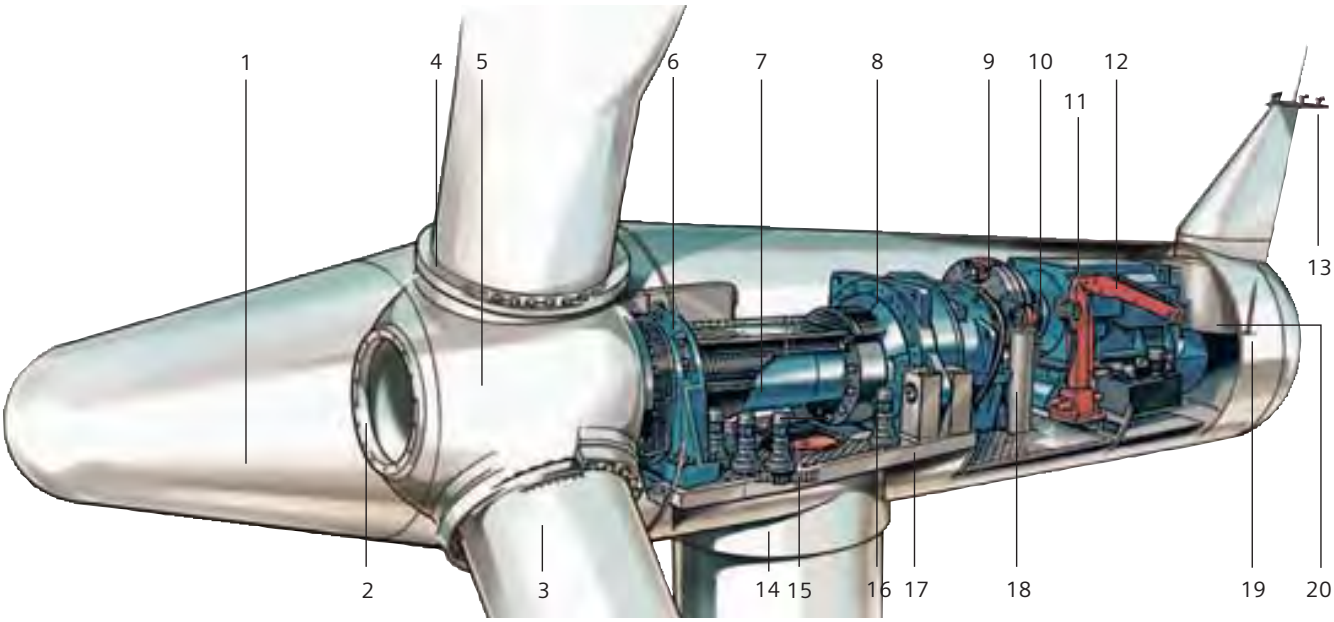
The TCM system continuously checks the external and internal condition of the wind turbine. Twenty-four hours a day, seven days a week precise measurements are taken of vibrations in the gearbox, the generator and the main shaft bearings. The system instantly detects deviations from normal operating conditions.

Using the knowledge gained from monitoring thousands of turbines over the years, Siemens' experts are exceptionally skilled at analyzing and predicting faults within a turbine. This allows Siemens to proactively plan the service and maintenance of the turbines as each fault can be categorized and prioritized based on the severity of the fault. Siemens can then determine the most appropriate course of action to keep the turbine running at its best.

# Technical specifications

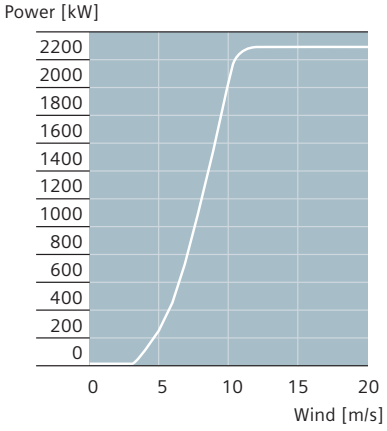
| | |
|---|---|
| **Rotor** | |
| Diameter | 101 m |
| Swept area | 8,000 m2 |
| Rotor speed | 6-16 rpm |
| Power regulation | Pitch regulation with variable speed |
| **Blades** | |
| Type | B49 |
| Length | 49 m |
| **Aerodynamic brake** | |
| Type | Full-span pitching |
| Activation | Active, hydraulic |
| **Transmission system** | |
| Gearbox type | 3-stage planetary/helical |
| Gearbox ratio | 1:91 |
| Gearbox oil filtering | Inline and offline |
| Gearbox cooling | Separate oil cooler |
| Oil volume | Approximately 400 l |
| **Mechanical brake** | |
| Type | Hydraulic disc brake |
| **Generator** | |
| Type | Asynchronous |
| Nominal power | 2,300 kW |
| Voltage | 690 V |
| Cooling system | Integrated heat exchanger |

| | |
|---|---|
| **Yaw system** | |
| Type | Active |
| **Monitoring system** | |
| SCADA system | WebWPS |
| Remote control | Full turbine control |
| **Tower** | |
| Type | Cylindrical and/or tapered tubular |
| Hub height | 80 m or site-specific |
| **Operational data** | |
| Cut-in wind speed | 3-4 m/s |
| Rated power at | 12-13 m/s |
| Cut-out wind speed | 25 m/s |
| Maximum 3 s gust | 55 m/s (standard version)<br>60 m/s (IEC version) |
| **Weights** | |
| Rotor | 62 tons |
| Nacelle | 82 tons |
| Tower for 80-m hub height | 162 tons |




**Sales power curve**

The calculated power curve data are valid for standard conditions of 15 degrees Celsius air temperature, 1013 hPa air pressure and 1.225 kg/m$^3$ air density, clean rotor blades and horizontal, undisturbed air flow. The calculated curve data are preliminary.




**Nacelle arrangement**

1. Spinner
2. Spinner bracket
3. Blade
4. Pitch bearing
5. Rotor hub
6. Main bearing
7. Main shaft
8. Gearbox
9. Brake disc
10. Coupling
11. Generator
12. Service crane
13. Meteorological sensors
14. Tower
15. Yaw ring
16. Yaw gear
17. Nacelle bedplate
18. Oil filter
19. Canopy
20. Generator fan

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# APPENDIX C

# Air Quality Technical Addendum

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| | Estimated Daily Emissions (pounds/day) | | | | |
|---|---|---|---|---|---|
| **Construction Activity** | **ROG** | **NOx** | **CO** | **PM10** | **PM2.5** |
| Existing Turbine Removal | 1.06 | 9.79 | 3.03 | 0.39 | 0.36 |
| New Turbine/Infrastructure Construction | 5.70 | 53.26 | 17.77 | 2.06 | 1.90 |
| On-site Subtotal | 6.76 | 63.05 | 20.79 | 2.45 | 2.26 |
| Off-site Vehicle Trips | 4.28 | 36.32 | 40.66 | 1.62 | 1.49 |
| **Total** | 11.04 | 99.36 | 61.46 | 4.07 | 3.75 |
| Proposed BAAQMD Signficance Threshold | 54 | 54 | NA | 82 | 54 |
| Significant Impact? | | | | | |

| | Estimated Total Emissions (metric tons/year) | | | |
|---|---|---|---|---|
| **Construction Activity** | **CO2** | **CH4** | **N2O** | **CO2e** |
| Existing Turbine Removal | 58.32 | 0.01 | 0.00 | 58.91 |
| New Turbine/Infrastructure Construction | 452.27 | 0.04 | 0.01 | 456.67 |
| Off-site Vehicle Trips | 319.59 | 0.01 | 0.01 | 321.46 |
| Water Use - Indirect Emissions | 3.00 | 0.00 | 0.00 | 3.02 |
| **Total** | 833.18 | 0.05 | 0.02 | 840.07 |
| Amortized (30 years) | | | | 28.00 |

## Indirect Water Useage Emissions

**Water Demand**

8.425 mill gallons/proj (Source: PD Table 3-7)

**Water Energy use factor* (CEC, 2005)**

1,500 kW-hr/MG

*Includes supply and conveyance, treatment, and distribution.

**Water Related Electrical Consumption**

12,638 kW-hr/yr
13 MW-hr/yr

**Electricity Use Emission Factors (PG&E, 2010 and CCAR, 2009)**

| | CO2 | CH4 | N2O |
|---|---|---|---|
| lbs/MW-hr | 524 | 0.0302 | 0.0081 |

**Electricity Use for Water Emissions**

| | CO2 | CH4 | N2O |
|---|---|---|---|
| lb/yr | 6,622.05 | 0.38 | 0.10 |
| CO2e lb/yr | 6,622.05 | 9.54 | 30.30 |
| CO2e ton/yr | 3.31 | 0.00 | 0.02 |
| CO2e MT/yr | 3.00 | 0.00 | 0.01 |
| Total CO2e MT/yr | | **3.02** | |

Global Warming Potential for CH4 = 25; GWP for N2O = 296.

**References:**

California Energy Commission (CEC), 2005. California's Water - Energy Relationship Prepared in Suppot of the 2005 Integrated Energy Policy Report Proceeding (04-IEPR-01E), November 2005 (Table 1-3, page 11).

California Climate Action Registry, 2009. General Reporting Protocol, Reporting Entity-Wide Greenhouse

Gas Emissions, Version 3.1, January 2009.Tables C.4 and C.7.

Pacific Gas and Electric (PG&E). 2008. Carbon Footprint Calculator website (http://www.pge.com/myhome/environment/calculator/) accessed April 16, 2010.

**Annual Construction On-road Emissions (metric tons/year) UPDATE PER CRITERIA POLLUTANT TRIP AMOUNTS**

| Vehicle Type | Trips/year | miles/trip | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|
| Light duty truck - 15 mph | 3,129 | 1 | 2.27 | 0.0003 | 0.0002 | 2.33 |
| Light duty truck - 25 mph | 3,129 | 1 | 1.51 | 0.0002 | 0.0001 | 1.55 |
| Light duty truck - 65 mph | 3,129 | 38 | 56.98 | 0.0066 | 0.0043 | 58.42 |
| Total (metric tons) | | | 60.77 | 0.0071 | 0.0046 | 62.30 |

It is assumed that each light-duty truck 25-mile round trip would include 1.0 mile of 15 mph travel, 1.0 mile of 25 mph travel, and 38 miles of 65 mile per hour travel.
Trips per are based on 8 new employees, generating 1.5 round trips per day, 5 days a week, 40 mile round trips.
The emissions for 15 mph include the start-up emissions for two starts.

Notes: 0.907194 metric tons = 1 ton; 2000 pounds = 1 ton; 2204.6 pounds = 1 metric ton.
Global Warming Potential for CH4 = 25; GWP for N2O = 296.

Gasoline emission of GHG

| | | | |
|---|---|---|---|
| 483.815 | g CO2/mile | | Offroad at 25 mph |
| 0.0563 | | 9 | (CCAR, 2009) |
| 0.03639 | g NO2/mile | | (CCAR, 2009) |
| CH4 emissions = | | 0.000116 | ratio of CH4 emission to CO2 Emissions |
| N2O emissions = | | 0.000075 | ratio of N20 emission to CO2 Emissions |

Diesel emission of GHG (CCAR, 2009)

| | | | |
|---|---|---|---|
| 1976.527 | g CO2/mile | | Offroad at 25 mph |
| 0.0048 | g CH4/mile | | (CCAR, 2009) |
| 0.0051 | g NO2/mile | | (CCAR, 2009) |
| CH4 emissions = | | 0.000002 | ratio of CH4 emission to CO2 Emissions |
| N2O emissions = | | 0.000003 | ratio of N20 emission to CO2 Emissions |

**References:**

California Climate Action Registry, General Reporting Protocol, Reporting Entity-Wide Greenhouse Gas Emissions, Version 3.1, January 2009. Tables C.3 and C.6.

Gasoline emissions are averaged for vehicle models from 1985 to present.

**ONROAD CRITERIA POLLUTANT EMISSIONS**

**Emission Factors**

| Vehicle Type | Running Exhaust Emission Factors (pounds/mile) | | | | | Starting Emission Factors (pounds/trip) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ROG | NOx | CO | PM10 | PM2.5 | ROG | NOx | CO | PM10 | PM2.5 |
| Light duty truck - 15 mph | 0.0003 | 0.0012 | 0.0077 | 0.0001 | 0.0001 | 0.0021 | 0.0019 | 0.0308 | 4.409E-05 | 4.409E-05 |
| Light duty truck - 25 mph | 0.0001 | 0.0010 | 0.0064 | 0.0001 | 0.0001 | | | | | |
| Light duty truck - 65 mph | 0.0001 | 0.0010 | 0.0038 | 0.0000 | 0.0000 | | | | | |
| Heavy duty truck -15 mph | 0.0061 | 0.0384 | 0.0242 | 0.0019 | 0.0017 | 0.0179 | 0.0240 | 0.3031 | 1.764E-05 | 1.764E-05 |
| Heavy duty truck -25 mph | 0.0027 | 0.0316 | 0.0150 | 0.0011 | 0.0010 | | | | | |
| Heavy duty truck -65 mph | 0.0021 | 0.0311 | 0.0110 | 0.0014 | 0.0013 | | | | | |

Note: used EMFAC 2007, for model years 1985 through 2011.

**Average Daily Construction Emissions**

| Vehicle Type | Trips/proj | miles/trip | ROG | NOx | CO | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|
| Light duty truck - 15 mph | 5,400 | 1 | 24.24 | 26.83 | 374.64 | 1.11 | 1.06 |
| Light duty truck - 25 mph | 5,400 | 1 | 0.77 | 5.32 | 34.62 | 0.35 | 0.32 |
| Light duty truck - 65 mph | 5,400 | 23 | 12.05 | 122.39 | 466.30 | 5.75 | 5.34 |
| Heavy trucks decomiss. -15 mph | 90 | 4 | 5.43 | 18.12 | 63.27 | 0.69 | 0.63 |
| Heavy trucks decomiss. - 25 mph | 90 | 1 | 0.24 | 2.84 | 1.35 | 0.10 | 0.09 |
| Heavy trucks decomiss. - 65 mph | 90 | 15 | 2.85 | 41.92 | 14.87 | 1.95 | 1.80 |
| Heavy trucks from Port -15 mph | 234 | 4 | 14.11 | 47.11 | 164.51 | 1.79 | 1.64 |
| Heavy trucks from Port - 25 mph | 234 | 1 | 0.63 | 7.38 | 3.51 | 0.26 | 0.24 |
| Heavy trucks from Port - 65 mph | 234 | 70 | 34.59 | 508.63 | 180.41 | 23.69 | 21.79 |
| Heavy cement trucks -15 mph | 657 | 4 | 39.62 | 132.27 | 461.90 | 5.02 | 4.62 |
| Heavy cement trucks -25 mph | 657 | 1 | 1.78 | 20.73 | 9.85 | 0.73 | 0.67 |
| Heavy cement trucks - 65 mph | 657 | 15 | 20.81 | 306.01 | 108.54 | 14.25 | 13.11 |
| Heavy gravel trucks -15 mph | 3,630 | 4 | 218.92 | 730.80 | 2,552.03 | 27.72 | 25.51 |
| Heavy gravel trucks -25 mph | 3,630 | 1 | 9.81 | 114.53 | 54.43 | 4.02 | 3.70 |
| Heavy gravel trucks -65 mph | 3,630 | 25 | 191.66 | 2,817.93 | 999.53 | 131.24 | 120.74 |
| Total Project Emissions | | | 577.53 | 4,902.82 | 5,489.76 | 218.66 | 201.27 |
| Total Average Daily Emissions | | | 4.28 | 36.32 | 40.66 | 1.62 | 1.49 |

It is assumed that the project would include approximately 135 workdays. Therefore, total project emissions are divided for 135 for the daily average amounts.
It is assumed that each light-duty truck 25-mile round trip would include 1.0 mile of 15 mph travel, 1.0 mile of 25 mph travel, and 23 miles of 65 mile per hour travel.
Light duty truck trips per project are based on an average of 40 commuting workers for 135 workdays.
Heavy truck trips from port are based on amounts presented in project description Table 3-8 all other heavy truck trip amounts are based on amounts in Table 3-6.
It is assumed that each 75-mile heavy-duty truck round trip would include 4.0 miles of 15 mph travel (at the windfarm), 1.0 mile of 25 mph travel (local roads), and 70 miles of 65 mph travel.
Average round-trip length from the Port of Oakland to the site is approximately 75 miles.
The emissions for 15 mph include the start-up emissions for two starts.

**ONROAD GREENHOUSE GAS EMISSIONS**

**Emission Factors**

| Vehicle Type | Running Exhaust Emission Factors (pounds/mile) | | | Starting Emission Factors (pounds/start-up) | | |
|---|---|---|---|---|---|---|
| | CO2 | CH4 | N2O | CO2 | CH4 | N2O |
| Light duty truck - 15 mph | 1.5504 | 0.0002 | 0.0001 | 0.0249 | 2.898E-06 | 1.873E-06 |
| Light duty truck - 25 mph | 1.0666 | 0.0001 | 0.0001 | | | |
| Light duty truck - 65 mph | 1.0567 | 0.0001 | 0.0001 | | | |
| Heavy duty truck -15 mph | 5.5704 | 0.0000 | 0.0000 | 0.2419 | 5.873E-07 | 6.241E-07 |
| Heavy duty truck -25 mph | 4.3574 | 0.0000 | 0.0000 | | | |
| Heavy duty truck -65 mph | 3.6664 | 0.0000 | 0.0000 | | | |

Note: used EMFAC 2007, for model years 1989 through 2009; average of speeds 25 mph and 55 mph.

**Annual Construction On-road Emissions (metric tons/year) UPDATE PER CRITERIA POLLUTANT TRIP AMOUNTS**

| Vehicle Type | Trips/year | miles/trip | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|
| Light duty truck - 15 mph | 5,400 | 1 | 3.92 | 0.0005 | 0.0003 | 4.02 |
| Light duty truck - 25 mph | 5,400 | 1 | 2.61 | 0.0003 | 0.0002 | 2.68 |
| Light duty truck - 65 mph | 5,400 | 23 | 59.53 | 0.0069 | 0.0045 | 61.03 |
| Heavy trucks decomiss. -15 mph | 90 | 4 | 0.93 | 0.0000 | 0.0000 | 0.93 |
| Heavy trucks decomiss. - 25 mph | 90 | 1 | 0.18 | 0.0000 | 0.0000 | 0.18 |
| Heavy trucks decomiss. - 65 mph | 90 | 15 | 2.25 | 0.0000 | 0.0000 | 2.25 |
| Heavy trucks from Port -15 mph | 234 | 4 | 2.42 | 0.0000 | 0.0000 | 2.42 |
| Heavy trucks from Port - 25 mph | 234 | 1 | 0.46 | 0.0000 | 0.0000 | 0.46 |
| Heavy trucks from Port - 65 mph | 234 | 70 | 27.24 | 0.0001 | 0.0001 | 27.26 |
| Heavy cement trucks -15 mph | 657 | 4 | 6.78 | 0.0000 | 0.0000 | 6.79 |
| Heavy cement trucks -25 mph | 657 | 1 | 1.30 | 0.0000 | 0.0000 | 1.30 |
| Heavy cement trucks - 65 mph | 657 | 15 | 16.39 | 0.0000 | 0.0000 | 16.40 |
| Heavy gravel trucks -15 mph | 3,630 | 4 | 37.48 | 0.0001 | 0.0001 | 37.52 |
| Heavy gravel trucks -25 mph | 3,630 | 1 | 7.17 | 0.0000 | 0.0000 | 7.18 |
| Heavy gravel trucks -65 mph | 3,630 | 25 | 150.93 | 0.0004 | 0.0004 | 151.05 |
| Total (metric tons) | | | 319.59 | 0.0083 | 0.0056 | 321.46 |

It is assumed that each light-duty truck 25-mile round trip would include 1.0 mile of 15 mph travel, 1.0 mile of 25 mph travel, and 23 miles of 65 mile per hour travel.
Light duty truck trips per project are based on an average of 40 commuting workers for 135 workdays.
Heavy truck trips from port are based on amounts presented in project description Table 3-8 all other heavy truck trip amounts are based on amounts in Table 3-6.
It is assumed that each 75-mile heavy-duty truck round trip would include 4.0 miles of 15 mph travel (at the windfarm), 1.0 mile of 25 mph travel (local roads), and 70 miles of 65 mph travel.
Average round-trip length from the Port of Oakland to the site is approximately 75 miles.
The emissions for 15 mph include the start-up emissions for two starts.

Notes: 0.907194 metric tons = 1 ton; 2000 pounds = 1 ton; 2204.6 pounds = 1 metric ton.
Global Warming Potential for CH4 = 25; GWP for N2O = 296.

Gasoline emission of GHG

| | | |
|---|---|---|
| 483.815 g CO2/mile | | Offroad at 25 mph |
| 0.0563 | 9 | (CCAR, 2009) |
| 0.03639 g NO2/mile | | (CCAR, 2009) |
| CH4 emissions = | 0.000116 | ratio of CH4 emission to CO2 Emissions |
| N2O emissions = | 0.000075 | ratio of N20 emission to CO2 Emissions |

Diesel emission of GHG (CCAR, 2009)

| | | |
|---|---|---|
| 1976.527 g CO2/mile | | Offroad at 25 mph |
| 0.0048 g CH4/mile | | (CCAR, 2009) |
| 0.0051 g NO2/mile | | (CCAR, 2009) |
| CH4 emissions = | 0.000002 | ratio of CH4 emission to CO2 Emissions |
| N2O emissions = | 0.000003 | ratio of N20 emission to CO2 Emissions |

**References:**

California Climate Action Registry, General Reporting Protocol, Reporting Entity-Wide GHGs Emissions, Version 3.1, January 2009. Tables C.3 and C.6.

Gasoline emissions are averaged for vehicle models from 1985 to present.

Title: Vasco On-road Emissions
Version: Emfac2007 V2.3, November 1 2006
Run Date: 4/23/2010 20:03:19
Scen Year: 2011 -- All model years in the range 1985 to 2011 selected
Season: Annual
Area: Contra Costa
**********
Year: 2011 -- Model Years 1985 to 2011 Inclusive -- Annual
Version: Emfac2007 V2.3, November 1 2006
County Average Contra Costa County Average
Table 1:00 Running Exhaust Emissions (grams/mile)

Pollutant Name: Reactive Org Gases; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.124 | 0 | 2.768 | 0 | 0 | 0.315 |
| 25 | 0 | 0.065 | 0 | 1.226 | 0 | 0 | 0.149 |
| 65 | 0 | 0.044 | 0 | 0.958 | 0 | 0 | 0.11 |

Pollutant Name: Carbon Monoxide; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 3.514 | 0 | 10.98 | 0 | 0 | 4.055 |
| 25 | 0 | 2.908 | 0 | 6.801 | 0 | 0 | 3.19 |
| 65 | 0 | 1.703 | 0 | 4.996 | 0 | 0 | 1.941 |

Pollutant Name: Oxides of Nitrogen; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.548 | 0 | 17.398 | 0 | 0 | 1.77 |
| 25 | 0 | 0.447 | 0 | 14.312 | 0 | 0 | 1.452 |
| 65 | 0 | 0.447 | 0 | 14.085 | 0 | 0 | 1.436 |

Pollutant Name: Carbon Dioxide; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 703.239 | 0 | 2526.74 | 0 | 0 | 835.462 |
| 25 | 0 | 483.815 | 0 | 1976.527 | 0 | 0 | 592.053 |
| 65 | 0 | 479.309 | 0 | 1663.101 | 0 | 0 | 565.147 |

Pollutant Name: Sulfur Dioxide; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.007 | 0 | 0.024 | 0 | 0 | 0.008 |
| 25 | 0 | 0.005 | 0 | 0.019 | 0 | 0 | 0.006 |
| 65 | 0 | 0.005 | 0 | 0.016 | 0 | 0 | 0.005 |

Pollutant Name: Particulate Matter (PM10); Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.053 | 0 | 0.862 | 0 | 0 | 0.111 |
| 25 | 0 | 0.029 | 0 | 0.502 | 0 | 0 | 0.063 |
| 65 | 0 | 0.021 | 0 | 0.656 | 0 | 0 | 0.067 |

Pollutant Name: Gasoline - mi/gal; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 12.484 | 0 | 6.752 | 0 | 0 | 12.462 |
| 25 | 0 | 18.125 | 0 | 11.606 | 0 | 0 | 18.101 |
| 65 | 0 | 18.369 | 0 | 11.267 | 0 | 0 | 18.342 |

Pollutant Name: Diesel - mi/gal; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 29.156 | 0 | 3.883 | 0 | 0 | 4.402 |
| 25 | 0 | 29.156 | 0 | 4.935 | 0 | 0 | 5.432 |
| 65 | 0 | 29.156 | 0 | 5.889 | 0 | 0 | 6.367 |

Pollutant Name: Particulate Matter (PM10) - Tire Wear; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.008 | 0 | 0.035 | 0 | 0 | 0.01 |
| 25 | 0 | 0.008 | 0 | 0.035 | 0 | 0 | 0.01 |
| 65 | 0 | 0.008 | 0 | 0.035 | 0 | 0 | 0.01 |

Pollutant Name: Particulate Matter (PM10) - Break Wear; Temperature 50 F; Relative Humidity 60%

| Speed MPH | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 15 | 0 | 0.013 | 0 | 0.028 | 0 | 0 | 0.014 |
| 25 | 0 | 0.013 | 0 | 0.028 | 0 | 0 | 0.014 |
| 65 | 0 | 0.013 | 0 | 0.028 | 0 | 0 | 0.014 |

Title: Vasco On-road Emissions
Version: Emfac2007 V2.3, November 1 2006
Run Date: 4/23/2010 20:03:19

Scen Year: 2011 -- All model years in the range 1985 to 2011 selected
Season: Annual
Area: Contra Costa
**********
Year: 2011 -- Model Years 1985 to 2011 Inclusive -- Annual
Version: Emfac2007 V2.3, November 1 2006
County Average Contra Costa County Average
Table 2:00 Starting Emissions (grams/trip)

Pollutant Name: Reactive Org Gases; Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 0.079 | 0 | 0.941 | 0 | 0 | 0.1 |
| 10 | 0 | 0.156 | 0 | 1.835 | 0 | 0 | 0.196 |
| 20 | 0 | 0.298 | 0 | 3.479 | 0 | 0 | 0.375 |
| 30 | 0 | 0.428 | 0 | 4.931 | 0 | 0 | 0.537 |
| 40 | 0 | 0.545 | 0 | 6.193 | 0 | 0 | 0.681 |
| 50 | 0 | 0.649 | 0 | 7.263 | 0 | 0 | 0.808 |
| 60 | 0 | 0.74 | 0 | 8.142 | 0 | 0 | 0.918 |
| 120 | 0 | 0.956 | 0 | 6.585 | 0 | 0 | 1.091 |
| 180 | 0 | 0.603 | 0 | 6.987 | 0 | 0 | 0.757 |
| 240 | 0 | 0.639 | 0 | 7.376 | 0 | 0 | 0.801 |
| 300 | 0 | 0.674 | 0 | 7.753 | 0 | 0 | 0.845 |
| 360 | 0 | 0.709 | 0 | 8.116 | 0 | 0 | 0.887 |
| 420 | 0 | 0.743 | 0 | 8.467 | 0 | 0 | 0.929 |
| 480 | 0 | 0.776 | 0 | 8.806 | 0 | 0 | 0.969 |
| 540 | 0 | 0.808 | 0 | 9.131 | 0 | 0 | 1.009 |
| 600 | 0 | 0.84 | 0 | 9.444 | 0 | 0 | 1.047 |
| 660 | 0 | 0.871 | 0 | 9.744 | 0 | 0 | 1.085 |
| 720 | 0 | 0.902 | 0 | 10.031 | 0 | 0 | 1.121 |

Pollutant Name: Carbon Monoxide; Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 1.022 | 0 | 14.755 | 0 | 0 | 1.353 |
| 10 | 0 | 2.013 | 0 | 28.91 | 0 | 0 | 2.66 |
| 20 | 0 | 3.896 | 0 | 55.422 | 0 | 0 | 5.135 |
| 30 | 0 | 5.65 | 0 | 79.536 | 0 | 0 | 7.427 |
| 40 | 0 | 7.275 | 0 | 101.252 | 0 | 0 | 9.535 |
| 50 | 0 | 8.77 | 0 | 120.569 | 0 | 0 | 11.459 |
| 60 | 0 | 10.136 | 0 | 137.489 | 0 | 0 | 13.2 |
| 120 | 0 | 13.978 | 0 | 84.533 | 0 | 0 | 15.675 |
| 180 | 0 | 8.273 | 0 | 87.004 | 0 | 0 | 10.166 |
| 240 | 0 | 8.803 | 0 | 89.556 | 0 | 0 | 10.745 |
| 300 | 0 | 9.285 | 0 | 92.19 | 0 | 0 | 11.279 |
| 360 | 0 | 9.718 | 0 | 94.906 | 0 | 0 | 11.767 |
| 420 | 0 | 10.103 | 0 | 97.703 | 0 | 0 | 12.21 |
| 480 | 0 | 10.439 | 0 | 100.581 | 0 | 0 | 12.607 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 540 | 0 | 10.726 | 0 | 103.541 | 0 | 0 | 12.959 |
| 600 | 0 | 10.965 | 0 | 106.582 | 0 | 0 | 13.265 |
| 660 | 0 | 11.156 | 0 | 109.705 | 0 | 0 | 13.526 |
| 720 | 0 | 11.297 | 0 | 112.909 | 0 | 0 | 13.741 |

Pollutant Name: Oxides of Nitrogen; Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 0.448 | 0 | 2.521 | 0 | 0 | 0.498 |
| 10 | 0 | 0.498 | 0 | 3.799 | 0 | 0 | 0.577 |
| 20 | 0 | 0.587 | 0 | 6.043 | 0 | 0 | 0.719 |
| 30 | 0 | 0.662 | 0 | 7.871 | 0 | 0 | 0.835 |
| 40 | 0 | 0.722 | 0 | 9.284 | 0 | 0 | 0.928 |
| 50 | 0 | 0.767 | 0 | 10.281 | 0 | 0 | 0.996 |
| 60 | 0 | 0.797 | 0 | 10.864 | 0 | 0 | 1.039 |
| 120 | 0 | 0.853 | 0 | 11.11 | 0 | 0 | 1.1 |
| 180 | 0 | 0.914 | 0 | 11.07 | 0 | 0 | 1.158 |
| 240 | 0 | 0.908 | 0 | 11.007 | 0 | 0 | 1.151 |
| 300 | 0 | 0.898 | 0 | 10.923 | 0 | 0 | 1.139 |
| 360 | 0 | 0.884 | 0 | 10.818 | 0 | 0 | 1.123 |
| 420 | 0 | 0.866 | 0 | 10.691 | 0 | 0 | 1.103 |
| 480 | 0 | 0.845 | 0 | 10.542 | 0 | 0 | 1.079 |
| 540 | 0 | 0.821 | 0 | 10.372 | 0 | 0 | 1.05 |
| 600 | 0 | 0.792 | 0 | 10.18 | 0 | 0 | 1.018 |
| 660 | 0 | 0.76 | 0 | 9.967 | 0 | 0 | 0.981 |
| 720 | 0 | 0.724 | 0 | 9.732 | 0 | 0 | 0.941 |

Pollutant Name: Carbon Dioxide; Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 13.751 | 0 | 4.629 | 0 | 0 | 13.531 |
| 10 | 0 | 16.239 | 0 | 9.232 | 0 | 0 | 16.07 |
| 20 | 0 | 21.726 | 0 | 18.361 | 0 | 0 | 21.645 |
| 30 | 0 | 27.893 | 0 | 27.388 | 0 | 0 | 27.881 |
| 40 | 0 | 34.741 | 0 | 36.313 | 0 | 0 | 34.778 |
| 50 | 0 | 42.269 | 0 | 45.135 | 0 | 0 | 42.338 |
| 60 | 0 | 50.477 | 0 | 53.854 | 0 | 0 | 50.558 |
| 120 | 0 | 110.888 | 0 | 91.597 | 0 | 0 | 110.424 |
| 180 | 0 | 126.711 | 0 | 108.215 | 0 | 0 | 126.267 |
| 240 | 0 | 142.32 | 0 | 123.852 | 0 | 0 | 141.876 |
| 300 | 0 | 157.713 | 0 | 138.509 | 0 | 0 | 157.251 |
| 360 | 0 | 172.892 | 0 | 152.184 | 0 | 0 | 172.394 |
| 420 | 0 | 187.856 | 0 | 164.879 | 0 | 0 | 187.303 |
| 480 | 0 | 202.605 | 0 | 176.593 | 0 | 0 | 201.979 |
| 540 | 0 | 217.139 | 0 | 187.326 | 0 | 0 | 216.422 |
| 600 | 0 | 231.459 | 0 | 197.078 | 0 | 0 | 230.632 |
| 660 | 0 | 245.563 | 0 | 205.849 | 0 | 0 | 244.608 |
| 720 | 0 | 259.453 | 0 | 213.64 | 0 | 0 | 258.351 |

Pollutant Name: Sulfur Dioxide; Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0 |
| 50 | 0 | 0.001 | 0 | 0.002 | 0 | 0 | 0.001 |
| 60 | 0 | 0.001 | 0 | 0.003 | 0 | 0 | 0.001 |
| 120 | 0 | 0.001 | 0 | 0.002 | 0 | 0 | 0.001 |
| 180 | 0 | 0.001 | 0 | 0.003 | 0 | 0 | 0.001 |
| 240 | 0 | 0.002 | 0 | 0.003 | 0 | 0 | 0.002 |
| 300 | 0 | 0.002 | 0 | 0.003 | 0 | 0 | 0.002 |
| 360 | 0 | 0.002 | 0 | 0.003 | 0 | 0 | 0.002 |
| 420 | 0 | 0.002 | 0 | 0.003 | 0 | 0 | 0.002 |
| 480 | 0 | 0.002 | 0 | 0.003 | 0 | 0 | 0.002 |
| 540 | 0 | 0.002 | 0 | 0.004 | 0 | 0 | 0.002 |
| 600 | 0 | 0.002 | 0 | 0.004 | 0 | 0 | 0.002 |
| 660 | 0 | 0.003 | 0 | 0.004 | 0 | 0 | 0.003 |
| 720 | 0 | 0.003 | 0 | 0.004 | 0 | 0 | 0.003 |

Pollutant Name: Particulate Matter (PM10); Temperature 50 F; Relative Humidity: ALL

| Time min | LDA | LDT | MDT | HDT | UBUS | MCY | ALL |
|---|---|---|---|---|---|---|---|
| 5 | 0 | 0.001 | 0 | 0.001 | 0 | 0 | 0.001 |
| 10 | 0 | 0.003 | 0 | 0.002 | 0 | 0 | 0.003 |
| 20 | 0 | 0.005 | 0 | 0.003 | 0 | 0 | 0.005 |
| 30 | 0 | 0.007 | 0 | 0.005 | 0 | 0 | 0.007 |
| 40 | 0 | 0.009 | 0 | 0.006 | 0 | 0 | 0.009 |
| 50 | 0 | 0.011 | 0 | 0.007 | 0 | 0 | 0.011 |
| 60 | 0 | 0.013 | 0 | 0.008 | 0 | 0 | 0.013 |
| 120 | 0 | 0.02 | 0 | 0.011 | 0 | 0 | 0.02 |
| 180 | 0 | 0.021 | 0 | 0.011 | 0 | 0 | 0.021 |
| 240 | 0 | 0.023 | 0 | 0.012 | 0 | 0 | 0.023 |
| 300 | 0 | 0.024 | 0 | 0.012 | 0 | 0 | 0.024 |
| 360 | 0 | 0.025 | 0 | 0.012 | 0 | 0 | 0.025 |
| 420 | 0 | 0.026 | 0 | 0.013 | 0 | 0 | 0.026 |
| 480 | 0 | 0.027 | 0 | 0.013 | 0 | 0 | 0.027 |
| 540 | 0 | 0.028 | 0 | 0.014 | 0 | 0 | 0.028 |
| 600 | 0 | 0.029 | 0 | 0.014 | 0 | 0 | 0.028 |
| 660 | 0 | 0.029 | 0 | 0.014 | 0 | 0 | 0.029 |
| 720 | 0 | 0.029 | 0 | 0.015 | 0 | 0 | 0.029 |

CRITERIA POLLUTANTS - OFFROAD

| Activity/Equipment | Quantity | Horsepower | Usage hrs/day | Usage days/proj | Usage hrs/project | Total Const Workdays | Equipment Emission Rates (lb/hour) ROG | NOx | CO | PM10 | PM2.5 | Daily Emissions (lb/day) ROG | NOx | CO | PM10 | PM2.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Existing Turbine Removal** | | | | | | | | | | | | | | | | |
| Small Crane | 1 | 250 | 6 | 45 | 270 | 135 | 0.117 | 1.152 | 0.327 | 0.043 | 0.039 | 0.23 | 2.30 | 0.65 | 0.09 | 0.08 |
| Excavator | 1 | 400 | 8 | 30 | 240 | 135 | 0.168 | 1.601 | 0.498 | 0.057 | 0.052 | 0.30 | 2.85 | 0.89 | 0.10 | 0.09 |
| Rough Terrain Forklift | 1 | 500 | 6 | 45 | 270 | 135 | 0.266 | 2.318 | 0.744 | 0.100 | 0.092 | 0.53 | 4.64 | 1.49 | 0.20 | 0.18 |
| | | | | | | | | | | | Subtotal | **1.06** | **9.79** | **3.03** | **0.39** | **0.36** |
| **New Turbine/Infrastructure Construction** | | | | | | | | | | | | | | | | |
| Grader | 2 | 350 | 10 | 24 | 240 | 135 | 0.182 | 1.780 | 0.564 | 0.066 | 0.060 | 0.65 | 6.33 | 2.01 | 0.23 | 0.21 |
| Track Type Dozer | 2 | 350 | 10 | 24 | 240 | 135 | 0.298 | 2.606 | 1.098 | 0.112 | 0.103 | 1.06 | 9.27 | 3.90 | 0.40 | 0.37 |
| Drum Type Compactor | 2 | 250 | 10 | 24 | 240 | 135 | 0.143 | 1.512 | 0.429 | 0.055 | 0.050 | 0.51 | 5.38 | 1.53 | 0.19 | 0.18 |
| Water Truck | 3 | 350 | 10 | 24 | 240 | 135 | 0.187 | 1.731 | 0.527 | 0.062 | 0.057 | 1.00 | 9.23 | 2.81 | 0.33 | 0.31 |
| Drilling Rig | 1 | 500 | 4 | 12 | 48 | 135 | 0.141 | 1.492 | 0.555 | 0.052 | 0.048 | 0.05 | 0.53 | 0.20 | 0.02 | 0.02 |
| Small Crane | 2 | 250 | 4 | 60 | 240 | 135 | 0.117 | 1.152 | 0.327 | 0.043 | 0.039 | 0.42 | 4.10 | 1.16 | 0.15 | 0.14 |
| Heavy Crane | 4 | 500 | 6 | 21 | 126 | 135 | 0.172 | 1.645 | 0.613 | 0.063 | 0.058 | 0.64 | 6.14 | 2.29 | 0.23 | 0.22 |
| Excavator | 1 | 350 | 8 | 21 | 168 | 135 | 0.157 | 1.520 | 0.457 | 0.053 | 0.049 | 0.20 | 1.89 | 0.57 | 0.07 | 0.06 |
| Rough Terrain Forklift | 2 | 350 | 4 | 60 | 240 | 135 | 0.266 | 2.318 | 0.744 | 0.100 | 0.092 | 0.94 | 8.24 | 2.64 | 0.36 | 0.33 |
| Dump Trucks | 1 | 335 | 4 | 21 | 84 | 135 | 0.187 | 1.731 | 0.527 | 0.062 | 0.057 | 0.12 | 1.08 | 0.33 | 0.04 | 0.04 |
| Cement Trucks | 1 | 335 | 4 | 21 | 84 | 135 | 0.187 | 1.731 | 0.527 | 0.062 | 0.057 | 0.12 | 1.08 | 0.33 | 0.04 | 0.04 |
| | | | | | | | | | | | Subtotal | **5.70** | **53.26** | **17.77** | **2.06** | **1.90** |
| | | | | | | | | | | | **Total Daily Average Equipment Emissions=** | **6.76** | **63.05** | **20.79** | **2.45** | **2.26** |

Note: PM10 and PM2.5 emissions are based on PM emissions factors from the Offroad model
with PM10 and PM2.5 fractions applied to the PM EF (SCAQMD, 2006)
Total annual construction emissions are divided by the number of total construction workdays for the daily average emissions.

**References:**

SCAQMD (South Coast Air Quality Management District). 2006. Final Methodology to Calculate
PM2.5 and PM2.5 Signficance Thresholds, Appendix A - Updated CEIDARS Table with PM2.5 Fractions.

OFFROAD MODEL OUTPUT

| CY | Equipment | Fuel | MaxHP | Class | C/R | Pre | Hand | Port | County | Air Basin | Air Dist. | Population | Activity | Consumption gal/day | Diesel Consumption gal/hour | ROG Exhaust | | CO Exhaust | | NOX Exhaust | | CO2 Exhaust | | SO2 Exhaust | | PM Exhaust | | CH4 Exhaust | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | lb/hour | | lb/hour | | lb/hour | | lb/hour | | lb/hour | | lb/hour | | lb/hour |
| 2011 | Pavers | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 3.49E+00 | 7.98E+00 | 8.47E+01 | **10.61** | 9.96E-04 | **0.25** | 4.29E-03 | **1.08** | 9.50E-03 | **2.38** | 9.30E-01 | **233.083** | 9.13E-06 | **0.002** | 3.80E-04 | **0.095** | 8.99E-05 | **0.023** |
| 2011 | Rollers | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.06E+01 | 2.05E+01 | 1.42E+02 | **6.93** | 1.47E-03 | **0.14** | 4.40E-03 | **0.43** | 1.55E-02 | **1.51** | 1.56E+00 | **152.195** | 1.76E-05 | **0.002** | 5.61E-04 | **0.055** | 1.33E-04 | **0.013** |
| 2011 | Rollers | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 7.46E+00 | 1.43E+01 | 1.43E+02 | **10.00** | 1.34E-03 | **0.19** | 5.19E-03 | **0.73** | 1.39E-02 | **1.94** | 1.57E+00 | **219.580** | 1.54E-05 | **0.002** | 5.13E-04 | **0.072** | 1.21E-04 | **0.017** |
| 2011 | Scrapers | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 4.23E+01 | 1.29E+02 | 1.89E+03 | **14.65** | 2.25E-02 | **0.35** | 9.06E-02 | **1.40** | 2.07E-01 | **3.21** | 2.07E+01 | **320.930** | 2.04E-04 | **0.003** | 8.30E-03 | **0.129** | 2.03E-03 | **0.031** |
| 2011 | Trenchers | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.25E+00 | 3.90E+00 | 5.53E+01 | **14.18** | 6.42E-04 | **0.33** | 2.95E-03 | **1.51** | 6.25E-03 | **3.21** | 6.07E-01 | **311.282** | 5.95E-06 | **0.003** | 2.50E-04 | **0.128** | 5.80E-05 | **0.030** |
| 2011 | Bore/Drill Rigs | D | 500 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | 7.85E+00 | 1.81E+01 | 2.55E+02 | **14.09** | 1.28E-03 | **0.14** | 5.02E-03 | **0.55** | 1.35E-02 | **1.49** | 2.82E+00 | **311.602** | 2.77E-05 | **0.003** | 4.72E-04 | **0.052** | 1.16E-04 | **0.013** |
| 2011 | Excavators | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.31E+02 | 5.12E+02 | 3.68E+03 | **7.19** | 3.50E-02 | **0.14** | 9.62E-02 | **0.38** | 3.48E-01 | **1.36** | 4.06E+01 | **158.594** | 4.56E-04 | **0.002** | 1.19E-02 | **0.046** | 3.16E-03 | **0.012** |
| 2011 | Excavators | D | 350 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **8.55** | | **0.16** | | **0.46** | | **1.52** | | **188.598** | | **0.002** | | **0.053** | | **0.014** |
| 2011 | Excavators | D | 400 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **9.23** | | **0.17** | | **0.50** | | **1.60** | | **203.600** | | **0.002** | | **0.057** | | **0.015** |
| 2011 | Excavators | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 9.45E+01 | 3.69E+02 | 3.91E+03 | **10.60** | 3.48E-02 | **0.19** | 1.07E-01 | **0.58** | 3.25E-01 | **1.76** | 4.31E+01 | **233.604** | 4.23E-04 | **0.002** | 1.18E-02 | **0.064** | 3.14E-03 | **0.017** |
| 2011 | Cranes | D | 250 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | 3.19E+01 | 1.12E+02 | 5.70E+02 | **5.09** | 6.55E-03 | **0.12** | 1.83E-02 | **0.33** | 6.45E-02 | **1.15** | 6.28E+00 | **112.143** | 7.06E-05 | **0.001** | 2.40E-03 | **0.043** | 5.91E-04 | **0.011** |
| 2011 | Cranes | D | 500 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | 1.17E+01 | 4.11E+01 | 3.36E+02 | **8.18** | 3.54E-03 | **0.17** | 1.26E-02 | **0.61** | 3.38E-02 | **1.64** | 3.70E+00 | **180.049** | 3.63E-05 | **0.002** | 1.29E-03 | **0.063** | 3.20E-04 | **0.016** |
| 2011 | Graders | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 8.74E+01 | 2.28E+02 | 1.78E+03 | **7.81** | 1.90E-02 | **0.17** | 5.37E-02 | **0.47** | 1.89E-01 | **1.66** | 1.96E+01 | **171.930** | 2.21E-04 | **0.002** | 6.87E-03 | **0.060** | 1.71E-03 | **0.015** |
| 2011 | Graders | D | 350 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **8.85** | | **0.18** | | **0.56** | | **1.78** | | **194.817** | | **0.002** | | **0.066** | | **0.016** |
| 2011 | Graders | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.47E+00 | 6.45E+00 | 6.71E+01 | **10.40** | 6.59E-04 | **0.20** | 2.27E-03 | **0.70** | 6.33E-03 | **1.96** | 7.39E-01 | **229.147** | 7.26E-06 | **0.002** | 2.37E-04 | **0.073** | 5.95E-05 | **0.018** |
| 2011 | Off-Highway Trucks | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.12E+01 | 1.16E+02 | 8.73E+02 | **7.53** | 8.95E-03 | **0.15** | 2.37E-02 | **0.41** | 8.53E-02 | **1.47** | 9.62E+00 | **165.862** | 1.08E-04 | **0.002** | 2.98E-03 | **0.051** | 8.08E-04 | **0.014** |
| 2011 | Off-Highway Trucks | D | 350 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **9.45** | | **0.19** | | **0.53** | | **1.73** | | **208.474** | | **0.002** | | **0.062** | | **0.017** |
| 2011 | Off-Highway Trucks | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.98E+01 | 1.63E+02 | 2.01E+03 | **12.33** | 1.93E-02 | **0.24** | 5.75E-02 | **0.71** | 1.73E-01 | **2.12** | 2.22E+01 | **272.393** | 2.18E-04 | **0.003** | 6.39E-03 | **0.078** | 1.74E-03 | **0.021** |
| 2011 | Crushing/Proc. Equipment | D | 250 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | 8.38E-01 | 2.20E+00 | 2.43E+01 | **11.05** | 2.28E-04 | **0.21** | 6.40E-04 | **0.58** | 2.59E-03 | **2.35** | 2.68E-01 | **243.636** | 3.02E-06 | **0.003** | 8.27E-05 | **0.075** | 2.06E-05 | **0.019** |
| 2011 | Crushing/Proc. Equipment | D | 350 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | | | | **13.37** | | **0.24** | | **0.73** | | **2.68** | | **295.214** | | **0.003** | | **0.088** | | **0.022** |
| 2011 | Crushing/Proc. Equipment | D | 500 | Construction and Mining Equipment | U | N | NHH | P | Contra Costa | SF | BA | 4.72E+00 | 1.24E+01 | 2.09E+02 | **16.85** | 1.78E-03 | **0.29** | 5.94E-03 | **0.96** | 1.97E-02 | **3.18** | 2.31E+00 | **372.581** | 2.26E-05 | **0.004** | 6.61E-04 | **0.107** | 1.61E-04 | **0.026** |
| 2011 | Rough Terrain Forklifts | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.68E+00 | 5.21E+00 | 4.03E+01 | **7.74** | 3.71E-04 | **0.14** | 1.05E-03 | **0.40** | 3.98E-03 | **1.53** | 4.45E-01 | **170.825** | 5.00E-06 | **0.002** | 1.32E-04 | **0.051** | 3.35E-05 | **0.013** |
| 2011 | Rough Terrain Forklifts | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.10E+00 | 3.43E+00 | 3.99E+01 | **11.63** | 3.39E-04 | **0.20** | 1.09E-03 | **0.64** | 3.46E-03 | **2.02** | 4.40E-01 | **256.560** | 4.31E-06 | **0.003** | 1.21E-04 | **0.071** | 3.06E-05 | **0.018** |
| 2011 | Rubber Tired Loaders | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 7.61E+01 | 2.04E+02 | 2.19E+03 | **10.74** | 2.10E-02 | **0.21** | 7.29E-02 | **0.71** | 2.04E-01 | **2.00** | 2.41E+01 | **236.275** | 2.36E-04 | **0.002** | 7.59E-03 | **0.074** | 1.89E-03 | **0.019** |
| 2011 | Rubber Tired Dozers | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.08E+01 | 4.84E+01 | 4.04E+02 | **8.35** | 6.43E-03 | **0.27** | 1.80E-02 | **0.74** | 5.61E-02 | **2.32** | 4.43E+00 | **183.058** | 4.99E-05 | **0.002** | 2.43E-03 | **0.100** | 5.80E-04 | **0.024** |
| 2011 | Rubber Tired Dozers | D | 350 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **9.85** | | **0.30** | | **1.10** | | **2.61** | | **215.749** | | **0.002** | | **0.112** | | **0.027** |
| 2011 | Rubber Tired Dozers | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 1.66E+01 | 7.44E+01 | 9.00E+02 | **12.10** | 1.29E-02 | **0.35** | 6.06E-02 | **1.63** | 1.13E-01 | **3.04** | 9.85E+00 | **264.785** | 9.66E-05 | **0.003** | 4.80E-03 | **0.129** | 1.17E-03 | **0.031** |
| 2011 | Tractors/Loaders/Backhoes | D | 250 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.40E+01 | 6.37E+01 | 4.96E+02 | **7.79** | 4.25E-03 | **0.13** | 1.23E-02 | **0.39** | 4.48E-02 | **1.41** | 5.47E+00 | **171.743** | 6.15E-05 | **0.002** | 1.49E-03 | **0.047** | 3.84E-04 | **0.012** |
| 2011 | Tractors/Loaders/Backhoes | D | 350 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | | | | **10.92** | | **0.18** | | **0.55** | | **1.83** | | **240.521** | | **0.003** | | **0.063** | | **0.016** |
| 2011 | Tractors/Loaders/Backhoes | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 3.87E+01 | 1.03E+02 | 1.61E+03 | **15.63** | 1.28E-02 | **0.25** | 4.14E-02 | **0.80** | 1.27E-01 | **2.47** | 1.77E+01 | **343.689** | 1.99E-04 | **0.004** | 4.51E-03 | **0.088** | 1.16E-03 | **0.023** |
| 2011 | Crawler Tractors | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 6.98E+01 | 2.01E+02 | 2.37E+03 | **11.79** | 2.80E-02 | **0.28** | 1.11E-01 | **1.10** | 2.57E-01 | **2.56** | 2.60E+01 | **258.706** | 2.56E-04 | **0.003** | 1.02E-02 | **0.101** | 2.52E-03 | **0.025** |
| 2011 | Other Construction Equipment | D | 500 | Construction and Mining Equipment | U | N | NHH | NP | Contra Costa | SF | BA | 2.01E+01 | 3.87E+01 | 4.46E+02 | **11.52** | 3.09E-03 | **0.16** | 1.10E-02 | **0.57** | 3.50E-02 | **1.81** | 4.92E+00 | **254.264** | 4.83E-05 | **0.002** | 1.17E-03 | **0.060** | 2.79E-04 | **0.014** |
| 2011 | Generator Sets | D | 250 | Light Commercial Equipment | U | N | NHH | P | Total | Total | Total | 6.48E+00 | 5.99E+00 | 5.76E+01 | **9.62** | 4.26E-04 | **0.14** | 1.39E-03 | **0.46** | 5.60E-03 | **1.87** | 6.36E-01 | **212.314** | 7.16E-06 | **0.002** | 1.61E-04 | **0.054** | 3.85E-05 | **0.013** |
| 2011 | Generator Sets | D | 350 | Light Commercial Equipment | U | N | NHH | P | Total | Total | Total | | | | **11.87** | | **0.17** | | **0.60** | | **2.20** | | **262.009** | | **0.003** | | **0.064** | | **0.015** |
| 2011 | Generator Sets | D | 500 | Light Commercial Equipment | U | N | NHH | P | Total | Total | Total | 1.44E+01 | 1.33E+01 | 2.03E+02 | **15.25** | 1.35E-03 | **0.20** | 5.30E-03 | **0.80** | 1.79E-02 | **2.69** | 2.24E+00 | **336.550** | 2.20E-05 | **0.003** | 5.32E-04 | **0.080** | 1.22E-04 | **0.018** |

**Note: emission factors for 350 hp and 400 hp equipment are estimated using ratios associated with the available 250 and 500 hp equipment.**

**Energy Displaced From the Electrical Grid**

| | MW-hrs |
|---|---|
| Proposed | 110,000 |
| Existing | 80,000 |
| Change | 30,000 |

**Electricity Use Emission Factors (PG&E, 2010 and CCAR, 2009)**

| | CO2 | CH4 | N2O |
|---|---|---|---|
| lbs/MW-hr | 524 | 0.0302 | 0.0081 |

**Emission Reduction (GHG Avoided)**

| | CO2 | CH4 | N2O |
|---|---|---|---|
| lb/yr | 15,720,000 | 906 | 243 |
| CO2e lb/yr | 15,720,000 | 22,650 | 71,928 |
| CO2e ton/yr | 7,860 | 11 | 36 |
| CO2e MT/yr | 7,129 | 10 | 33 |
| Total CO2e MT/yr | | **7,172** | |

Global Warming Potential for CH4 = 25; GWP for N2O = 296.

**References:**

California Energy Commission (CEC), 2005. California's Water - Energy Relationship Prepared in Suppot of the 2005 Integrated Energy Policy Report Proceeding (04-IEPR-01E), November 2005 (Table 1-3, page 11).

California Climate Action Registry, 2009. General Reporting Protocol, Reporting Entity-Wide Greenhouse

Gas Emissions, Version 3.1, January 2009.Tables C.4 and C.7.

Pacific Gas and Electric (PG&E). 2008. Carbon Footprint Calculator website (http://www.pge.com/myhome/environment/calculator/) accessed April 16, 2010.

GHG - OFFROAD

| Activity/Equipment | Quantity | Horsepower | Usage | | | Equipment Emission Rates (lb/hour) | | | Annual Emissions (metric tons per year) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | hrs/day | days/proj | hrs/proj | CO2 | CH4 | N2O | CO2 | CH4 | N2O | CO2e |
| **Existing Turbine Removal and Restoration of Turbine Sites** | | | | | | | | | | | | |
| Small Crane | 1 | 250 | 6 | 45 | 270 | 112.143 | 0.011 | 0.00287 | 13.73 | 0.00 | 0.00 | 13.87 |
| Excavator | 1 | 400 | 8 | 30 | 240 | 203.600 | 0.015 | 0.00522 | 22.16 | 0.00 | 0.00 | 22.37 |
| Rough Terrain Forklift | 1 | 500 | 6 | 45 | 270 | 183.058 | 0.024 | 0.00469 | 22.42 | 0.00 | 0.00 | 22.66 |
| | | | | | | | | Subtotal | **58.32** | **0.01** | **0.00** | **58.91** |
| **Road, Pad, and Collector Line Construction** | | | | | | | | | | | | |
| Grader | 2 | 350 | 10 | 24 | 240 | 194.817 | 0.016 | 0.00499 | 42.42 | 0.00 | 0.00 | 42.83 |
| Bulldozer | 2 | 350 | 10 | 24 | 240 | 215.749 | 0.027 | 0.00553 | 70.46 | 0.01 | 0.00 | 71.22 |
| Drum Type Compactor | 2 | 250 | 10 | 24 | 240 | 152.195 | 0.013 | 0.00390 | 3.31 | 0.00 | 0.00 | 3.35 |
| Water Truck | 3 | 350 | 10 | 24 | 240 | 208.474 | 0.017 | 0.00534 | 45.39 | 0.00 | 0.00 | 45.83 |
| Drilling Rig | 1 | 500 | 4 | 12 | 48 | 311.602 | 0.013 | 0.00798 | 71.24 | 0.00 | 0.00 | 71.85 |
| Small Crane | 2 | 250 | 4 | 60 | 240 | 112.143 | 0.011 | 0.00287 | 8.55 | 0.00 | 0.00 | 8.63 |
| Heavy Crane | 4 | 500 | 6 | 21 | 126 | 180.049 | 0.016 | 0.00461 | 39.20 | 0.00 | 0.00 | 39.58 |
| Excavator | 1 | 350 | 8 | 21 | 168 | 188.598 | 0.014 | 0.00483 | 41.06 | 0.00 | 0.00 | 41.45 |
| Rough Terrain Forklift | 2 | 350 | 4 | 60 | 240 | 183.058 | 0.024 | 0.00469 | 39.86 | 0.01 | 0.00 | 40.29 |
| Dump Trucks | 1 | 335 | 4 | 21 | 84 | 208.474 | 0.017 | 0.00534 | 45.39 | 0.00 | 0.00 | 45.83 |
| Cement Trucks | 1 | 335 | 4 | 21 | 84 | 208.474 | 0.017 | 0.00534 | 45.39 | 0.00 | 0.00 | 45.83 |
| | | | | | | | | Subtotal | **452.27** | **0.04** | **0.01** | **456.67** |
| **Total Equipment Emissions** | | | | | | | | | **510.58** | **0.05** | **0.01** | **515.58** |

Notes: 0.907194 metric tons = 1 ton; 2000 pounds = 1 ton.

Global Warming Potential for CH4 = 25; GWP for N2O = 296.

Diesel emission of GHG (CCAR, 2009)

10150 g CO2/gal

0.26 g N2O/gal

N2O emissions = 0.000026 ratio of N20 emission to CO2 Emissions

**References:**

California Climate Action Registry, General Reporting Protocol, Reporting Entity-Wide Greenhouse Gas Emissions, Version 3.1, January 2009. Tables C.3 and C.6.

# APPENDIX D

# Biological Data Addendum

# APPENDIX D1
# Biological Resources-Species Descriptions

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## Invertebrates

### *Federal or State Threatened and Endangered Species*

**Longhorn fairy shrimp (*Branchinecta longiantenna*).** Longhorn fairy shrimp occur in several vernal pool habitat types in California, ranging from small, clear, sandstone outcrop pools to large, turbid, alkaline, grassland pools. However, in Contra Costa and Alameda counties this species is only described from a small series of sandstone outcrop pools.

Two local longhorn fairy shrimp records occur in the Project area: Souza Ranch and Vasco Caves Regional Preserve. Both of these locations are shallow sandstone-rock-outcrop vernal pools within non-native grasslands (East County HCP, 2007). The nearest reported occurrence is located on rock outcrops at Vasco Caves Regional Preserve, on Project area lands owned by EBRPD. With the exception of the Preserve, rock outcrops in the Project area were not identified to provide suitable or occupied habitat (Ecology and Environment, Inc., 2009).

**Vernal Pool Fairy Shrimp (*Branchinecta lynchi*).** Vernal pool fairy shrimp occur in a variety of vernal pool habitats, ranging from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools. Although the species has been collected from large vernal pools, it tends to occur in smaller ones. Most commonly they occur in grass- or mud-bottomed swales, or basalt flow depression pools in unplowed grasslands (USFWS, 2005a).

Vernal pool fairy shrimp occur at the Vasco Caves Regional Preserve and at the Kellogg Vernal Pool complex in the Los Vaqueros Watershed. An extant population also occurs in the local vicinity of Byron Airport within vernal pool fairy shrimp critical habitat Unit 19B (CDFG, 2010; USFWS, 2006) and at the Brushy Peak Regional Preserve. While rock outcrops at Vasco Caves Regional Preserve in the Project area do support this species, project activities would occur at a distance greater than 500 feet; no other potential habitat was identified in the Project area (Ecology and Environment, Inc., 2009).

**Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*).** Valley elderberry longhorn beetles are unique insects that spend most of their lives within the stems of elderberry (*Sambucus* spp.) trees and shrubs. Often, the only indicators of their presence are the distinctive small oval openings that are left after larvae pupate and emerge (UC Berkeley, 2005; USFWS, 1999a). Valley elderberry longhorn beetles use elderberry shrubs with a stem diameter of at least 1-inch (at ground level) as a host plant (USFWS, 1999a). Elderberry shrubs typically grow in association with other riparian species, but they also occur as isolated shrubs in upland areas (UC Berkeley, 2005).

Three isolated elderberry shrubs were identified within Project area grasslands, one approximately 500 feet west of Turbine String C and the other two growing together just southwest of the existing O&M building (Ecology and Environment, Inc., 2009). Larval exit holes were not noted in these shrubs. The nearest documented valley elderberry longhorn beetle activity is in Los Vaqueros Watershed, downstream from the dam (CCWD and Reclamation, 2010).

#### *Federal or State Species of Special Concern*

**Midvalley Fairy Shrimp (*Branchinecta mesovallensis*).** Midvalley fairy shrimp occur in small, shallow, short-lived vernal pools, vernal swales, and artificial ephemeral wetland habitats. They are found in Contra Costa, Sacramento, Solano, Yolo, San Joaquin, Madera, Merced, and Fresno Counties. Three records are reported locally: one is north of the Los Vaqueros Reservoir, and the other two are 1.8 miles east and 3.4 miles east of the Project area (CDFG, 2010). Midvalley fairy shrimp populations have not been identified in the Project area. Based on its known range, this species is considered unlikely in the Project area.

**Curved-foot Hygrotus Diving Beetle (*Hygrotus curvipes*).** Hygrotus beetles are predatory diving beetles in both their adult and larval stages that feed on small aquatic invertebrates (Borror and White, 1970). They occur in stock ponds, irrigation channels, roadside drainages, ponds, alkali pools, and drying portions of creeks.

Five individuals were collected in 1990 from a stock pond in the Project area, located centrally to turbines A3, B5, and B6 at a distance of approximately 0.2 mile (CCWD and Reclamation, 2010). In a 1988 survey, individuals were found in stock ponds throughout the Los Vaqueros Watershed (Hafernik, 1988). The CNDDB documents an additional 20 extant occurrences of this species in Contra Costa and Alameda counties within 5 miles of the Project area (CDFG, 2010), and additional suitable habitat is present in stock ponds identified throughout the Project area.

### Amphibians

#### *Federal or State Threatened and Endangered Species*

**California Tiger Salamander (*Ambystoma californiense*).** California tiger salamanders are principally an upland species found in annual grasslands and in the grassy understory of valley-foothill hardwood habitats in Central and Northern California. They require underground refuges (usually California ground squirrel, valley pocket gopher (*Thomomys bottae*) or other small mammal burrows), where they spend the majority of their annual cycle. Between December and February, when seasonal ponds begin to fill, adult California tiger salamanders engage in mass migrations to aquatic sites during a few rainy nights and are prolific breeders (Barry and Shaffer, 1994).

During drought years when ponds do not form, adults may spend the entire year in upland environments, while juveniles may spend 4 to 5 years in their upland burrows before reaching sexual maturity and breeding for the first time (Petranka, 1998; Trenham et al., 2000). Adult tiger salamanders swiftly disperse after breeding and have been documented to migrate more than 400 feet the first night after leaving a breeding pond (Loredo et al., 1996). Adult California tiger salamanders readily aestivate in grasslands near ponds and at great distances from breeding ponds. Adults are known to travel distances greater than 0.62 mile from breeding ponds and have been documented at distances of 1.2 miles or more (Orloff, 2007).

California tiger salamanders occur in foothill grasslands throughout the APWRA and are expected to use grassland habitat throughout the Project area, including laydown and staging areas, for aestivation, foraging, and dispersal. This species is expected in moderate to high densities at all

times of the year. Breeding occurrences are known from four stock ponds in the Survey Area (Ecology and Environment, 2009), and an additional 16 locations in the Project area (CCWD and Reclamation, 2010). Potential breeding habitat is also present in slow-moving portions of creeks. This species is presumed present year-round within Project area uplands and seasonally present in wetlands.

**California Red-Legged Frog (*Rana draytonii*).** California red-legged frogs are largely aquatic frogs found at ponds and slow-moving streams with permanent or semipermanent water. This species opportunistically moves into upland habitats and may aestivate in upland environments when aquatic sites are unavailable or environmental conditions are inhospitable. If water is unavailable, they shelter from dehydration in a variety of refuges, including boulders, downed wood, moist leaf litter, and small mammal burrows.

Historically, the California red-legged frog occurred along the California coast from the vicinity of southern Mendocino County, and inland from Redding, Shasta County, southward to northwestern Baja California, Mexico (Jennings and Hayes, 1994). The majority of California red-legged frog occurrences in the San Francisco Bay Area are from Contra Costa and Alameda counties.

California red-legged frogs are documented throughout the APWRA. Breeding occurrences are known from five stock ponds in the Survey Area (Ecology and Environment, Inc., 2009) and from an additional 17 locations within the Project area (CCWD and Reclamation, 2010; CDFG, 2010). Potential breeding habitat is also available in Project area creeks. Stock ponds in the Los Vaqueros Watershed, which overlaps the northern portion of the Project area, support some of the highest densities of California red-legged frog in the region (East County HCP, 2007). Adult, sub-adult, and juvenile frogs actively disperse through annual grasslands in search of cover and breeding habitat. Habitat for this species is actively managed within the Los Vaqueros Watershed, and includes non-native predator (i.e., American bullfrog, *Lithobates catesbeianus*) exclusion and control.

California red-legged frogs are expected year-round in any aquatic or semiaquatic environments in the Project area. These environments include stock ponds, creeks, and drainages in the local area. Red-legged frogs are expected to use ephemeral drainages on a seasonal basis during movements, especially after the onset of rain in the fall (Tatarian, 2004). Additionally, adult, sub-adult, and juvenile frogs are expected to intermittently use annual grasslands and other upland habitats.

## Reptiles

### *Federal or State Threatened and Endangered Species*

**Alameda Whipsnake (*Masticophis lateralis euryxanthus*).** Alameda whipsnakes are dependent upon open chaparral, sage scrub, and coastal scrub. However, telemetry data indicate that although home ranges are centered on such shrub communities, they extensively use adjacent habitats, including grassland, oak savanna, and occasionally oak-bay woodland (USFWS, 2005b). Alameda whipsnakes use grassland habitats for periods of up to several weeks, with males using grassland habitats more frequently in the mating season and females using grassland habitats after mating

occurs. Rock outcrops are an important feature of Alameda whipsnake habitat because they provide retreat opportunities and promote lizard populations (USFWS, 2002; 2005b).

Historically, Alameda whipsnakes were probably found in the coastal scrub and oak woodland communities of the East Bay in Contra Costa, Alameda, western San Joaquin, and northern Santa Clara counties (USFWS, 2002). Currently, they are only found in the inner Coast Range in western and central Contra Costa and Alameda counties (USFWS, 2002). Five isolated populations of Alameda whipsnake are now recognized within its historical range: Tilden–Briones, Oakland–Las Trampas, Hayward–Pleasanton Ridge, Sunol–Cedar Mountain, and Mt. Diablo–Black Hills (USFWS, 1997). The Project area falls within the range of the Mt. Diablo-Black Hills population of Alameda whipsnake.

Alameda whipsnake has been documented from the Vasco Caves Regional Preserve (EBRPD, 2009) and is also present in the Los Vaqueros Watershed west of the reservoir (CCWD and Reclamation, 2010). Despite the scarcity of scrub habitat on the Project site, Alameda whipsnakes may be intermittently present in the Project area during routine use of non-scrub, grassland habitat.

#### *Federal or State Species of Special Concern*

**Western Pond Turtle (*Actinemys marmorata*).** Western pond turtles are commonly found in ponds, lakes, marshes, rivers, streams, and irrigation ditches with rocky or muddy substrates surrounded by aquatic vegetation. These watercourses usually are within woodlands, grasslands, and open forests, between sea level and 6,000-foot elevation. Turtles bask on logs or other objects when water temperatures are lower than air temperatures. Nests are located at upland sites, often up to 0.25 mile from an aquatic site (Jennings and Hayes, 1994; Stebbins, 2003; Zeiner et al. 1988).

Western pond turtles are uncommon and discontinuously distributed throughout California west of the Cascade-Sierran crest, with isolated populations in the Mojave River area and Andreas Canyon (Jennings and Hayes, 1994). However, western pond turtles are known to occur throughout the Los Vaqueros Watershed (East County HCP, 2007; CDFG, 2010). Within the Project area, a variety of habitats such as creeks, ponds, and drainages, as well as semipermanent marsh, alkali marsh, riparian woodland, and some grasslands, provide pond turtle habitat.

Four pond turtle occurrences are reported within 5 miles of the Project area (CCWD and Reclamation, 2010; CDFG, 2010), with the nearest documented occurrence being 0.4 miles north (Ecology and Environment, Inc., 2009). However, western pond turtles may be present in aquatic habitats, and in upland areas within roughly 0.5 mile of aquatic sites. This species is expected to occur in the Project area within or near identified aquatic features, including twenty stock ponds, three significant seasonal creeks, and several smaller-order seasonal drainages, and may also be encountered in upland areas within 0.5 mile of aquatic features.

**San Joaquin Coachwhip (*Masticophis flagellum ruddocki*).** The San Joaquin coachwhip (whipsnake) uses open, dry areas with little or no tree cover. In the western San Joaquin Valley, they occur in valley grassland and saltbush scrub associations and are known to climb shrubs

and bushes to view prey and potential predators. They use small mammal burrows for refuge and probably for egg-laying sites as well (Jennings and Hayes, 1994).

San Joaquin coachwhips range from the eastern edge of the San Joaquin Valley from Colusa County southward to Kern County and into the inner South Coast Ranges, with an isolated population in the Sutter Buttes. Five occurrences are reported from Contra Costa, Alameda, and San Joaquin counties (CDFG, 2010), one within five miles of the Project area where, in 1980, a San Joaquin coachwhip was identified in the footprint of the Los Vaqueros Reservoir Dam (CDFG, 2010). No other occurrences are reported in the Los Vaqueros Watershed or near any other Project facilities. The Project area provides suitable open grassland habitat for San Joaquin coachwhip; therefore, this species is presumed present.

**Coast Horned Lizard (*Phrynosoma coronatum frontale*).** The coast horned lizard occurs in several habitat types, including areas with an exposed gravelly-sandy substrate containing scattered shrubs, clearings in riparian woodlands, dry uniform chamise chaparral, and annual grassland with scattered perennial seepweed or saltbush. Horned lizard populations reach maximum abundance in sandy loam areas and on alkali flats often dominated by iodine bush. Coast horned lizards use small mammal burrows or burrow into loose soils under surface objects during extended periods of inactivity or hibernation (Jennings and Hayes, 1994). There is only one documented record of this species within 5 miles of the Project area, located approximately 3.5 miles northeast (CDFG, 2010). Preferred habitat for the species, such as sandy loam soils, are absent from the Project area, but alkali grasslands provide potentially suitable habitat.

## Birds

Listed birds, special-status birds, Fully Protected birds, birds of local concern and others are impacted by wind farms in the APWRA. A detailed discussion is provided for species known to reside in the Project area. Ideally, information on local abundance and local population trends for each species would help determine the impacts that wind energy projects have on various bird species. Unfortunately, local data is non-existent for most bird species, and for some species even national population trend data are scarce or unknown. Where possible, population trends are discussed for those species documented in APWRA fatality studies, drawing from a variety of sources.

### *Federal or State Threatened and Endangered Species*

**Swainson's Hawk (*Buteo swainsoni*).** Swainson's hawks are large migratory hawks that nest in North America and winter in southern South America. Swainson's hawks begin arriving in California in late February and depart for their wintering grounds in early September (Woodbridge, 1998). Nests are typically constructed in sturdy trees within or near agricultural lands, riparian corridors, and roadside trees. In California, the Swainson's hawk breeds from late March to mid-August, with peak activity from late May to late July (Tesky, 1994). The Swainson's hawk nesting range is restricted to portions of the Central Valley and Great Basin regions, where suitable habitat is still present (Shuford and Gardali, 2008). The highest density currently is in the Central Valley, between Sacramento and Modesto, and in the northern San Joaquin Valley (Woodbridge, 1998).

Neither the CNDDB nor CCWD report Swainson's hawk nesting in the Project area or within the APWRA. Two nest sites are reported approximately 4.5 miles north, and another approximately 7.0 miles northeast, of Los Vaqueros Reservoir (CDFG, 2010; CCWD and Reclamation, 2010), with the latter supporting nesting in 2006 (CCWD and Reclamation, 2010). The *Contra Costa Breeding Bird Atlas* (2002) notes nesting in the area northeast of the Los Vaqueros Watershed and CCWD staff have observed individual Swainson's hawks in the Los Vaqueros Watershed (CCWD and Reclamation, 2010). Though not identified during past wildlife surveys performed in support of the Los Vaqueros Reservoir Expansion Project, Swainson's hawk may nest in the Los Vaqueros Watershed (CCWD and Reclamation, 2010).

The Project would traverse annual grasslands, so potential nesting sites are limited in the Project area. Swainson's hawk may nest in trees scattered along creeks and drainages, where Oregon oak woodland and other riparian vegetation grows, though nesting has not been documented from this area. This species may also nest in oak woodlands present at Vasco Caves Regional Preserve. Agricultural lands in the Central Valley are this species' primary foraging grounds, though grassland communities in the Project area may provide limited foraging habitat.

***Population Trends and Local Impacts.*** The Audubon Society (2010a) includes Swainson's hawk on their Watch List as a declining or rare species of national conservation concern, stating that the California population has declined approximately 10 percent from historical levels. Friends of the Swainson's Hawk reports a pre-European California population estimate of 20,000 nesting pairs, a present global population of 500,000 individuals, and a present California population of about 1,900 nesting pairs (Bradbury, 2010). North American Breeding Bird Survey trends report a rising California population since surveys began in 1968, and a slightly declining national and global population, but caution that important deficiencies in the underlying data may make these trends inaccurate (Sauer, et al., 2008).

The most recent fatality data estimate between one and two Swainson's hawks are killed annually by wind turbines in the APWRA (Smallwood, 2010), with no fatalities reported specifically from the Tres Vaqueros Wind Project. Documented fatalities occurred at 95-200 kW turbines.

**American Peregrine Falcon (*Falco peregrinus*).** American peregrine falcon is an uncommon California migrant. This species can be found throughout the Central Valley in winter and in the western Sierra Nevada in the spring and fall. Wetlands and riparian areas provide important, year-round habitat. The peregrine falcon is a bird specialist, hunting in flight and preying upon a variety of birds including pigeons and ducks. Their diet occasionally includes mammals, insects, and fish. This species requires protected cliffs and ledges for cover (Zeiner, et. al., 1989).

Throughout California, peregrine falcon is a very uncommon breeding resident, though breeding locations are known near Santa Barbara, in the Sierra Nevada range, and in other mountains of northern California (Audubon, 2008; CDFG, 2010). They may compete with ravens and prairie falcons for nest sites. The nearest reported peregrine falcon nesting sites are located approximately 10 miles northwest of the Project area at Mt. Diablo State Park and approximately 12 miles north of the Project area at the Antioch Bridge (Bay Nature, 2006; SCPBRG, 2008).

***Population Trends and Local Impacts*.** Limited historical data suggest a national population estimated at 3,875 nesting pairs (USFWS, 1999b). By 1975, when the species was listed as endangered, the national population had been reduced to 324 known nesting pairs. Delisted in 1999 as a result of pesticide regulation and aggressive recovery activities, the American population (Canada, the United States and Mexico) is now estimated at between 2,000 and 3,000 breeding pairs (USFWS, 1999b). The known California population in 1970 was just five nesting pairs, but over 300 active breeding sites were reported in 2008 (Audubon, 2008).

The most recent fatality data estimate between one and five peregrine falcons are killed annually by wind turbines in the APWRA (Smallwood, 2010), with no fatalities reported specifically from the Tres Vaqueros Wind Project. Documented fatalities occurred at 95-200 kW turbines.

**Bald Eagle (*Haliaeetus leucocephalus*).** Bald eagles occupy a wide range of habitats, including woodlands, forests, grasslands, and wetlands. They winter throughout California near lakes, reservoirs, rivers, and some rangelands and coastal wetlands. Nesting is usually restricted to mountainous habitats near reservoirs, lakes, and rivers. Bald eagles usually nest in large coniferous trees within one mile of permanent water. They forage on large water bodies or rivers with easily approached snags and other perches (Zeiner et al., 1989).

The nearest reported bald eagle nest sites are located at Del Valle Reservoir in Alameda County, 15 miles southeast of the Project area (CDFG, 2010); since 2006, bald eagles have also nested at San Pablo Reservoir in Contra Costa County, about 25 miles west of the Project area (CDFG, 2010).

Bald eagles winter in small numbers near Los Vaqueros Reservoir, and remain in the area into the spring and summer months. Winter roosting sites in the Los Vaqueros Watershed have been observed in valley/foothill woodland and forest habitats. Before the establishment of the existing reservoir, bald eagles were not documented from the Los Vaqueros Watershed. Habitat suitability within the Project area is limited by the lack of tall conifers available for nesting. The *Contra Costa Breeding Bird Atlas* (2002) does not report bald eagle breeding in the Project vicinity.

Bald eagles have not been identified in wind turbine fatality data. Though primarily fish-eaters and thus restricted to foraging in the Los Vaqueros Reservoir, they occasionally scavenge and hunt in grasslands. For these reasons, the Project area may provide foraging habitat, especially near the F String which is located in proximity to the reservoir. The Project area does not provide suitable bald eagle nesting habitat.

**Brown Pelican (*Pelecanus occidentalis*).** Brown pelican is a northern California migrant. In early May, brown pelican individuals leave breeding colonies in Mexico and in the Channel Islands and disperse along the entire California coast; small numbers visit the Salton Sea and Colorado River Reservoirs. They usually return to their breeding colonies by March of the following year (Zeiner, et al., 1989). Intermittent breeding occurred off the length of the California coast prior to 1959, at which time pesticide use caused North American populations to undergo significant declines (USFWS, 2009). After nearly 40 years on the federal endangered species list, the brown pelican has made a recovery, and, in 2009, was removed from both Federal and State endangered species lists.

***Population Trends and Local Impacts*.** Historical population estimates were not identified. The current population across Florida and the Gulf and Pacific Coasts is estimated at more than 620,000 birds (Audubon, 2010b). Approximately 6,000 breeding pairs are reported in southern California, with thousands of migrants moving up and down the Pacific coast annually (USFWS, 2009).

The APWRA is apparently an annual migration corridor for an unknown number of individuals. The most recent fatality data estimate between five and eleven brown pelicans are killed annually by wind turbines in the APWRA (Smallwood, 2010), with no fatalities documented specifically from the Tres Vaqueros Windfarm. Documented fatalities occurred at 40-65 kW turbines.

#### *Federal or State Species of Special Concern*

**Tricolored Blackbird (Nesting Colony) (*Agelaius tricolor*).** Tricolored blackbirds are a colonial species that nest in dense vegetation in and around freshwater wetlands. When nesting, tricolored blackbirds generally require freshwater wetland areas large enough to support colonies of 50 pairs or more. They prefer freshwater emergent wetlands with tall, dense cattails or tules for nesting, but will also breed in thickets of willow, blackberry, wild rose, or tall herbs. During the nonbreeding season, flocks are highly mobile and forage in grasslands, croplands, and wetlands (Zeiner et al., 1989). Tricolored blackbirds are locally common throughout the Central Valley and coastal areas south of Sonoma County. The East County HCP/NCCP (East County HCP, 2007) considered tricolored blackbirds a sporadic resident of their inventory area.

Tricolored blackbird nesting has been documented at two stock ponds in the northeast portion of the Project area (Ecology and Environment, Inc., 2009). The CNDDB notes an additional three tricolored blackbird occurrences; two are about 2 and 2.5 miles, respectively, north of the Project area, and the other is about 4 miles southeast of the Project area (CDFG, 2010).

***Population Trends and Local Impacts*.** In the *Conservation Plan for the Tricolored Blackbird*, this species was identified as a regional and national Bird of Conservation Concern, a California Bird Species of Special Concern, and a Partners in Flight Watch List species (Tricolored Blackbird Working Group, 2009). Tricolored blackbird is largely native to California, with more than 99 percent of the population residing in the State and 90 percent of the population residing specifically in the Central Valley (Shuford and Gardali, 2008). Historical population estimates are not comprehensive, but the first systematic population survey identified more than 736,000 adults from eight counties in the Central Valley; in contrast, the 2002 global population (California, Oregon, Washington, Nevada, and Baja) was estimated at 163,000 adults (Shuford and Gardali, 2008).

The most recent fatality data estimate between one and nine tricolored blackbirds are killed annually by wind turbines in the APWRA (Smallwood, 2010), with no fatalities documented specifically from the Tres Vaqueros Windfarm. Documented fatalities occurred at 40-65 kW and 95-200 kW turbines.

**Golden Eagle (*Aquila chrysaetos*).** Golden eagles nest in open areas on cliffs and in large trees, often constructing multiple nests in one breeding territory (Zeiner et al., 1989). They prefer open

habitats such as rolling grasslands, deserts, savannahs, and early successional forest and shrub habitats, with cliffs or large trees for nesting and cover (Zeiner et al., 1989).

This species is a resident breeder within the APWRA and the area is also used by migrant eagles during the nonbreeding season. Approximately 35 nest locations are recorded within five miles of the Project area (CDFG, 2010; CCWD and Reclamation, 2010; Ecology and Environment, Inc., 2009). Three golden eagle nests were observed in or near the Project area, reported approximately 0.25 mile west of Turbine String C, 0.25 mile north of Turbine String C, and 0.3 mile west of Turbine String A (Ecology and Environment, Inc., 2009). These specific nesting occurrences are also reported by the CNDDB (CDFG, 2010), and it is unclear whether the last reported nesting activity occurred in 2006 or 2008.

Nesting occurrences are predominantly in the northern watershed except for two nests located approximately three miles southwest of the Project area. Nesting dates for these locations are unknown. The present activity status of these nest locations is also unknown; however, within an active nesting area nest locations can change slightly from year to year, and nests may not be reused every consecutive year. Nesting has been documented as recently as 2006 at Project area locations, confirming it as an active golden eagle nesting area. The Project area traverses primarily treeless annual grasslands, and potential breeding sites only occur in large trees associated with drainages. Golden eagle foraging habitat is present throughout the Project area.

***Population Trends and Local Impacts.*** Throughout the United States and Canada, the golden eagle population appears stable from 1968 through present, but underlying deficiencies in the data make conclusions about population trends potentially inaccurate (Sauer, et al., 2008). Other researchers have indicated that more data is needed before conclusions can be made regarding the golden eagle population in the western U.S. (USFWS, 2004). No California data was available from the North American Breeding Bird Survey (Sauer, et al., 2008). Despite the lack of a larger population context, there is data on eagle populations in the region. The golden eagle population density around the APWRA is thought to be one of the highest in the world (CEC, 2002). Fifty-eight golden eagle breeding territories occur within 19 miles of the APWRA boundaries, each occupied by a breeding pair (CEC, 2006). The same territories were occupied by breeding pairs in a 2000 survey, a condition that could indicate a stable, rather than declining, population. However, 167 breeding pairs are necessary to support a blade-strike mortality of 50 eagles per year so the population is likely being sustained by eagles coming in from other areas (CEC, 2006).

The most recent fatality data estimate between 67 and 122 golden eagles are killed annually by wind turbines in the APWRA (Smallwood, 2010), with between one and two per year killed at Tres Vaqueros. Documented fatalities occurred at all evaluated turbine types, including 40-65 kW, 95-200 kW, 250-400 kW, 300 kW, 660 kW, and 1 MW turbines. Turbines at the Buena Vista Wind Energy project, repowered in 2007, have resulted in ongoing golden eagle fatalities, though all fatalities are from turbines located in ridge saddles (Insignia Environmental, 2009). Comprehensive pre- and post-repowering comparative reports for Buena Vista could inform best repowering practices for the Project, but are not yet available because the survey period is still underway. In general, bird fatality rates relate strongly to wind turbine size, with fatalities declining as overall turbine height and rotor diameter increases, but not for golden eagle (Smallwood, 2010).

Although larger turbines have not correlated with lower strike risks for golden eagle at recently repowered facilities, recent research on flight behavior and topographical micrositing may reduce fatalities at future repowered facilities. Flights by golden eagles are significantly more common on the windward aspect of hills and ridges, where they fly over slopes that face strong, prevailing winds (CEC, 2009). Golden eagles appear to follow topographical contours while hunting, and a growing body of evidence has linked raptor fatalities to wind turbines located on landscape aspects that are lower than immediately surrounding terrain or that represent sudden changes in elevation, such as saddles, notches, and benched slopes (Smallwood and Neher, 2010).

Micrositing factors specific to golden eagle that are associated with increased risk include whether: the low reach of the blade is within 26 feet of the ground; there are fewer than 24 other turbines within 984 feet (300 meters); a turbine is at the edge of a local cluster of turbines, at the end of a row, or by itself; a turbine is on a ridgeline, canyon, or steep slope greater than 14 percent; and/or a turbine is on a slope facing one prevailing wind direction and perpendicular to the other (Smallwood, et al., 2009).

**Great Blue Heron (*Ardea herodias*).** The great blue heron is a relatively common California resident, found throughout most of the State in shallow estuaries and fresh and saline emergent wetlands. It is less commonly found along riparian corridors, croplands, pastures, and high-elevation foothills. Most of the great blue heron diet is fish, but also includes small rodents, amphibians, snakes, lizards, and insects, among other things. Great blue herons roost and nest in colonies atop large trees, and may be found intermixed in nesting egret colonies (Zeiner, et al., 1989).

Rookeries are known throughout Northern California. The nearest reported nesting locations are approximately 19 miles northeast of the site near the Sacramento River Delta, approximately 16 miles southwest near the town of Sunol, and approximately 20 miles southwest near the City of Fremont. Project area grasslands offer suitable foraging habitat, and this species has been observed foraging within the Project area (CCWD and Reclamation, 2010).

***Population Trends and Local Impacts*.** The global population of great blue herons is unknown, but the continental population is estimated at 124,500 birds (Audubon, 2010c). Although they suffered from hunting in the early 1900s, they are presently one of the most abundant wading birds in North America (Audubon, 2010bc. North American Breeding Bird Survey data indicate that great blue heron populations are increasing throughout the United States, and in California's Central Valley and foothills (Sauer, et al., 2008). Despite their abundance, however, rookeries are vulnerable to disruption and may be abandoned if disturbed (Audubon, 2010c); they are also protected in California.

The most recent fatality data estimate between one and two great blue herons are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW and 660 kW turbines.

**Burrowing Owl (*Athene cunicularia*).** Burrowing owls are relatively small, semicolonial owls, and are mostly residents of open dry grasslands and desert areas. They occupy burrows for both breeding and roosting. They use burrows excavated by ground squirrels and other small mammals

and where the number and availability of natural burrows is limited, may occupy human-made burrows such as drainage culverts, cavities under piles of rubble, discarded pipe, and other tunnel-like structures (Zeiner et al., 1989). Burrowing owls hunt from perches and are opportunistic feeders. They consume arthropods, small mammals (e.g., meadow voles), birds, amphibians, and reptiles. Insects are often taken during the day, while small mammals are taken at night (Zeiner et al., 1989).

Fifteen burrowing owl occurrences are reported in the Project area (Ecology and Environment, Inc., 2009), with an additional twenty-two occurring outside of the Project area but within the Los Vaqueros Watershed (CCWD and Reclamation, 2010; CDFG, 2010). A total of 63 burrowing owl occurrences are reported within five miles of the Project area. Project area breeding locations occur along entrance roads and near Turbine Strings A, B, C, and D. Foraging habitat is present throughout Project area grasslands.

***Population Trends and Local Impacts.*** According to the North American Breeding Bird Survey, burrowing owl is experiencing a population decline throughout Canada and the United States (Sauer, et al., 2008). The Point Reyes Bird Observatory reports that data for most of the U.S. are insufficient to estimate trends in abundance and that burrowing owls may be decreasing in some areas while stable or increasing in others (Bates, 2006). A comprehensive California survey estimated 9,266 breeding pairs in California (not including the Great Basin and desert areas, and the Channel Islands) (DeSante, et al., 2007). California surveys from 1986 through 1991 found a declining number of breeding groups and breeding pairs (Bates, 2006); comprehensive surveys from 1991 through 1993 found that California's population is generally declining and locally vanishing (DeSante, et al., 2007). This species is a Species of Special Concern in California, and a USFWS Bird of Conservation Concern throughout the U.S.

The most recent fatality data estimate between 354 and 1,083 burrowing owls are killed annually by wind turbines in the APWRA, with between 40 and 69 killed per year at Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, 330 kW, 250-400 kW, and 660 kW turbines, but have not been documented at 1 MW turbines. At the Buena Vista Wind Energy Project, no burrowing owl fatalities have been reported in the first 1.5-year survey period; post-repowering mortality surveys at the Diablo Winds Wind Energy Project, repowered in 2004, report a 24 percent reduction in burrowing owl fatalities (Smallwood, et al, 2009). This is thought to be generally attributable to repowering with new-generation wind turbines, but detailed pre- and post-repowering comparative reports are not yet available because the survey period is still underway.

Burrow locations are also a good predictor of turbine-related mortality, as burrow complexes that are located within 180 feet of a turbine have been correlated to higher fatalities (Smallwood, et al., 2009). Burrowing owls are selective about which ground squirrel burrows they commandeer, and these burrows are typically sited within a narrow elevational zone. Such burrows are located in a valley transition zone that is thought to offer improved visibility for predator detection, auditory detection of approaching predators, predator escape opportunities, and foraging opportunities (Smallwood, et al., 2009).

The burrowing owl fatality rate at wind turbines in the valley transition zone is twice the fatality rate outside this zone, likely due to increased burrow presence; a higher number of end-of-row turbines [associated with higher fatality rates (Orloff, et al., 1992; Smallwood, 2007; Insignia Environmental, 2009)]; bird behavior, as birds may fly through the APWRA using the lowest portions of the landscape; and a 3.3-times greater turbine density in this zone (Smallwood, et al., 2009).

Micrositing factors specific to burrowing owl that are associated with increased risk include whether a specific turbine has a rotor-swept area[1] less than 23,056 square feet; has a supporting tower with a tubular/vertical axis; is non-functional or next to a nonfunctional turbine or tower; is not part of a wind wall or is at the end of a row; is located in a canyon or valley or is at-or-below 771 feet elevation (Smallwood, et al., 2009).

**Ferruginous Hawk (*Buteo regalis*).** The ferruginous hawk is an uncommon northern California winter resident and migrant of open grasslands in the Modoc Plateau, Coast Ranges, and Central Valley, though a fairly common winter resident in grasslands and agricultural areas in southern California. Per their seasonal migration, they generally arrive in California in September and depart by mid-April (Zeiner, et al., 1989). This species is associated with open grasslands, sagebrush flats, desert scrub, low-elevation valley foothills, and pinyon-juniper fringe habitats. Ferruginous hawks perform low flight over open terrain in search of rabbits, ground squirrels, mice, frogs, snakes, and other prey; they also hover, and hunt from high perches (Zeiner, et al., 1989). They roost in trees and utility poles, and nest in low cliffs, cut banks, shrubs, and trees.

The nearest reported breeding occurrences are approximately 5 miles south towards the City of Livermore (1998 record), 5 miles southwest near the Lawrence Livermore Laboratory (1996 record), 8 miles west towards the City of San Ramon (2003 record), 11 miles southeast on lands owned by the Lawrence Livermore Laboratory (1993 record), and 18 miles north of the Project area near the City of Clayton (2006 record) (CDFG, 2010). Project area grasslands provide suitable foraging habitat.

***Population Trends and Local Impacts*.** This species is thought to be declining throughout its range (Canada, the United States, and Mexico) (Sauer et al., 2008), with severe declines and local extinctions occurring in Canada (Hunting, undated). The total population is estimated at 23,000 birds (Audubon, 2011). A conservative estimate for the California wintering population is between 400 and 500 birds (Hunting, undated).

The most recent fatality data estimate between five and 10 ferruginous hawks are killed annually by wind turbines in the APWRA, with between two and six killed annually at Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, 250-400 kW, 330 kW, and 660 kW turbines.

**Northern Harrier (*Circus cyaneus*).** Northern harriers are found in a wide variety of habitats from annual grasslands up to lodgepole pines and alpine meadow habitats. They are known to

[1] Rotor-swept area is the area through which the blades of a wind turbine spin, as seen when directly facing the wind turbine. The power output of a wind turbine is related to the swept area of its blades; the longer the blade, the more power it can extract from the wind.

frequent meadows, grasslands, open rangelands, desert sinks, and freshwater and saltwater emergent wetlands. Harriers are seldom found in wooded areas. Nests are constructed amid shrubby vegetation usually in emergent wetlands or near a river or lake. They may also nest in grasslands, grain fields, or sagebrush flats several miles from water (Zeiner et al., 1989). Northern harriers are commonly observed foraging over croplands, marshlands, or grasslands within the Project region.

The Los Vaqueros Watershed provides suitable open grassland nesting habitat for northern harriers. The nearest reported breeding occurrences are about 7 miles southwest and 8 miles east of the Project area (CDFG, 2010). The *Contra Costa Breeding Bird Atlas* (2002) indicates that breeding is probable within marshland habitats of the Los Vaqueros Watershed. The Project area traverses open grassland habitat that is suitable for harrier nesting and foraging.

***Population Trends and Local Impacts*.** Northern harrier is a USFWS Bird Species of Concern and a California Species of Special Concern. The northern harrier appears to be experiencing a range-wide population decline, although underlying deficiencies in the data require caution in drawing this conclusion (Sauer, et al., 2008). Hawk Mountain, a nonprofit raptor conservation group, reports an estimated 450,000 harriers (35 percent of the global population) nesting in North America, but other researchers estimated the North American wintering population (which is thought to be higher than the breeding population) at only 111,500 birds (Shuford and Gardali, 2008). Various data (including data from the North American Breeding Bird Survey) indicate populations in the western U.S. declined after the late 1990s (Hawk Mountain, 2007). The late-1980 California wintering population was estimated at 13,200 birds; the breeding population would be lower (Shuford and Gardali, 2008).

The most recent fatality data estimate between three and 14 northern harriers are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW and 95-200 kW turbines.

**White-Tailed Kite (*Elanus leucurus*).** White-tailed kites forage in open grasslands, meadows, farmlands, and emergent wetlands. They typically nest in oak woodlands or trees, especially along marsh or river margins, although they will use any suitable tree or shrub that is of moderate height. They are rarely found far from agricultural areas (Zeiner et al., 1989).

The Project area provides suitable foraging and nesting habitat for white-tailed kite. The *Contra Costa County Breeding Bird Atlas* (2002) reports kite breeding in the Los Vaqueros Watershed. The CNDDB occurrence closest to the Project area is about 7.5 miles southeast of the Los Vaqueros Reservoir, in Contra Costa County (CDFG, 2010). This species may nest in oak trees within the Project area.

The Project area traverses open grassland habitat that is suitable for foraging, and the riparian corridor along one drainage provides wooded areas suitable for nesting. Grassland habitat is not suitable for nesting. Though no nesting occurrences are identified in these areas by the CNDDB or Contra Costa County Breeding Bird Atlas, this species may nest in the Project area wherever habitat conditions are appropriate. This species is regularly seen foraging in APWRA grasslands.

***Population Trends and Local Impacts.*** The white-tailed kite may have been nearly extinct in the U.S. by 1930 or earlier. Though it later rebounded and reoccupied its former range and expanded into new areas, the white-tailed kite has experienced population declines since the 1980s (AZGFD, 2002). The California population also severely declined in the early 1900s, when its range was reduced to western California and its extinction was predicted to occur by 1930 (PRBO, 2000). Presently, California contains the largest number of white-tailed kites in North America (PRBO, 2000). Populations have decreased in the Central Valley since the 1980s, but not significantly (Sauer, et al., 2008; PRBO, 2000).

The most recent fatality data estimate about one white-tailed kite is killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW and 95-200 kW turbines.

**California Horned Lark (*Eremophila alpestris*).** California horned larks are brown songbirds that form large flocks for foraging and roosting. They build grass-lined nests directly on the ground in dry, open habitats with sparse vegetation. This species is a common-to-abundant resident songbird in a variety of open habitats. Range-wide, California horned larks breed in level or gently sloping shortgrass prairie, montane meadows, barren fields, open coastal plains, fallow grain fields, row crops, and alkali flats.

Horned larks range across North America from Alaska and the Canadian arctic southward to southern Mexico. Nesting is documented at the Vasco Caves Regional Preserve in the Project area (EBRPD, 2007), and this species is infrequently but persistently observed in portions of the APWRA where regular grazing helps to maintain annual grasses at a short height (CCWD and Reclamation, 2010). Horned larks are expected to nest and forage in short grasslands that occur throughout the Project area.

***Population Trends and Local Impacts.*** Horned larks have experienced a population decline throughout their range since the 1960s (Sauer, et al., 2008). California's horned lark population has declined 84 percent since 1967, with a 75 percent decrease in its breeding population (Audubon, 2010d; Sauer, et al., 2008).

The most recent fatality data estimate between 97 and 405 California horned larks are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, 660 kW, and 1 MW turbines. With their affinity for open habitats, resident populations may be large in the APWRA, but it is unknown what percentage of the population is killed annually by wind turbines and whether flight behavior contributes to strike mortality.

**Prairie Falcon (*Falco mexicanus*)**. Habitat use by the prairie falcon ranges from annual grasslands to alpine meadows, and primarily includes perennial grasslands, savannahs, rangeland, some agricultural fields, and desert scrub areas. Throughout most of California, this species is a year-round resident in suitable habitat.

Eastern Contra Costa and Alameda counties are within the year-round range of the prairie falcon. The CNDDB documents five breeding occurrences within five miles of the Project area. Breeding

habitat, which includes cliffs and bluffs, are present at the Vasco Caves Regional Preserve and at least one pair actively bred in 2008 at the Preserve (Doug Bell, pers. comm., 2010).

***Population Trends and Local Impacts.*** The global prairie falcon population is estimated at 40,000 birds, with 30,000 residing in North America (RMBO, 2007). In 1979, the total North American population was estimated at between 5,000 and 6,000 breeding pairs (USFS, undated Species Account). North American breeding bird survey data is collected but currently unavailable for prairie falcon. A 1978 publication of California Bird Species of Special Concern indicated that the total population within California was small and vulnerable, with an alarming reduction in the Central Valley's occupied nesting territories and recruitment[2] (Remsen, 1978). The Bureau of Land Management (BLM) reports an overall stable population with declines in California, Idaho, and Alberta (BLM, undated Species Account).

The most recent fatality data estimate between two and four prairie falcons are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, and 1 MW turbines.

**Loggerhead Shrike (*Lanius ludovicianus*).** Loggerhead shrikes are a semi-permanent resident California species that occurs in abundance in the Central Valley and Central Coast where shrub habitats and open woodlands are available. Shrikes generally forage on the fringes of open habitats where suitable hunting perches are available. This species typically hunts from dead trees, tall shrubs, utility wires and fences, impaling their prey on sharp twigs, thorns, or barbed wire.

The breeding distribution of this species is not well characterized by the CNDDB; however, loggerhead shrike populations are readily encountered within appropriate habitat in the outer Coast Range of eastern Contra Costa and Alameda counties (CCWD and Reclamation, 2010). Populations are known from wooded riparian corridors and grazed lands, with breeding often occurring in blackberry and willows ranging in size from individual shrubs to dense thickets. Shrikes are common throughout California and are expected to occur in moderate to high densities throughout the Project area where shrubby wooded habitat provides adequate cover and nesting sites.

Within the Project area, loggerhead shrike may be encountered near wooded drainages or areas with moderate to dense shrub cover. Habitat in the Project area occurs sporadically in and next to seasonal and intermittent drainages, and in Oregon oak woodland near the existing O&M Building.

***Population Trends and Local Impacts.*** Loggerhead shrike is a California Species of Special Concern. Historically, loggerhead shrike was abundant throughout its range but is now virtually gone from the northeastern United States and is declining throughout its range (Yosef, 1996). North American Breeding Bird Survey data indicate that California populations have been declining since the survey began in 1968 (Sauer, et al., 2008). Audubon California lists the loggerhead shrike as one of California's common birds in decline, noting a 76 percent decline since 1967 (Audubon California, 2010d). Breeding abundance is highest in portions of the

[2] "Recruits" are individuals added to a regional population (in this case the APWRA) either from within the population as surviving young, or from outside the population as immigrants.

Central Valley, Coast Ranges, and a few other locations, and data show a significant decline throughout this region (Shuford and Gardali, 2008).

The most recent fatality data estimate between 39 and 170 loggerhead shrikes are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, 250-400 kW, and 660 kW turbines. It is unknown what percentage of the population is killed annually by wind turbines and whether flight behavior contributes to strike mortality.

#### *Species of Local Concern*

In addition to golden eagles and western burrowing owls, two non-listed common raptors are species of local concern: red-tailed hawk and American kestrel. As previously described in Section 4.4.2.2, golden eagles, burrowing owls, red-tailed hawks and American kestrels are disproportionately impacted by wind farms throughout the United States, including the APWRA (USFWS, 2010). As such, these species were identified as focal study species and detailed information on their biology and population status is provided below.

**Red-tailed Hawk (*Buteo jamaicensis*).** Red-tailed hawks are common in many habitats throughout California. They can be permanent breeding residents, winter residents, or migrants, and they are found in nearly all habitats and elevations. Red-tail hawks consume small mammals, birds, reptiles, amphibians, and carrion. During search and pursuit of prey, they may soar, perch, pounce, hover, or perform low, quartering flights (Zeiner, et al., 1989). They forage over grasslands and roost in large trees, or occasionally on cliffs or low ledges.

CNDDB does not routinely track the nesting locations of common species. However, this species is known to nest in wooded portions of the Los Vaqueros Watershed. The Project area provides abundant foraging habitat, and trees in riparian corridors and along seasonal drainages provide suitable nesting locations.

***Population Trends and Local Impacts*.** An estimated 89 percent of the global population of red-tailed hawks is found in North America, with approximately 1,960,000 breeding birds (Hawk Mountain, 2007). Populations have remained stable or increased throughout most of the western United States since the 1980s, growing 1.5 percent in California between 1983 and 2005 (Hawk Mountain, 2007; Sauer, et al., 2008). California foothill populations have remained stable since 1968, while the Central Valley population has significantly increased (Sauer, et al., 2008).

The most recent fatality data estimate between 347 and 519 red-tailed hawks are killed annually by wind turbines in the APWRA, with between 10 and 17 fatalities documented at Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, 250-400 kW, 330 kW, 660 kW, and 1 MW turbines. Red-tail hawk fatality rates are highest on notches, plateaus, and hill peaks (Smallwood, 2010). In general, the number of bird deaths declines for red-tailed hawks as the turbine size increases (Smallwood, 2010).

Micrositing factors specific to red-tailed hawks that are associated with increased risk include whether a specific turbine is at the end of a turbine row or at the edge of a turbine cluster; has fewer

than 13 other turbines within 984 feet (300 meters); is located in a canyon, on a ridgeline or ridge saddle; is located on a northwest or south/southeast-facing slope; and/or is at or above 935 feet elevation (Smallwood, et al., 2009).

**American Kestrel (*Falco sparverius*).** The American kestrel is a common resident throughout California, occurring in open grasslands, shrub and early successional forests, and forest openings. This species preys upon small mammals, birds, insects, worms, reptiles, and amphibians, which they hunt from a perched or hovering position. Kestrels roost in trees, snags, rock outcrops, banks, and buildings, where they may also nest in suitable cavities on the buildings (Zeiner, et al., 1989).

CNDDB does not routinely track the nesting locations of common species; thus, the nearest nesting location is unknown. The Project area provides abundant foraging habitat, and trees in Project-area riparian corridors and along seasonal drainages provide suitable nesting locations, as do rock outcrops.

***Population Trends and Local Impacts*.** The North American population of American kestrels is estimated at more than 4,000,000 birds, representing 75 percent of the global population (Hawk Mountain, 2007). Populations have declined over the western U.S. since the 1980s, pronouncedly so since the 1990s (Hawk Mountain, 2007). This trend is also apparent for California's foothill and Central Valley populations (Sauer, et al., 2008).

The most recent fatality data estimate between 239 and 715 American kestrels are killed annually by wind turbines in the APWRA, with between two and five fatalities documented from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at all evaluated turbines, including 40-65 kW, 95-200 kW, 250-400 kW, 330 kW, 660 kW, and 1 MW turbines, although the number of deaths declined as turbine size increased. American kestrel fatality rates were highest on ridgelines, ridge crests, and ridge saddles (Smallwood, 2010).

Micrositing factors specific to American kestrel that are associated with increased risk include whether a specific turbine: has a rotor plane swept area greater than 35,359 feet$^2$; is located on a ridgeline or ridge saddle; and/or is located at-or-below 443 feet or above 1,263 feet elevation (Smallwood, et al., 2009).

**Other Common Birds.** Other common, non-special status birds are killed each year by APWRA wind turbines. Such birds include mallard (*Anas platyrhynchos*), pied-billed grebe (*Podilymbus podiceps*), great egret (*Ardea alba*), turkey vulture (*Cathartes aura*), killdeer (*Charadrius vociferous*), black-necked stilt (*Himantopus mexicanus*), California gull (*Larus californicus*), rock pigeon (*Columbia livia*), barn owl (*Tyto alba*), great-horned owl (*Bubo virginianus*), white-throated swift (*Aeronautes saxatalis*), northern flicker (*Colaptes auratus*), Say's phoebe (*Sayornis says*), flycatcher species (Tyrannidae family), warbling vireo (*Vireo gilvus*), western scrub jay (*Aphelocoma californica*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), cliff swallow (*Petrochelidon pryyhonota*), rock wren (*Salpinctes obsoletus*), house wren (*Troglodytes aedon*), mountain bluebird (*Sialia currucoides*), northern mockingbird (*Mimus polyglottos*), American pipit (*Anthus rubescens*), Wilson's warbler (*Wilsonia pusilla*), western tanager (*Piranga ludoviciana*), red-winged blackbird (*Agelaius phoeniceus*), western meadowlark

(*Sturnella neglecta*), Brewer's blackbird (*Euphagus cyanocephalus*), and the invasive and MBTA-excluded European starling (*Sturnus vulgaris*).

Annual APWRA turbine-related fatalities were estimated for common species, with a low and high estimate provided for each one (Smallwood, 2010). Fatalities range from a high estimate of 0.8 in the case of American coot to a high estimate of approximately 2,827 in the case of European starlings. Thus, while four raptor species comprise the APWRA focal species for research and monitoring, the APWRA impacts a large number and variety of other birds. These species' perceived abundance, difficulty in detection during avian-use surveys, migratory habits, lack of listing status, and a lack of survey funding are presumably reasons why the native species of these additional birds are not included as APWRA focal species.

## Mammals

### *Federal or State Threatened and Endangered Species*

**San Joaquin Kit Fox (*Vulpes macrotis mutica*).** The San Joaquin kit fox is a permanent resident of arid grasslands and open scrubland, where friable soils are present. Dens are required year-round for reproduction, shelter, temperature regulation, and protection from predators (USFWS, 1998). Historically their habitat included native alkali marsh and saltbush scrub of the valley floor, but the availability of such habitats has diminished markedly due to agricultural conversion. Grasslands with friable soils are considered the principal habitat for denning, foraging, and dispersal, while open oak woodlands provide lower quality foraging and dispersal habitat. Kit foxes will use habitats that have been extensively modified by humans, including grasslands and scrublands with wind turbines, agricultural areas and active oil fields (USFWS, 1998). In the northern portion of its range, California ground squirrels are a chief component of the kit fox diet (Hall, 1983).

San Joaquin kit foxes occur only in and around the Central Valley, inhabiting open habitat in the San Joaquin Valley and surrounding foothills such as the Altamont. Kit fox populations in the northern portion of their range are highly fragmented and sparsely distributed (Orloff et al., 1986), occurring primarily in foothill grasslands because much of their former habitat on the valley floor has been eliminated. The northern population is known to have different habitat characteristics than the southern population. Orloff found that the northern population habitats have steeper slopes, up to 40 degrees, and dens on slopes range from 2 to 14 percent; however, they preferentially dwell and migrate on relatively flat or low-gradient slopes (e.g., less than 15 degrees) (CCWD and Reclamation, 2010).

The CNDDB reports 23 kit fox occurrences within 5 miles of the Project area (CDFG, 2010), dated between 1973 and 2002, and numerous other occurrences are reported from other sources (CCWD and Reclamation, 2010). The Project area is in the northwestern extent of the San Joaquin kit fox range. Recent kit fox observations from the regional vicinity include a sighting at Brushy Peak in 2002 and Vasco Caves Regional Preserve in 2001 and 2002 (CDFG, 2003). Twelve kit fox sightings have been reported from the Project area, all from the 1980s.

The Project area traverses annual grassland habitats that could support kit fox denning, foraging, or dispersal. Surveyors identified burrows and rock outcrops in the Project footprint that could potentially provide kit fox habitat (Ecology and Environment, Inc., 2009).

#### *Federal or State Species of Special Concern*

The Western Bat Working Group reports that California has 25 bat species, many of which do not occur in the areas where wind turbine projects are constructed but that have the potential to be impacted during seasonal migrations and during foraging activities (CBWG, 2006). Some bat species travel hundreds of miles from their roost sites to foraging grounds, and thus have the potential to be affected year-round by turbine activity (WBWG, 2005; CBWG, 2006). Roosting locations and the foraging habits of many species are not well known (CDFG, 2010; CBWG, 2006). Moreover, little information is available on the local distribution of bat species in Contra Costa and Alameda counties. The likelihood of encountering special status bat species was estimated from species range maps, which for the bats considered includes most of the State of California; from information provided by EBRPD personnel; and from an evaluation of available habitat in the Project area. Available data sources identify a few special status bat roost sites about 9 miles from the Project area, but with little exception these date back to the 1940s and earlier. Thus, while detailed distribution data is not available for the following species, they are included herein because they are not well studied in the Project region, and because fatalities of several bat species have been documented at APWRA wind farms and wind farms in neighboring counties.

**Pallid Bat (*Antrozous pallidus*).** Pallid bats inhabit low elevation (< 6,000 feet) rocky arid desert lands and canyonlands, shrub-steppe grasslands, and higher elevation coniferous forests (> 7,000 feet). Pallid bats roost in rock crevices, unoccupied buildings, hollows in large trees, and under bridges. They are most abundant in xeric (dry) ecosystems, including the Great Basin, Mojave, and Sonoran Deserts (WBWG, 2005).

This is the most widely described special status bat species in central California and in the Project area, with the nearest active occurrence located approximately 10 miles northwest of the Project area, reported in 2003 (CDFG, 2010). Active roosts are also recorded about 12 miles north of the Project area at Black Diamond Mines. Though not verified within the Project area, roosting habitat for this species is available in large hollow trees, snags, or under loose bark in forested areas of the Los Vaqueros Watershed, and in large rock outcrops at the Vasco Caves Regional Preserve. Open grasslands in the Project area provide foraging habitat, but the Project footprint does not encompass suitable roosting habitat for pallid bat.

**Townsend's Big-Eared Bat (*Corynorhinus townsendii*).** Townsend's big-eared bats have been reported in a wide variety of habitat types including coniferous forests, mixed mesophytic forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitat, ranging from sea level to 10,827 feet (WBWG, 2005). Their most typical habitat is arid western desert scrub and pine forest regions. Townsend's big-eared bats occur throughout the west, with their distribution strongly correlated with the availability of caves and cave-like roosting habitat, including abandoned mines. The CNDDB reports 243 occurrences for this species in the State of California (CDFG, 2010). The nearest reported occurrence is located 42 miles southwest of the Survey Area near the Santa Cruz Mountains (CDFG, 2010).

Though not verified within the Project area, roosting habitat may be available in large trees in the Project area, and the Vasco Caves Regional Preserve offers more typical cave roosting habitat. Open grasslands in the Project area provide foraging habitat, but the Project footprint does not encompass suitable roosting habitat for Townsend's big-eared bat.

**Greater Western Mastiff Bat (*Eumops perotis californicus*).** The greater western mastiff bat prefers open, semiarid to arid habitats with low elevation and rugged, rocky areas that have suitable crevices for roosting. They roost in buildings and trees, provided they have adequate drops to allow them to take flight (Williams, 1986; Zeiner et al., 1990). Greater western mastiff bats are uncommon, widespread residents of the San Joaquin and Salinas Valleys and coastal lowlands south of San Francisco Bay (Williams, 1986; Zeiner et al., 1990). The CNDDB reports 293 occurrences for this species in the State of California, most of them in the southern half of the State (CDFG, 2010).

The nearest documented occurrence is approximately 12 miles southeast of the Project area, reported in 1991 (CDFG, 2010). Rock crevices and riparian trees in the Project area provide potential roosting habitat. Open grasslands in the Project area provide foraging habitat, but the Project footprint does not encompass suitable roosting habitat for greater western mastiff bat.

**Western Red Bat (*Lasiurus blossevillii*).** Western red bat may be associated with intact riparian vegetation such as willows, cottonwoods, and sycamores, and day roosts are commonly located in edge habitats adjacent to streams, open fields, orchards, and occasionally urban areas (WBWG, 2005). Large trees provide the most frequent roosts, but caves may also be used. Late-summer peaks in activity are recorded from the Central Valley, suggesting a seasonal migration event in the area (Rainey, et al. 2006).

The CNDDB contains 183 records for this species throughout the State of California, most of them in the northern half of the State. The nearest occurrence is a 1998 record located approximately 14 miles north of the Project area near Antioch (CDFG, 2010). Riparian corridors in the Project area may provide potential roosting habitat. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for western red bat.

The most recent fatality data estimate between 23 and 50 western red bats are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 95-200 kW, and 250-400 kW turbines. Other research indicates that bat carcass detectability may be lower, and scavenger removal rates higher, than estimated here (CBWG, 2006). Red bats, in low numbers, were one of four species also documented in fatality reports at the nearby High Winds project in Solano County, California (Kerlinger, et al., 2006).

**Small-footed Myotis Bat (*Myotis ciliolabrum*).** Small-footed myotis bat is distributed in deserts, chaparral, riparian zones, western coniferous forest, and pinyon-juniper forest. Individuals are known to roost singly or in small groups in cliff and rock crevices, buildings, concrete overpasses, caves, and mines.

The range of the small-footed myotis includes much of the State of California and the western half of North America (CDFG, 2005). Roost sites are not documented within 90 miles of the Project area (CDFG, 2010). Vasco Caves Regional Preserve provides potential roosting habitat, but based on the described distribution of roost sites, there is low likelihood that this species would be encountered as a resident in the Project area. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for small-footed myotis bat.

**Fringed Myotis Bat (*Myotis thysanodes*).** The fringed myotis bat is most common in dry woodlands (oak, pinyon-juniper, ponderosa pine), and is found in a wide variety of habitats including desert scrub, mesic coniferous forest, grassland, and sage-grass steppe. Night and day roosts include caves, mines, and buildings (typically abandoned). Hibernacula include caves and buildings, but not much is known about their wintering whereabouts (WBWG, 2005).

Fringed myotis bats range through much of western North America from southern British Columbia, Canada south to Chiapas, Mexico, and from Santa Cruz Island in California east to the Black Hills of South Dakota.

The species' described range includes much of California, and the CNDDB reports 81 occurrences throughout the State. The nearest described occurrence is a 2005 observation near Crystal Springs Reservoir, San Mateo County, about 40 miles west of the Project area (CDFG, 2010). Project area grasslands, caves, and rock outcrops provide suitable roosting and foraging habitat, and fringed myotis bat may be encountered as a resident or migrant. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for fringed myotis bat.

**Yuma Myotis Bat (*Myotis yumanensis*).** Yuma myotis bats are usually associated with permanent sources of water, but also with natural water catchment basins in the arid West (WBWG, 2005). They occur in a variety of habitats including riparian, arid scrublands, deserts, and forests. Occasionally roosting in mines or caves, these bats are most often found in buildings or bridges. Bachelors also sometimes roost in abandoned cliff swallow nests, but tree cavities were probably the original sites for most nursery roosts.

The species' described range includes much of California, and the CNDDB reports 81 occurrences throughout the State. The nearest described observation is a 2003 sighting in the City of Pleasanton, Alameda County, 14 miles southwest of the Project area (CDFG, 2010). Project area trees and rock outcrops provide suitable roosting habitat, and Yuma myotis bat may be encountered as a resident or migrant. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for Yuma myotis bat.

**San Francisco Dusky-Footed Woodrat (*Neotoma fuscipes annectens*).** One of eleven subspecies found in forest and shrubland communities throughout most of California and parts of Oregon and Baja, California, the San Francisco dusky-footed woodrat is found throughout the San Francisco Bay area. They live in grasslands, scrub, and wooded areas, where they consume an herbivorous diet consisting of foliage, forbs, nuts, fruit, and fungi. They build noticeable stick

houses, usually on the ground, which are often located in dense brush; these houses are multi-generational and can last for decades.

The CNDDB reports one San Francisco dusky-footed woodrat occurrence within 5 miles of the Project area, to the west at a distance of approximately 3 miles. The Project area provides habitat for this species in the Oregon Oak Woodland vegetation community that occurs behind the existing Operations and Maintenance Building, and in scrub habitat that is sparsely distributed in the Project area (Ecology and Environment, Inc., 2009), but Project activities are not proposed in these habitats. Grasslands in the Project area are not part of an oak woodland understory, so they are unlikely to provide habitat for woodrats.

**San Joaquin Pocket Mouse (*Perognathus inornatus inornatus*).** The San Joaquin pocket mouse lives in dense annual grasslands, saltbush scrub, and oak savannah habitats, exploiting the topography of flat ground and low hills. It is usually found in areas with friable soils, constructing its small burrows in sandy soil near bases of bushes. Microhabitats include dense grass, dirt roadsides, and rock outcroppings.

The CNDDB reports two San Joaquin pocket mouse occurrences within 5 miles of the Project area, located about 3.5 miles to the east near Clifton Court Forebay and 3.7 miles to the north (CDFG, 2010). Rock outcrops and non-native annual grasslands throughout the Project area may provide potential habitat in areas with appropriate friable soil.

**American Badger (*Taxidea taxus*).** In California, American badgers occupy a diversity of habitats. Grasslands, savannas, and mountain meadows near the timberline are preferred, though they can be found in deserts as well. The principal requirements seem to be sufficient food, friable soils, and relatively open, uncultivated ground.

In California, badgers range throughout the state, except for the humid coastal forests of northwestern California in Del Norte County and the northwestern portion of Humboldt County (Williams, 1986). CNDDB reports seven badger occurrences within 5 miles of the Project area (CDFG, 2010) and recent badger activity was identified at five locations in the Project area (Ecology and Environment, Inc., 2009). American badger is expected to occur in low densities in grassland habitats throughout the Project area.

#### *Mammal Species of Local Concern*

**Silver-haired Bat (*Lasionycteris noctivagans*).** The silver-haired bat is found from southern Alaska to northeastern Mexico, and is distributed throughout most of the United States. It is primarily a forest bat, associated with coniferous and mixed conifer/hardwood forests. Roosts are almost exclusively in large diameter trees, but occasionally in rock crevices, caves, mines, and buildings. Its presence in dry, lower-elevation areas is associated with winter and seasonal migrations (WBWG, 2005).

Vasco Caves Regional Preserve provides potential habitat, but based on the described distribution of roost sites, there is low likelihood that this species would be encountered as a resident in the Project area. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for silver-haired bat.

Silver-haired bats, in low numbers, were one of four species documented in fatality reports at the nearby High Winds project in Solano County, California (Kerlinger, et al., 2006), but they have not been documented in APWRA fatality reports.

**Hoary Bat (*Lasiurus cinereus*).** The hoary bat is the most widespread of all North American bats, ranging from Canada to Argentina and Chile in South America, and found even in Hawaii and the Galapagos Islands. They are uncommon throughout the eastern U.S. and northern Rocky Mountains, but more common in the Midwest and Pacific Northwest. In the western U.S., they are strongly associated with forested habitat (WBWG, 2005). Roosts are primarily in coniferous and deciduous trees, but occasionally in caves, rock ledges, and under loose woody debris. They are thought to be highly migratory during fall, and slightly less so during spring, but wintering sites are not well documented and migratory pathways are unknown (WBWG, 2005).

Vasco Caves Regional Preserve provides potential habitat, but based on the described distribution of roost sites, there is low likelihood that this species would be encountered as a resident in the Project area. Open grasslands in the Project area may provide potential foraging habitat, but the Project footprint does not encompass suitable roosting habitat for hoary bat.

The most recent fatality data estimate between one and 97 hoary bats are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 250-400 kW, 660 kW, and 1 MW turbines. As noted above, other research indicates that bat carcass detection may be misleadingly low, and therefore detector-error and/or scavenger removal rates higher, than estimated here (CBWG, 2006). Hoary bats were the most numerous bat fatalities documented at the High Winds project in nearby Solano County, California (Kerlinger, et. al., 2006).

**Mexican Free-tailed Bat (*Tadarida brasiliensis*).** The Mexican free-tailed bat is one of the most widely distributed mammalian species in the Western Hemisphere. Throughout the western U.S., this species is commonly associated with dry, lower-elevation habitats. Though abundant in numbers, its tendency toward roosting in large numbers in relatively few roosts makes it especially vulnerable (WBWG, 2005). Mexican free-tailed bats often fly more than 31 miles to reach foraging areas (WBWG, 2005).

The most recent fatality data estimate between 1 and 7 Mexican free-tailed bats are killed annually by wind turbines in the APWRA, with no fatalities documented specifically from Tres Vaqueros (Smallwood, 2010). Documented fatalities occurred at 40-65 kW, 660 kW and 1 MW turbines. As previously noted, other research indicates that bat carcass detectability may be lower, and scavenger removal rates higher, than estimated here (CBWG, 2006) and therefore, undocumented bat fatalities may occur at Tres Vaqueros. Mexican free-tailed bats were the second largest group of bat fatalities reported at the High Winds project in nearby Solano County, California (Kerlinger, et al., 2006).

## Plants

Twenty-three plants listed under federal or state endangered species acts or under CRPR Lists 1 and 2 have potential to occur in the Project area. These species are listed in **Table 4.4-2**. CRPR List 3 and 4 plants are not included in the table, but if present were identified and recorded during

floristic surveys. Species that are listed under federal or state Endangered Species Acts, or are identified by CDFG and CNPS as CRPR species, and that were observed or have a moderate-to-high potential to occur in the Project footprint and buffer area (Survey Area) are discussed in detail below, including species for which potential habitat is present. Species determined to have low potential to occur within the Project area are listed in Table 4.4-2 but are not discussed further in this document, with the exception of Contra Costa goldfields.

Focused botanical surveys were performed by Ecology & Environment, Inc., biologists on June 10, June 19, and July 12, 2008 in a Survey Area defined as: all areas within 328 feet of an existing or proposed turbine pad; the project staging area; a 164-foot-wide corridor centered on the trench for electrical facilities; areas along and within 164 feet of existing and new Project access roads; and all wetland and alkaline soil areas within the Project area (Ecology & Environment, Inc., 2009).

No listed or CNPS List 1A or 1B plants were identified in the Survey Area (Ecology and Environment, Inc., 2009) but previously-identified populations of brittlescale and San Joaquin spearscale occur in the Project Area (CCWD and Reclamation, 2010). The following CNPS List 3 or 4 plants were identified but are not further discussed: crownscale, ball saltbush (*Atriplex fruticulosa)*, fragrant cudweed (*Gnaphalium obtusifolium*), hop tree (*Ptelea crenulata*), and blue elderberry (*Sambucus mexicana*). Ecology & Environment, Inc. identified the following plants as having a moderate potential to occur, but upon further professional review by ESA ecologists these species were determined by ESA to have a low occurrence potential: Contra Costa goldfields, palmate-bracted bird's-beak, Livermore tarplant, recurved larkspur, diamond-petaled poppy, chaparral ragwort, and caper-fruited tropidocardum.

#### *Federal or State Threatened and Endangered Species*

**Contra Costa Goldfields (*Lasthenia conjugens*).** Contra Costa goldfields is a small spring annual in the sunflower family (Asteraceae), flowering between March and June. Habitat for this species occurs in vernal pools, swales and moist flats within alkaline playas, valley and foothill grasslands, and cismontane woodland below a 1,500-foot elevation (CNPS, 2010). The species is often found in association with other endemic vernal pool plants such as coyote thistle, smooth goldfields (*Lasthenia glaberrima*), flatface downingia (*Downingia pulchella*), and common mousetail (*Myrica californica*) (CDFG, 2010).

Historically, Contra Costa goldfields was known from the north coast, the southern Sacramento Valley, the San Francisco Bay Area, and the southern coast. Currently, this species is known to occur in Contra Costa, Alameda, Mendocino, Napa, Marin, Solano, Sonoma, and Monterey counties, and is believed to be extirpated from Santa Barbara and Santa Clara counties (CNPS, 2010). CDFG (2010) reports one extant occurrence in Contra Costa County and three in Alameda County.

No occurrences of Contra Costa goldfields are known within the Project area, with the nearest occurrence reported 11 miles north of the Project area (CDFG, 2010). Although suitable habitat for Contra Costa goldfields occurs within the Survey Area, the species was not detected during preliminary floristic surveys conducted in June 2008 (Ecology & Environment, 2009).

### *Federal or State Species of Special Concern*

**Heartscale (*Atriplex cordulata*).** Heartscale is a low-growing annual herb in the goosefoot family (Chenopodiaceae). Leaves are attached directly at the base without a stem and flowers appear from May through October. Like other atriplex species, heartscale is relatively tolerant of disturbance. Heartscale often grows in association with other atriplex, saltgrass, alkali heath, and common tarweed (*Hemizonia pungens*). Habitat for this species is generally found within sandy, saline, or alkaline flats or scalds, in chenopod scrub, meadows, and valley and foothill grassland at less than 1,230-foot elevations (CDFG, 2010).

Heartscale is known to occur within the southern Sacramento Valley to the San Joaquin Valley. Its current distribution ranges from Glenn and Butte counties in the north to Kern County in the south (CNPS, 2010). Three populations are recorded to the south of the Project area, the closest of which is approximately three miles away (CDFG, 2010). All of these populations were documented within the past 15 years (CDFG, 2010). Although suitable habitat for heartscale occurs within the Project area, the species was not detected in the Survey Area during preliminary floristic surveys conducted in summer 2008 (Ecology & Environment, 2009).

**Brittlescale (*Atriplex depressa*).** Brittlescale is associated with alkaline or clay soils in chenopod scrub, playas, vernal pools, or seeps, and in valley grassland at less than 1,050-foot elevations (CNPS, 2010). It often occurs in the alkali soils of the Pescadero and Solano series and is known within the southern end of the Sacramento Valley through the San Joaquin Valley. It is currently known within Contra Costa, Alameda, Butte, Colusa, Fresno, Glenn, Kern, Madera, Merced, Solano, Tulare, and Yolo counties (East County HCP, 2007). Populations occur in semibarren areas of saline and alkaline meadows with other atriplex, alkali heath, salt grass, alkali mallow, meadow barley (*Hordeum brachyantherum*), common tarweed, and bush seepweed. Brittlescale is sometimes associated with other rare plants such as palmate-bracted bird’s-beak and San Joaquin saltbush (CDFG, 2010). As with heartscale, it flowers between May and October.

Brittlescale has been recorded in the Los Vaqueros Watershed downstream from the Los Vaqueros Reservoir (CDFG, 2010). Documented in 1988, about 500 plants were found 0.8 mile south of Marsh Creek Road, another 500 were observed about 0.6 mile north of Vasco Road, and 150 plants were found on the western side of the reservoir spillway south of Los Vaqueros Dam (Jones & Stokes, 1988). The CNDDB has 15 known occurrences within five miles of the Project area.

Brittlescale occurs within the eastern Project area (CCWD and Reclamation, 2010). However, the species was not detected in the Survey Area during preliminary floristic surveys conducted in summer 2008 (Ecology & Environment, 2009).

**San Joaquin Spearscale (*Atriplex joaquiniana*).** San Joaquin spearscale is in the goosefoot family (Chenopodiaceae). This annual herb is grayish, erect, and can reach a height of one to three feet. Small green flowers bloom between April and September. Habitat for this species is restricted to saline soils supporting alkali sink vegetation within alkali wetlands and along alkaline watercourses, in both the Central Valley and the adjacent Coast Ranges (Munz and Keck, 1970).

This species is known to occur on the eastern side of the southern inner Coast Ranges, the southern end of the Sacramento Valley, and the San Joaquin Valley. Historically, the species' range extended from Glenn County in the north to Tulare County in the south, but it is currently assumed to be extirpated from Santa Clara, San Joaquin, and Tulare Counties (CNPS, 2010).

San Joaquin spearscale occurs within the southern Project area (CCWD and Reclamation, 2010). However, the species was not detected in the Survey Area during floristic surveys conducted in summer 2008 (Ecology & Environment, 2009).

**Round-leaved Filaree (*California macrophylla*).** Round-leaved filaree is an annual herb in the geranium family (Geraniaceae), blooming from March to May. Round-leaved filaree is native to California and can be found in cismontane woodland and valley and foothill grasslands from 50 feet to 3,937 feet elevation.

Suitable habitat for this species is present within the Project area. The CNDDB shows four occurrences within five miles of the Project area, the nearest about 1.8 miles away (CDFG, 2010). Preliminary floristic surveys were conducted in summer 2008, and would probably not have detected this species within the Survey Area due to the difference in blooming periods.

**Congdon's tarplant *(Centromadia parryi* ssp. *congdonii).*** Congdon's tarplant is an annual herb in the sunflower family (Asteraceae). This small, yellow-flowered plant blooms between May and October. Habitat for this species can be found in woodlands and grassland openings, sometimes on serpentine soils.

Suitable habitat for this species is present in alkaline seeps and seasonal wetlands within the Project area. The CNDDB shows one recorded occurrence to the south, approximately 3.7 miles from the Project area (CDFG, 2010). Although suitable habitat for Congdon's tarplant occurs within the Project area, the species was not detected in the Survey Area during preliminary floristic surveys conducted in summer 2008 (Ecology & Environment, 2009).

**Hispid bird's-beak (*Cordylanthus mollis* ssp. *hispidus*).** Hispid bird's beak is one of two subspecies of Cordylanthus mollis and occurs in alkaline meadows. The hispid bird's-beak, a bushy, herbaceous annual of the figwort family (Scrophulariaceae), reaches a height of 6 to 8 inches prior to producing highly irregular, two-lipped (hence "bird's beak) flowers between March and June. The flowers are white to yellowish-white with a green base. This plant occurs in alkaline areas usually surrounded by grassland (Munz and Keck, 1970).

Suitable habitat for this species is present in alkaline meadows within the Project area. The CNDDB shows multiple occurrences, with the nearest approximately 1.8 miles southwest from the Project area (CDFG, 2010). Although suitable habitat for hispid bird's-beak occurs within the Project area, the species was not detected in the Survey Area during preliminary floristic surveys conducted in June 2008 (Ecology & Environment, 2009).

## Critical Habitat

As discussed in *Section 4.2.2.2, Regulatory Setting*, Critical Habitat is designated by the USFWS. Critical Habitat is a term defined and used in the Endangered Species Act, referring to a specific

geographic area or areas that contain features essential to the continued well-being of a threatened or endangered species. These areas may require special management and protection. These areas may also include habitat that is not presently occupied by the species, but will be crucial at some point in the future for its recovery. Projects in these areas may require consultation with USFWS if they will affect a species' primary constituent element (PCE) - a physical or biological feature of a landscape that a species needs to survive and reproduce.

The Project area encompasses critical habitat for longhorn fairy shrimp present at the Vasco Caves Regional Preserve. However, Project activities would avoid rock outcrops at the Preserve by at least 500 feet and no direct or indirect impacts are anticipated. The Project area is located within five miles of critical habitat for several other species, but this habitat would also not be impacted. Critical habitat for vernal pool fairy shrimp and Contra Costa goldfields occurs approximately 0.5 mile east of the Project area. Critical habitat for delta smelt occurs approximately 3 miles northeast, east, and southeast of the Project area. Critical habitat for California red-legged frog occurs approximately 1 mile south of the Project area.

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# APPENDIX D2
# Baseline Avian and Bat Fatality Rates

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**Baseline Avian and Bat Fatality Rates at the Tres Vaqueros Wind Project, Contra Costa County, California**

**Report to the East Bay Regional Park District**

K. Shawn Smallwood

21 March 2010

**ABSTRACT**: To inform proposed plans to repower the Tres Vaqueros Wind Farm in the Contra Costa County portion of the Altamont Pass Wind Resource Area (APWRA), I relied on data from fatality searches over the last four years (2005-2009) to estimate avian and bat fatality rates at Tres Vaqueros, as well as at the other old-generation wind turbines throughout the APWRA and at the modern wind turbines at two repowered projects, i.e., Diablo Winds and Buena Vista. I relied on data outside the Tres Vaqueros Wind Farm because fatality rates were relatively low at Tres Vaqueros from 2005 to 2009, likely due to declining operations of the Howden model wind turbines. Therefore, I developed several sets of baseline fatality rate estimates, but I recommend the set presented in Table 4 that I believe is most robust and most representative of fatality rates that likely were caused by the Howden turbines prior to their decline in operations. My recommended baseline estimates were derived from least-squares regression models fitted to fatality rates estimated among turbine sizes, ranging from 0.04 MW to 1 MW in size (see Table 3). Fatality rates of most species and species groups declined with increasing turbine size, so I used the variation among all turbine size classes to predict the likely fatality rates among the 0.33 MW Howden turbines prior to their decline.

My models predicted that the 25-MW Tres Vaqueros project likely killed averages of 0.5 golden eagles (i.e., 1 every other year), >12 red-tailed hawks per year, 9 American kestrels per year, 51 burrowing owls per year, 57 raptors per year (38 to 77 per year), 206 birds per year (149 to 259 per year), overall, and >7 bats per year. Relying on data from Tres Vaqueros alone, I estimated that over the past four years the Howden wind turbines killed on average 0.75 golden eagles per year (i.e., 3 eagles every 4 years),10 red-tailed hawks per year, 2 American kestrels per year, 39 burrowing owls per year, 65 raptors per year, 218 birds per year (20 to 417 per year), but no bats. As an indicator of the fatality rates that could be expected if the new wind turbines are not sited carefully to minimize impacts, the fatality rates at the Buena Vista project can be compared, though these were based on fatality searches only over the past two years, January 2008 thorugh November 2009. The fatality rates at Buena Vista, projected to 25 MW at Tres Vaqueros, would predict mean annual fatalities of 3.5 golden eagles, 8.5 red-tailed hawks, 6.7 American kestrels, 0 burrowing owls, 20 raptors, 80 birds of all types, and 31 bats. Unless the repowered turbines are sited to minimize impacts, the repowering of Tres Vaqueros might increase fatalities of golden eagles and bats, but should reduce fatality rates by at least 65% for raptors as a group and at least 61% for all birds as a group.

## INTRODUCTION

East Bay Regional Park District (EBRPD) holds title to land in the Altamont Pass Wind Resource Area (APWRA) where an existing wind power project – Tres Vaqueros -- may soon be repowered with modern, larger wind turbines. The APWRA, with between 4,000 and 5,000 existing wind turbines, is known to cause a significant number of avian deaths, estimated at 9,300 birds, including 2,230 raptors, annually (Smallwood and Karas 2009). The mission of the EBRPD is to preserve natural resource values for future generations, while the State of California has set high goals for developing renewable energy sources. Given that renewable energy development in the APWRA appears to adversely affect both birds and bats, the EBRPD places a premium on obtaining the most accurate and scientifically defensible estimates of wind generation impacts to assess both current threats to birds and bats as well as to discern means by which to reduce those impacts. Thus, the EBRPD needs estimates of baseline fatality rates resulting from operation of the existing Tres Vaqueros wind turbines. These baseline rates then need to be compared to predicted and measured fatality rates caused by the repowering of the Tres Vaqueros Wind Farm.

As of November 2009 the Tres Vaqueros Wind Farm included addresses for 85 330 kilowatt (kW) Howden turbines and one 750 kW turbine, though at least 8 of those addresses were vacant since 2000. Repowering the Tres Vaqueros Wind Farm will likely involve replacing all 86 of the originally sited Howden turbines with either 26 to 28 Turbines of 1.5 MW each or 21 to 23 turbines of 2 MW each. The repowered turbines will likely be larger than the 1 megawatt (MW) Mitsubishi turbines used in the Buena Vista project across Vasco Road. Comparing the baseline fatality rates of the existing Tres Vaqueros Wind Farm to predicted and measured fatality rates following repowering would enable EBRPD to assess whether and to what degree the repowering project changed avian and bat fatality rates. The goal, of course, would be to reduce fatality rates to the lowest levels possible. Remaining fatality levels would likely serve as the basis for compensatory mitigation.

I initially sought to develop three types of baseline estimates, and I added a fourth as the analysis progressed:

(1) Total annual fatalities caused by the Tres Vaqueros project;

(2) Fatalities per MW per year (rated capacity);

(3) Fatalities per GWH per year (actual production); and,

(4) Fatalities per MW per year projected from a model of mean fatality rates regressed on wind turbine size (MW) among all models used throughout the APWRA.

An estimate of the total annual fatalities caused by the existing Tres Vaqueros project (baseline estimate #1) informs of the total impact, regardless of the other goals of the project, such as power generation. It can contribute to concluding whether the repowering reduced the total number of fatalities. However, total annual fatalities does not provide an estimate of the number of deaths relative to the size or power output of the project, so to compare this project's impacts

to those of other projects the rates need to be normalized by a common denominator. Comparing fatalities per MW per year (baseline estimates #2) using rated capacity of the wind project provides information on the project's impacts relative to its size, and enables comparisons of impacts between wind farms in the APWRA and other wind resource areas. However, comparing fatalities per MW per year does not account for variation in power output between turbine models and turbine locations within a wind farm; in other words, it does not factor in turbine performance. Comparing fatalities per gigawatt-hour (GWH) per year (baseline estimate #3) relates the number of birds or bats killed to the actual electric power produced by a wind project. This comparison can be useful for assessing the balance achieved between turbine-caused fatalities and renewable energy generation. Additionally, the number of fatalities per GWH is a useful metric for comparing the relative impacts of existing wind turbines if the location and output of individual wind turbines is known, which might help with future turbine siting and decisions about turbine operations.

Baseline fatality rates projected from a regression model based on turbine size (baseline estimates #4) emerged during the analysis as I discovered that the Howden wind turbines had been declining rapidly since the start of fatality monitoring in 2005 (Figure 1). In fact, none of the Howden turbines continued to operate after November 2008. Using the fatality monitoring data from Tres Vaqueros alone could prove misleading as the foundation for baseline fatality rates because the baseline conditions were rapidly changing. The regression model projections from thousands of wind turbines that were not declining at the same rate as Tres Vaqueros might represent more robust baseline fatality rates typical of the Tres Vaqueros Wind Farm prior to fatality monitoring in 2005.

The objectives for this study were to: (1) Estimate fatality rates and total annual fatalities among the Howden turbines in the Tres Vaqueros project over the past four years (fall 2005 to fall 2009); (2) Estimate fatality rates among all old-generation wind turbines in the APWRA over the past four years; (3) Estimate fatality rates of repowered modern turbines; (4) Estimate monthly fatality rates; and (5) Test whether fatality rates at the most similar repowered project (Buena Vista) relate to topographic features. The first three objectives were intended to establish baseline fatality rates for comparison to fatality rates that may be realized by the repowering of the Tres Vaqueros project. Objectives 4 and 5 were intended to identify opportunities for minimizing fatality rates through turbine siting and turbine operations.

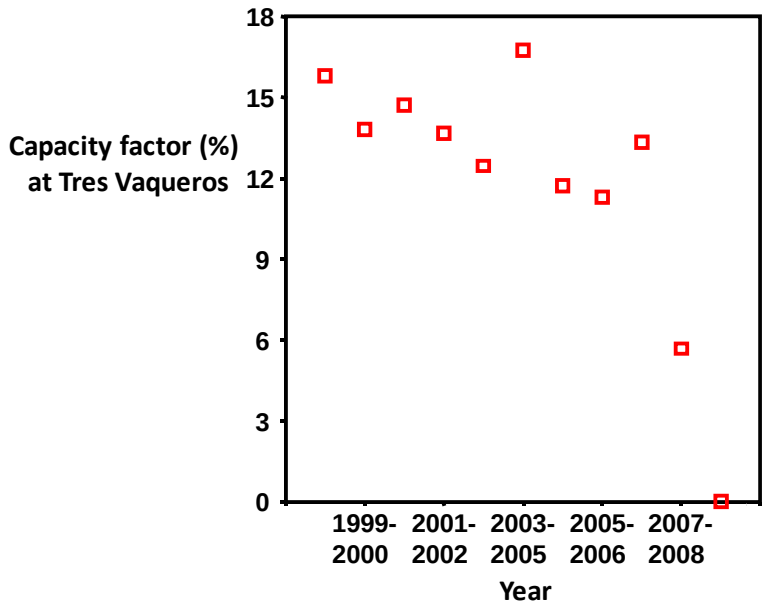



Figure 1. Project-wide capacity factor declined since 1998, but dropped to zero during the four year period of fatality monitoring that was used to establish baseline fatality rates at Tres Vaqueros Wind Farm.

## METHODS

### Study Site

*APWRA*.--The Altamont Pass Wind Resource Area encompasses about 165 $km^2$ (16,500 ha) of ridges and hills generally extending northwest to southeast in eastern Alameda and southeastern Contra Costa Counties, California. Located in the Inner Coast Range geomorphic province and bordering the Central Valley province, slopes are steep above intermittent streams, springs, and stock ponds. Elevations range 78 m to 470 m above mean sea level. Slopes are covered mostly by non-native, annual grasses, which grow mostly during January through March and are dead or dormant by June. Cattle grazers hold most of the land, leasing out wind energy rights to wind power companies. Wind turbines in the APWRA are arranged in rows of 2 to 62 turbines, typically along ridge crests (i.e., peaks of the ridge features) and ridgelines extending down toward ephemeral streams. Wind turbine rows also occupy slopes, valleys, and hill peaks, and all operate in winds from any direction, although most winds originate from the southwest or northwest. Old-generation wind turbine models are listed in Smallwood and Thelander (2008).

*Tres Vaqueros*.—The Tres Vaqueros Windfarms LLC (Tres Vaqueros) proposed repowering project site is located within the northern portion of the APWRA, where elevations range 70 m to 300 m. The site is about 6 km southwest of Byron. The land encompassed by Tres Vaqueros includes a portion of the 2,983.35 acre Vasco Caves Regional Preserve, which is owned and managed by the East Bay Regional Park District (EBRPD) and a portion of the Los Vaqueros Reservoir watershed, which is owned and operated by the Contra Costa Water District (CCWD). However, no wind turbines are currently situated on CCWD land. Wind right ownership is complex. Blackhawk Nunn Partners and Vaquero Farms, Inc. retain wind rights to all of the land

encompassed by Tres Vaqueros Windfarms LLC except for a 249.7 ha parcel situated within Vasco Caves Regional Preserve. The EBRPD retains the wind rights over this parcel, known as Souza 1. Pattern Energy owns the 75 330-KW Howden wind turbines on Tres Vaqueros and has wind leases with EBRPD, Blackhawk Nunn Partners and Vaquero Farms, Inc. The original total rated capacity of the project was 28.8 MW, but the operating capacity was closer to 25 MW in 2005.

**Avian Fatality Monitoring in the APWRA**

Field methods have been described in multiple reports (Smallwood and Thelander 2008, Smallwood and Karas 2009, Smallwood et al. 2009b, Smallwood et al. 2010, Insignia Environmental 2009). A team of investigators funded by the California Energy Commission searched for fatalities at systematically selected turbine rows in Tres Vaqueros during 2002-2003, but only twice and separated by about 90 days (Smallwood and Thelander 2004, 2008). Given the number of surveys performed in more recent fatality monitoring, I did not see much value in relying on the earlier surveys to establish baseline fatality rates for repowering. Therefore, the baseline fatality rates considered herein were estimated from surveys performed since 2005. (However, most estimates of monthly fatality rates presented here were based on surveys performed in the APWRA from 1998 through 2009.)

The Alameda County Avian Monitoring Team searched for fatalities among about 2,700 turbines beginning in 2005 (Table 1). Searches were performed at all very small turbines (40-65 KW), all large turbines (250-400 KW), all Diablo Winds repowered turbines (660 KW), and randomly selected blocks of medium-sized old-generation turbines (95-200 KW). Thus, all Tres Vaqueros turbines were searched beginning in fall 2005. In spring 2006, EBRPD took over the fatality searches among 42 of the Tres Vaqueros turbines, consisting of all the turbines on the Souza 1 parcel of Vasco Caves Regional Preserve. These 42 turbines were searched by EBRPD through September 2007, but they were not searched by anyone afterwards. The other Tres Vaqueros turbines have been searched by the Alameda County Avian Monitoring Team since fall 2005.

**Data Management**

The data collected from the Alameda County Avian Monitoring Team were made publicly available in July 2009, but the complexity of the data base required considerable data management and coordination with the Monitoring Team to understand the data and correct errors. I also had to transfer the data to a professional analytical software package, i.e., to SPSS. Most of the assumptions I used in this analysis were debated and finally agreed upon by the Alameda County Scientific Review Committee (SRC) and Avian Monitoring team.

**Study Design**

WEST, Inc. initially designed the current APWRA fatality monitoring program. Begun in the fall of 2005, this monitoring program relied on a stratified sampling design based on wind turbine size classes (Table 1). The APWRA monitoring team has since implemented modifications to the sampling design as recommended by the SRC. It is important to understand the sampling design because I estimated fatality rates separately for each of five sampling strata.

Table 1. Summary of fatality searches in the APWRA since 2005, including searches by Alameda County Avian Monitoring Team (Alameda), Insignia environmental (Insignia), and East Bay Regional Park District (EBRPD).

| Sample | Searched | Search team | No. towers | MW of rated capacity | Search radius (m) | Mean search interval (days) | Mean years | Dates |
|---|---|---|---|---|---|---|---|---|
| Diablo Winds 660 KW | All | Alameda | 31 | 20.46 | 75 | 32.08 | 4.33 | Apr 2005 to Oct 2009 |
| Buena Vista 1 MW | All | Insignia | 38 | 38.00 | 75 | 15/30 | 1.92[a] | Jan 2008 – Nov 2009 |
| Old turbines 95-200 KW | Random blocks | Alameda | 1,869 | 188.69 | 50 | 34.75 | 3.72 | Oct 2005 – Oct 2009[b] |
| Small turbines 40-65 KW | All | Alameda | 759 | 45.10 | 50 | 35.91 | 3.90 | Oct 2005 – Oct 2009 |
| Old turbines 250-400 KW | All | Alameda/ EBRPD | 135 | 45.54 | 50-60 | 34.63 | 3.08 | Oct 2005 – Oct 2009 |
| -- Tres Vaqueros 330 KW | All off Souza | Alameda | 41 | 13.53 | 60 | 35.70 | 3.88 | Nov 2005 – Oct 2009 |
| -- Tres Vaqueros 330 KW | All on Souza | EBRPD | 34 | 11.22 | 60 | 15.90 | 1.31 | Jun 2006 – Sep 2007 |
| Northwind (65 KW) | All on Souza | EBRPD | 20 | 1.30 | 50 | 18.22 | 0.98[c] | Oct 2006 – Sep 2007 |

[a] Monthly searches were performed for 8 months, then bimonthly searches performed over following 15 months.
[b] Added 536 turbines to the search rotation in March 2007, increasing turbine sample from 1,233 to 1,869.
[c] Although these turbines were searched, the majority of Northwind turbines located off EBRPD property were not searched and therefore fatality rates for the Northwind wind farm were not calculated here.

Furthermore, all of the Tres Vaqueros wind turbines fell within the stratified sampling design framework. In the initial design, all very small turbines were selected for fatality searches, including all turbines rated 40 KW to 65 KW (Stratum 1). All large old-generation turbines (except, inexplicably, for 2 KVS-33 turbines) were also selected for fatality searches, including all turbines rated 250 KW to 400 KW (Stratum 2). All of the Vestas V-47 turbines in the Diablo Winds repowering project were searched (Stratum 3). All of the 38 1-MW turbines in the repowered Buena Vista project were searched by Insignia Environmental since January 2008 (Stratum 4). The remaining 430.9 MW of old-generation wind turbines in the APWRA were divided into blocks of turbine rows, where the blocks included turbines of similar type and location (Stratum 5). The pool of blocks was divided into north and south substrata, divided by Old Altamont Pass Road and I-580. Blocks were selected randomly from each substratum, but when estimating fatality rates, I ignored the north-south stratification in the initial design. Fatality rates from the randomly selected turbine blocks (Stratum 5) were the only rates that required extrapolation to turbines that were not searched, extrapolating from 188.69 MW to 430.9 MW. The Northwind turbines were excluded from the selection process because Northwind Energy refused to cooperate with the Alameda County Avian Wildlife Protection Program.

At Tres Vaqueros, specifically, all Howden turbines were searched beginning in late 2005 and early 2006, but EBRPD took over the searches of 42 of the turbines in June 2006 (Smallwood et al. 2009b). These turbines were on the Souza 1 parcel, which EBRPD obtained in 2005. The searches were modified from about monthly to about bimonthly and they continued through October 2007. The other Howden turbines at Tres Vaqueros were searched through 2009, but turbine operations ceased after October 2008.

**Estimation of fatality rates**

I included fatalities for estimating fatality rates if the fatalities were determined to have been possibly, probably, or certainly caused by wind turbines, and death estimated to have occurred within 90 days of carcass discovery. Also, carcasses must have been discovered within 125 m of a turbine, formerly birds capable of flying (i.e., not a nestling), and they were with certainty not counted twice due to scattered or remaining body parts. Included fatalities were tallied by species per row of turbines, so fatality rates were first calculated by turbine row and then averaged among the rows in the sample stratum. Fatalities were tallied per row of turbines because fatality searches were made at turbine rows as opposed to at individual turbines and because the close distances separating old-generation turbines often made it difficult to determine which turbine killed a bird.

Fatality rates were represented as means and standard errors among the rows of wind turbines and per period of time with distinct search intervals, and weighted means were taken when search intervals differed substantially between series of searches. The rates were then adjusted for the fatalities not found due to scavenger removal and searcher detection errors:

$$F_A = \frac{F_U}{p \times R_C},$$

where $p$ was the proportion of fatalities found by searchers, and $R_C$ was the estimated cumulative proportion of carcasses remaining since the last fatality search, assuming wind turbines will deposit carcasses at a steady rate through the search interval. Both $p$ and $R_C$ were averaged from trials throughout the U.S. (Smallwood 2007), but I also use new $R_C$ values based on novel scavenger removal trials performed in Vasco Caves Regional Preserve (Smallwood et al. 2010):

$$R_C = \frac{\sum_{i=1}^{I} R_i}{I},$$

where $R_i$ was the model-predicted proportion of carcasses remaining by the $i$th day following the initiation of a scavenger removal trial, and $I$ was duration of the scavenger removal trial. I carried the error terms from the adjustments by using the Delta Method (Goodman 1960). Fatality rates were calculated only for species for which carcasses were detected.

For estimating monthly fatality rates, I used the same carcass inclusion rules as described previously, but my calculation of these rates differed slightly from the conventional method. Rather than expressing years as the time span from start to finish of contiguous, periodic fatality searches, I expressed years as the number of times a particular month (e.g., April or September) was covered by the fatality searches. During the current APWRA monitoring program, all 12 months would have been covered 4 times for most turbine rows, though fewer times for those rows added to the search rotation in spring 2007 and up to 5 times for turbine rows including Diablo Winds turbines.

Besides estimating fatality rates for each species, I also estimated fatality rates for groups of species. **All bats** included Mexican free-tailed bat, Hoary bat, Western red bat, and Unknown bat. **All native small birds** included Pied-billed grebe, Killdeer, Mourning dove, Dove spp., Common poorwill, White-throated swift, Northern flicker, Hammond's flycatcher, Pacific-slope flycatcher, Say's phoebe, Western kingbird, Flycatcher spp., Loggerhead shrike, Warbling vireo, Vireo spp., Western scrub-jay, American crow, Horned lark, Corvid spp., Tree swallow, Violet-green swallow, Cliff swallow, Barn swallow, Swallow spp., Rock wren, House wren, Western bluebird, Mountain bluebird, Bluebird spp., Swainson's thrush, Northern mockingbird, American pipit, Yellow warbler, Black-throated gray warbler, Wilson's warbler, Western tanager, Spotted towhee, Savannah sparrow, Fox sparrow, Lincoln sparrow, Golden-crowned sparrow, Sparrow spp., Red-winged blackbird, Tricolored blackbird, Western meadowlark, Brewer's blackbird, Brown-headed cowbird, Blackbird spp., House finch, Lesser goldfinch, and Unknown bird. **All native medium and large birds** included Mallard, Ring-necked duck, Duck spp., Brown pelican, Double-crested cormorant, Great blue heron, Great egret, Cattle egret, Black-crowned night-heron, American coot, Sandhill crane, Black-necked stilt, American avocet, Lesser yellowlegs, Bonaparte's gull, Ring-billed gull, Western gull, California gull, Herring gull, Gull spp., and Common raven. **All native nonraptors** included all native small birds and all native medium and large birds. **All exotic birds** included Cockatiel, Wild turkey, Rock pigeon, European starling, and House sparrow. **All target raptors** included Golden eagle, Red-tailed hawk, American kestrel, and Burrowing owl. **All raptors** included all target raptors and Turkey vulture, White-tailed kite, Northern harrier, Red-shouldered hawk, Swainson's hawk, Ferruginous hawk, Buteo spp., Hawk spp., Peregrine falcon, Prairie falcon, Falcon spp., Raptor,

Large raptor, Small raptor, Barn owl, and Great-horned owl. **All birds** included all native nonraptors, all raptors, and all exotic birds.

I estimated fatalities/year (Baseline estimate #1) and fatalities/MW/year (Baseline estimates #2 and #3) using the fatality monitoring data collected by the Alameda County Avian Monitoring Team and by me and EBRPD during our Vasco Caves study (Smallwood et al. 2010). These fatality rate estimates were adjusted for scavenger removal rates reported in both Smallwood (2007) and Smallwood et al. (2010). Baseline estimate #3 required additional data from Pattern Energy, namely power output data from individual turbines. I received the output data for the Howden turbines in the Tres Vaqueros Wind Farm, but not for any other wind project in the APWRA. Information on individual wind farm energy production tends to be carefully guarded by energy companies. Fatality rates in baseline estimates #3 were adjusted for scavenger removal rates reported in Smallwood et al. (2010).

Baseline estimate #4 was derived by estimating fatality rates separately for each size of wind turbine (i.e., MW of rated capacity) and then using least-squares regression to estimate average fatality rates of wind turbines of the same size as the Howden model turbines, namely 330 KW. In this way the error and bias in the fatality rates that were specific to the Howden turbines were softened in their impacts on the estimates by including fatality rate estimates from thousands of other turbines operating concurrently throughout the APWRA. The intent of baseline estimate #4 was to represent typical fatality rates at Tres Vaqueros that would have preceded the decline in operations of the Howden model wind turbines since 2005. The turbine sample size was small for a couple of size classes, so I excluded these size classes as outliers when 0 values or otherwise extreme values were obtained. For burrowing owls, I excluded turbine size classes that generally occurred either along the western side of the APWRA or on the relatively flat terrain of the far eastern side, because burrowing owl abundance and fatalities were generally much lower in those areas. Fatality rates in baseline estimates #4 were adjusted for scavenger removal rates reported in Smallwood et al. (2010).

### Golden eagle age classes

To help interpret patterns of fatalities of golden eagles, and to perhaps contribute to formulating more effective mitigation measures for golden eagle fatalities, I also tested whether monthly fatality rates differed by age class among golden eagles APWRA-wide. This test has become possible now that sufficient data are available.

## RESULTS

### Total fatalities (Baseline estimate #1)

Using fatality rates as adjusted by Smallwood et al. (2010), I estimated that the 24.75 MW of Tres Vaqueros wind turbines killed 225 birds per year over the past four years (2005-2009), including 91 native small birds, 67 raptors, <1 golden eagle, 2 American kestrels, 10 red-tailed hawks, and 40 burrowing owls (App. 1). Over the past nearly two years (2008-2009), I estimated that the 38 MW of Buena Vista wind turbines killed 122 birds per year, including 74

native small birds, 31 raptors, 5 golden eagles, 10 American kestrels, 13 red-tailed hawks, and 0 burrowing owls (App. 3).

**Fatalities per MW per year (Baseline estimate #2)**

Avian fatality rates were lower at Tres Vaqueros ($\bar{x}$ = 7.3-8.7) and among all the large old-generation wind turbines ($\bar{x}$ = 6.2-7.3) than observed at small and medium-sized wind turbines during 2005-2009 ($\bar{x}$ = 21.7-28.8 and 14.3-17.2, respectively), but they were greater than observed at the repowered Buena Vista wind turbines ($\bar{x}$ = 2.5-3.2) during the past two years (App. 1 and 2). However, golden eagle and American kestrel fatality rates were lower at Tres Vaqueros ($\bar{x}$ = 0.017-0.029 and 0.086-0.087) than they were at Buena Vista ($\bar{x}$ = 0.084-0.143 and 0.228-0.267). Also, no bats were found dead under Tres Vaqueros wind turbines, whereas >1 bat/MW/year was found at Buena Vista (App. 2 and 3). On the other hand, burrowing owl mortality was much greater at Tres Vaqueros than at Buena Vista ($\bar{x}$ = 1.36-1.56 compared to 0 fatalities at Buena Vista).

*Monthly fatality rates*.—Over the past decade and among all wind turbines monitored in the APWRA, fatality rates of golden eagle increased steadily through spring and summer and declined in fall to a winter-time nadir (Figure 2A). Fatality rates of red-tailed hawk decreased through spring and summer and jumped higher over fall and winter (Figure 2A). Fatality rates of American kestrel were relatively constant throughout the year, but dipped in April and October, and fatality rates of burrowing owl peaked in late summer/early fall and during winter (Figure 2A). The monthly trend in fatality rates of all raptors combined resembled those of red-tailed hawks and burrowing owls (Figure 2B), because their rates were among the highest among raptors and paralleled each other. The fatality rates of all birds combined peaked in mid-winter and May, and were lowest in late winter/early spring and early fall (Figure 2B). The monthly fatality rates of all bats as a group peaked in August/September with a secondary peak in March/April (Figure 2B).

Among golden eagles assigned an age class (37%), golden eagle fatality rates were similar among age classes except for substantial deviations during fall and winter (Figure 3). Fatalities of subadult eagles declined to low levels during fall, while fatality rates of adults and juveniles increased. By the middle of winter, however, fatality rates of adult eagles declined to 0, while fatality rates of juveniles and subadults surged. Fatality rates of subadult eagles declined to 0 during spring.

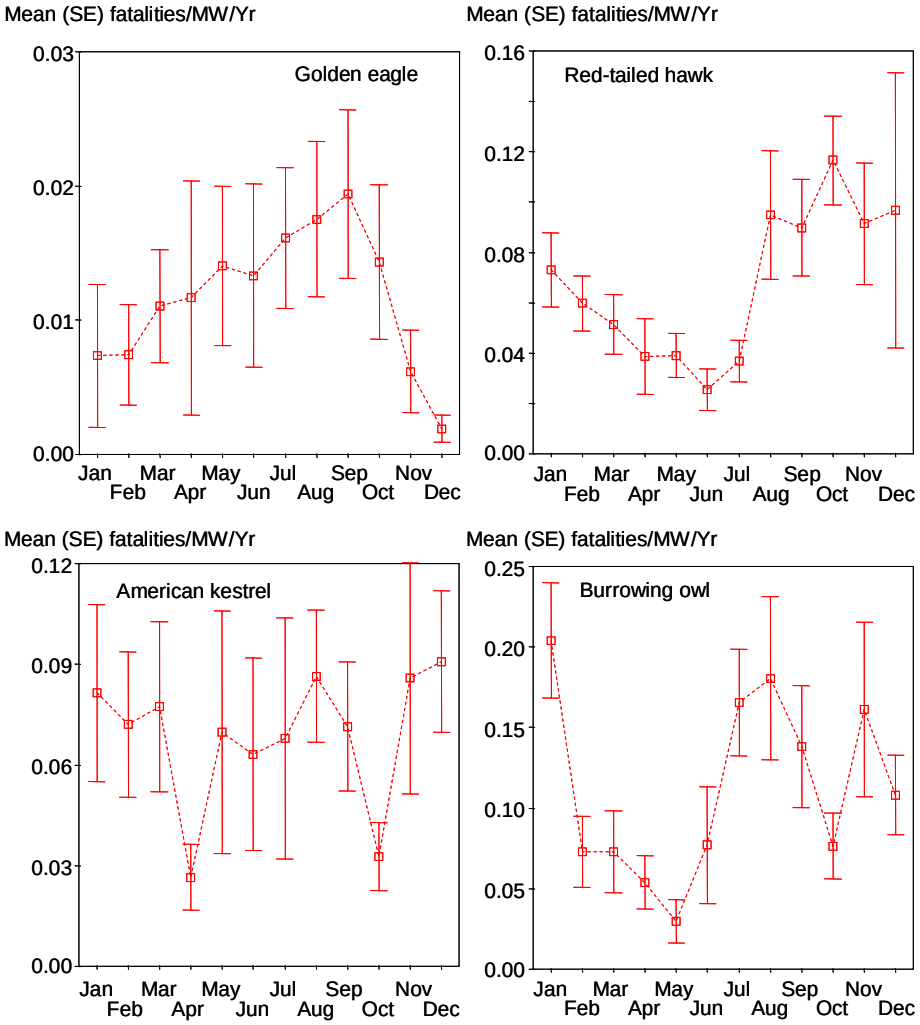
Monthly fatality rates of all birds and all raptors as groups were similar between Tres Vaqueros and the repowered wind projects over the past four years (2005-2009), though there was a notable exception (Figure 4). An exception was the lack of a January peak in fatality rates of all birds at the repowered wind turbines.

**Fatalities per GWH per year (Baseline estimate #2)**

At Tres Vaqueros, the number of fatalities/GWH/year corresponded with energy generation for all birds and for burrowing owls in particular (Figure 5). When power output increased in 2006,

so did the fatality rates. And when power output decreased after 2006, fatality rates also decreased. Fatalities continued to be found after the Howden wind turbines were completely shut down over the last year, but they numbered 78% fewer for all birds as compared to the preceding three years. For burrowing owls, they numbered 77% fewer during the last year compared to the preceding three years, and 83% fewer compared to the first two years of monitoring. Similar to the result reported in Smallwood et al. (2010), burrowing owl fatalities/GWH/year declined with increasing average capacity factor among turbine rows (Figure 6). Fatality rates established from the old-generation turbines across the APWRA as well as solely from Tres Vaqueros Wind Farm appear in Table 2.

Figure 2A. Mean (and standard error) monthly fatality rates of Golden eagle, red-tailed hawk, American kestrel, and burrowing owl across all time periods and all wind turbines monitored in the APWRA from 1998 through 2009.



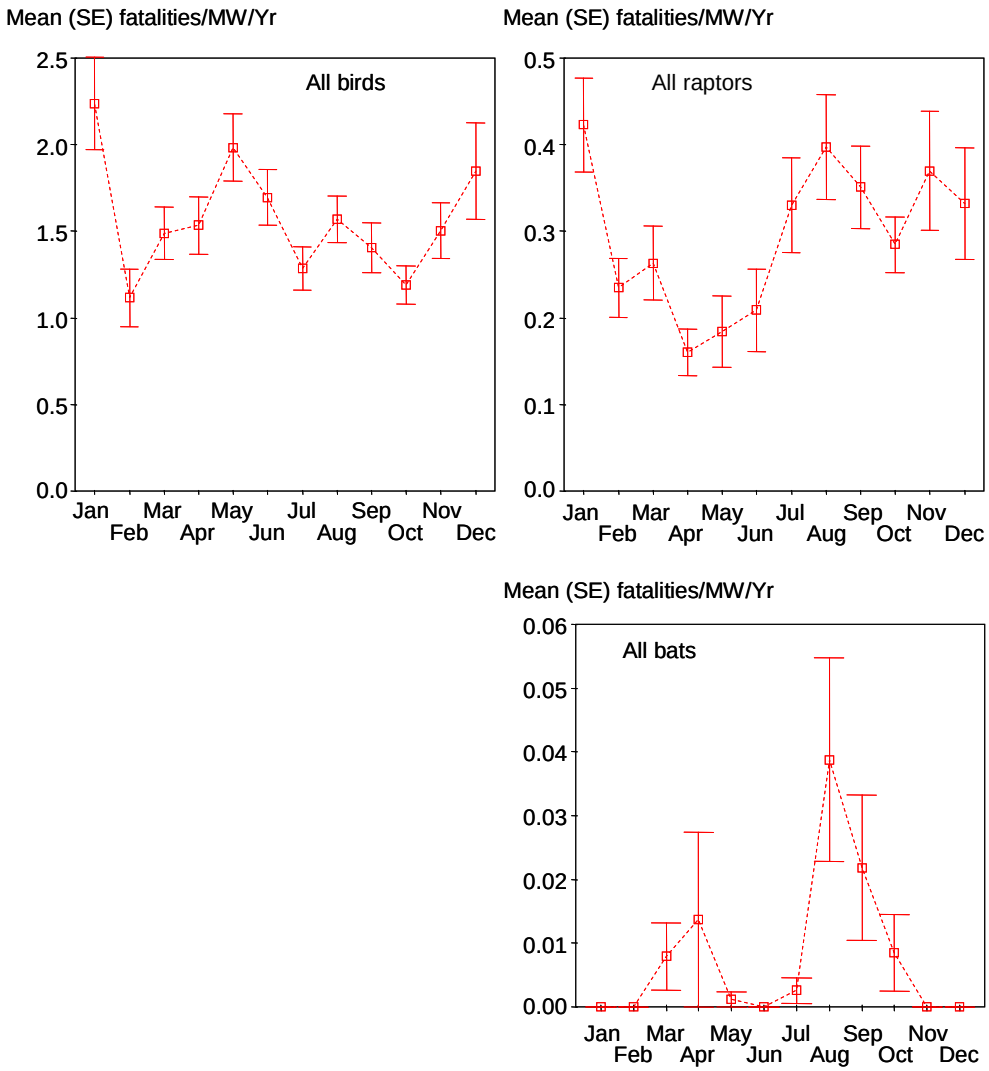



Figure 2B. Mean (and standard error) monthly fatality rates of all birds, all raptors and all bats across all time periods and all wind turbines monitored in the APWRA from 1998 through 2009.

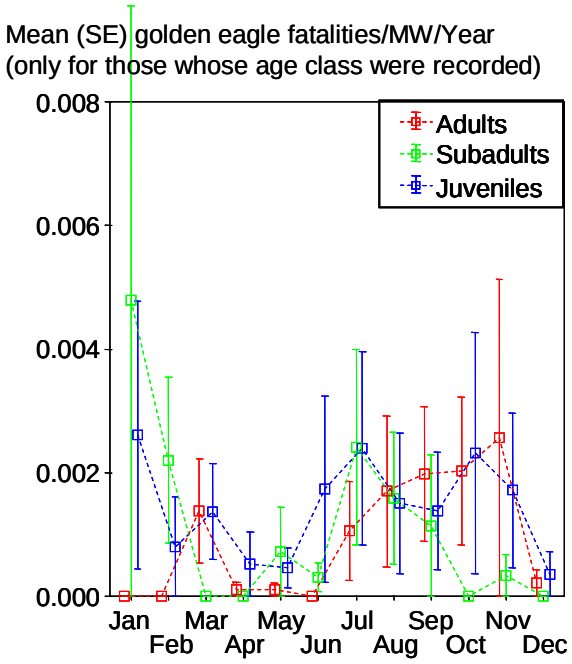



Figure 3. Monthly fatality rates of golden eagles by age class in the Altamont Pass Wind Resource Area, 1998-2009.

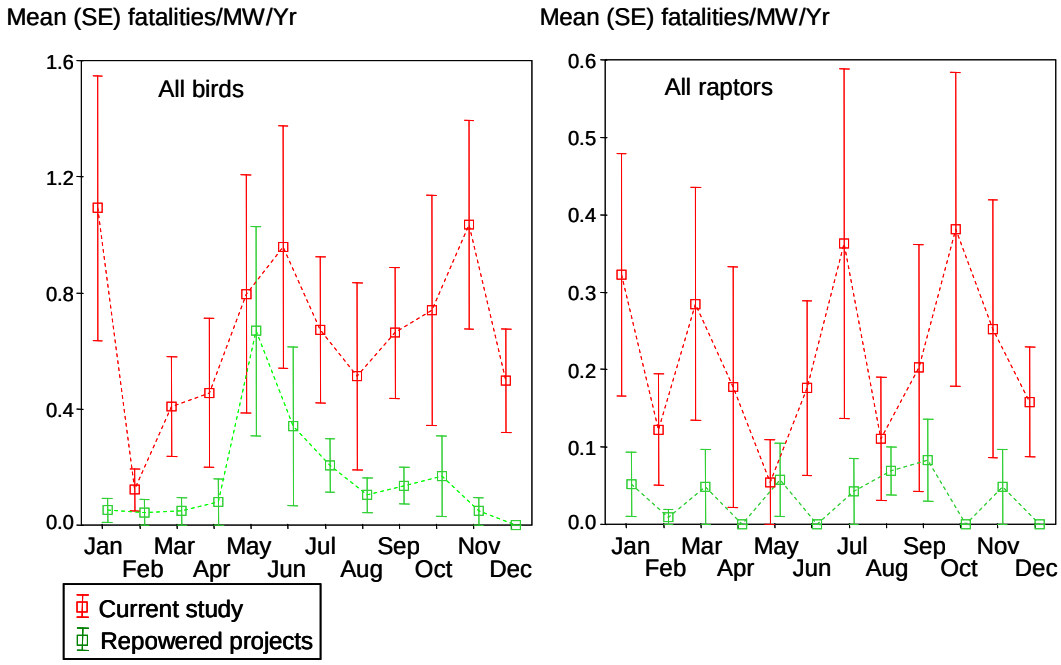



Figure 4. Comparison of monthly fatality rates between Tres Vaqueros turbines over the past 4 years (2005-2009) and both repowering projects at Buena Vista and Diablo Winds.

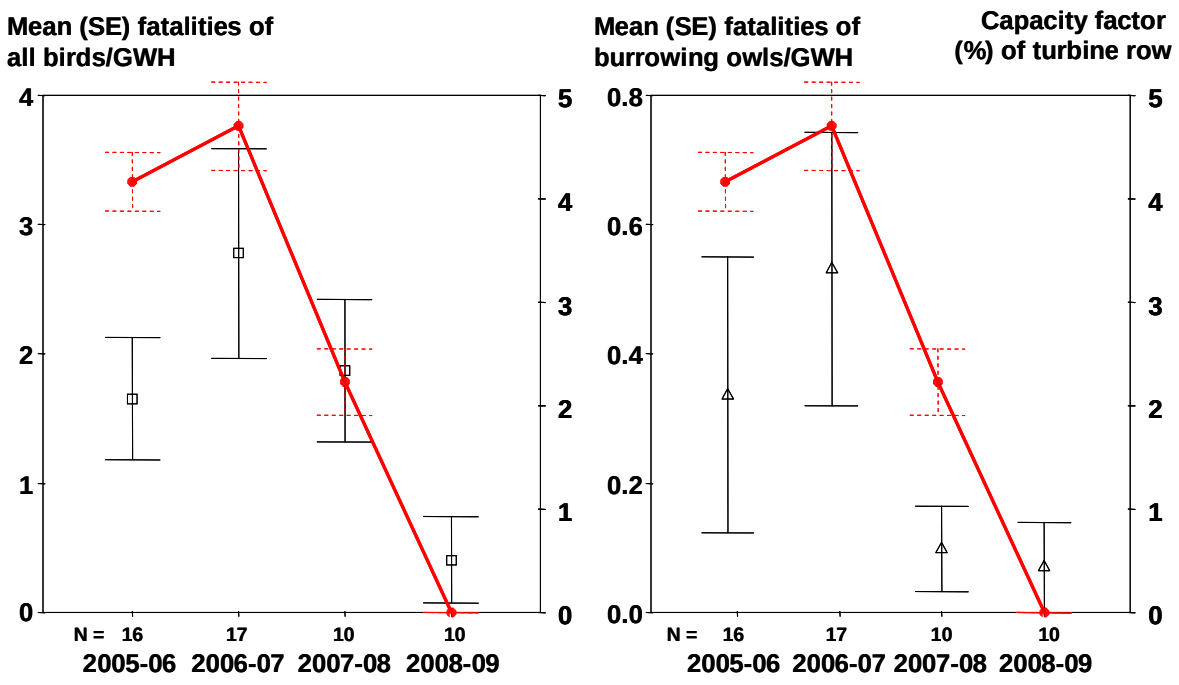



Figure 5. Estimates of mean (and standard error) annual fatalities per GWH at Tres Vaqueros for all birds as a group (left graph, squares) and for burrowing owls (right graph, triangles) compared to mean capacity factor (solid red trend line; SE denoted by dashed bars), where each year spanned November through October.

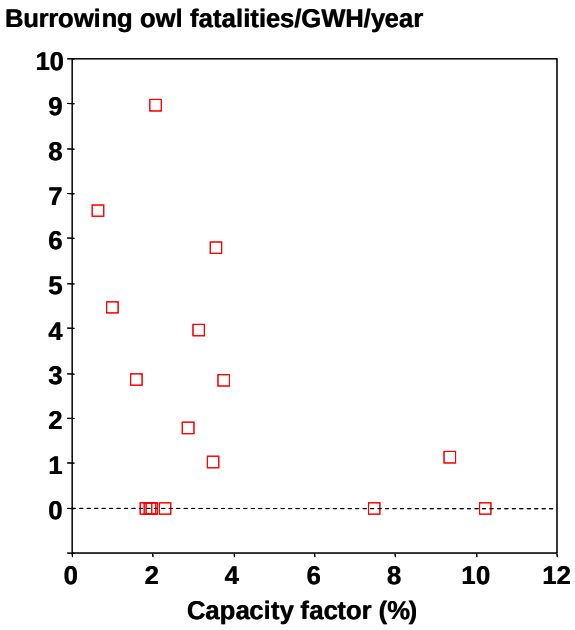



Figure 6. Burrowing owl fatalities per GWH per year declined with increasing capacity factor of the wind turbine row among the Howden turbines at Tres Vaqueros.

Table 2. Estimates of mean (standard error) annual fatalities caused by Howden wind turbines in the Tres Vaqueros wind project, Contra Costa County, California, from 2005 to 2009, calculated as fatalities per MW of rated capacity per year and as fatalities per GWH generated during the study. All estimates were adjusted by scavenger removal trials intended to prevent scavenger swamping (Smallwood et al. 2010). Estimates were from 24.75 MW of rated capacity and 5.19 GWH of average annual energy production at Tres Vaqueros.

| | **Adjusted annual fatalities** | | | | | |
|---|---|---|---|---|---|---|
| | **Across APWRA's old wind turbines** | | **At Tres Vaqueros Wind Farm** | | | |
| | **Per MW** | | **Per MW** | | **Per GWH** | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Red-tailed hawk | 0.786 | 0.106 | 0.404 | 0.196 | 0.460 | 0.221 |
| Ferruginous hawk | 0.008 | 0.009 | 0.093 | 0.090 | 0.128 | 0.095 |
| Golden eagle | 0.169 | 0.132 | 0.029 | 0.022 | 0.067 | 0.046 |
| American kestrel | 0.900 | 0.347 | 0.086 | 0.067 | 0.144 | 0.100 |
| Barn owl | 0.236 | 0.050 | 0.437 | 0.200 | 0.299 | 0.193 |
| Burrowing owl | 1.337 | 0.526 | 1.560 | 0.863 | 2.467 | 0.701 |
| Rock pigeon | 2.001 | 0.387 | 0.386 | 0.244 | 0.357 | 0.200 |
| Cliff swallow | 0.013 | 0.023 | 0.173 | 0.365 | 0.182 | 0.181 |
| European starling | 3.715 | 1.329 | 1.085 | 0.737 | 1.630 | 0.953 |
| Western meadowlark | 2.938 | 1.034 | 1.900 | 0.886 | 3.464 | 1.660 |
| All raptors | 3.660 | 1.168 | 2.608 | 1.437 | 3.632 | 0.866 |
| All birds | 17.483 | 6.169 | 8.743 | 6.204 | 10.971 | 2.857 |
| All bats | 0.166 | 0.135 | 0.000 | 0.000 | 0.000 | 0.000 |

**Projected fatality rates for normally operating Howden turbines (Baseline estimate #4)**

Mean fatality rates declined as an inverse power function with increasing turbine size for all birds as a group, all raptors as a group, and all small endemic birds as a group (Figure 7A, Table 3). Mean fatality rates decreased with increasing turbine size for red-tailed hawk, American kestrel, and burrowing owl (Figure 7B). Golden eagle fatality rates increased with increasing turbine size over two size ranges of turbines, first with turbines ranging in size from 40 KW to 200 KW, and then again with turbines ranging in size from 330 KW to 1 MW (Figure 7B). Due to the sample size available, I also related rock pigeon fatality rates to turbine size, to demonstrate the generality of the pattern between fatality rates and turbine size (Figure 7C). Bat fatality rates increased with increasing turbine size (Figure 7C). Table 4 presents estimates of annual fatalities at Tres Vaqueros derived from the models depicted in Figure 7 and listed in Table 3.

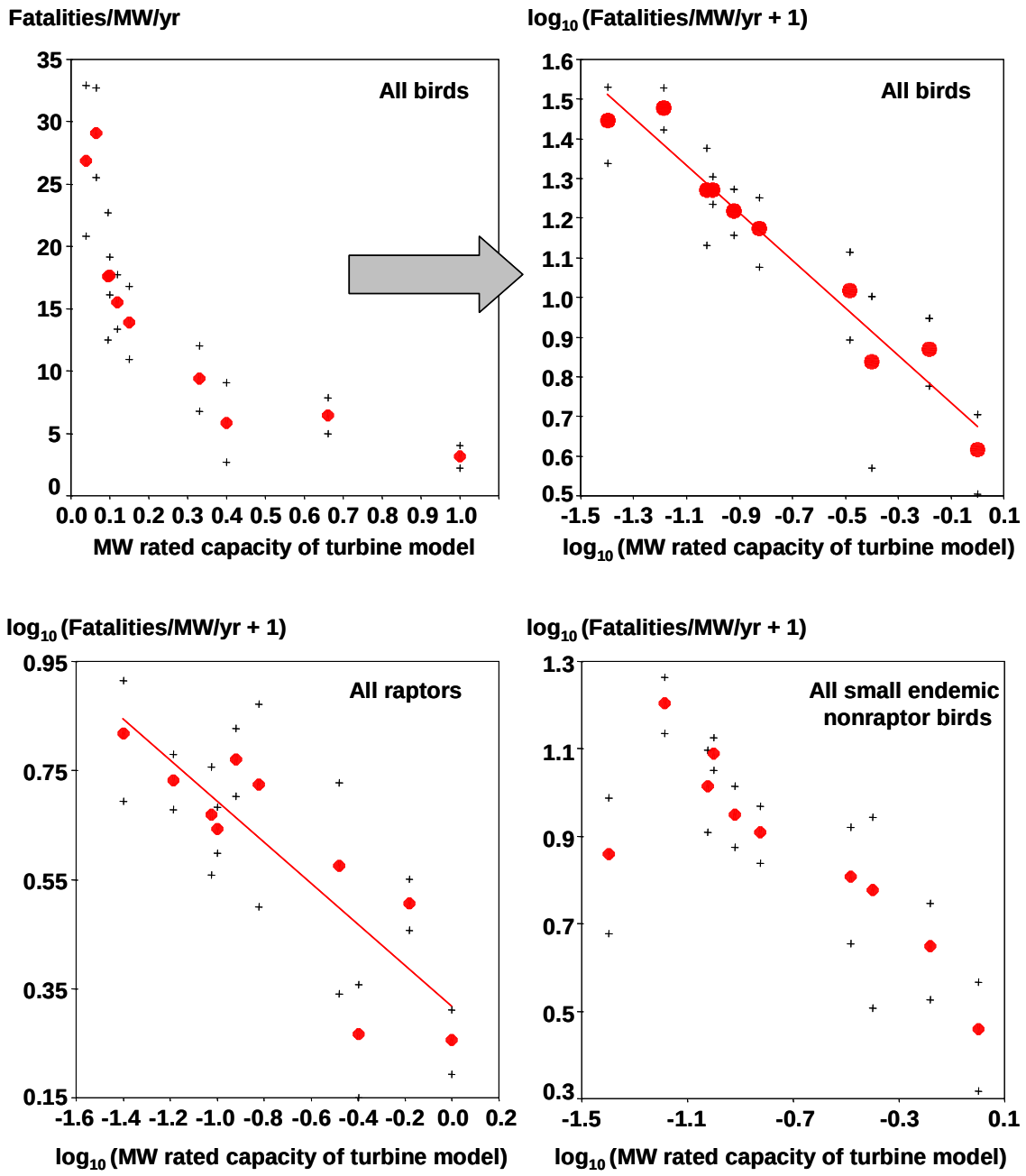



Figure 7A. Mean fatality rates (red circles) and lower and upper bounds of 80% confidence intervals (black crosses) by wind turbine size in the Altamont Pass Wind Resource Area, 2005-2009. Due to small sample size (3 turbine rows), 150-KW turbines were excluded from the comparisons. The arrow between the top graphs shows the transition from untransformed axes to $\log_{10}$-trasnformed axes.

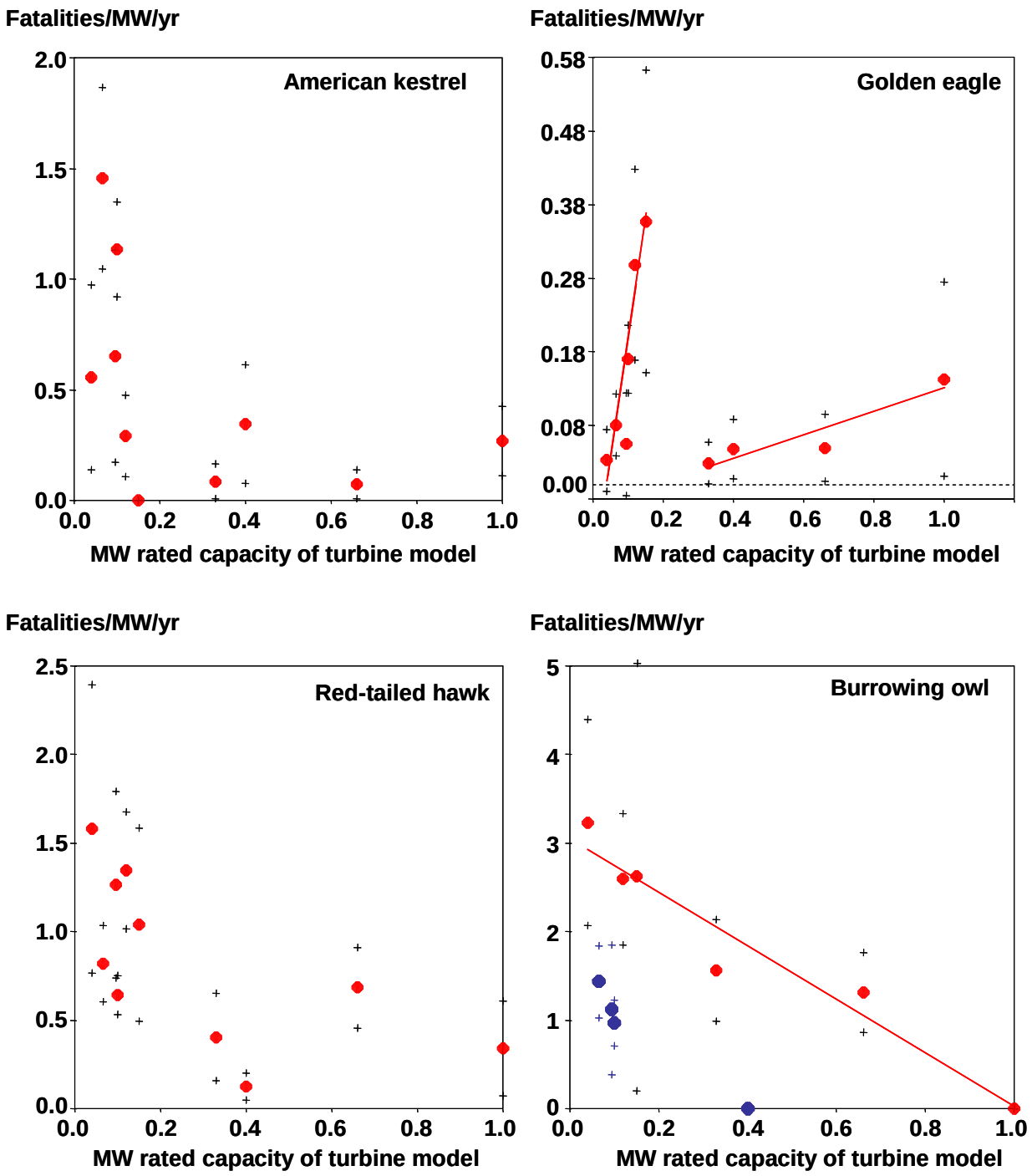



Figure 7B. Mean fatality rates (red circles) and lower and upper bounds of 80% confidence intervals (black crosses) by wind turbine size in the Altamont Pass Wind Resource Area, 2005-2009. Due to small sample size (3 turbine rows), 150-KW turbines were excluded from the comparisons. In the burrowing owl graph, blue circles denote mostly turbines on lattice towers on the west side and extreme east side of the APWRA, and the red circles and regression line represent turbines mostly on tubular towers on the hilly portion of the east side.

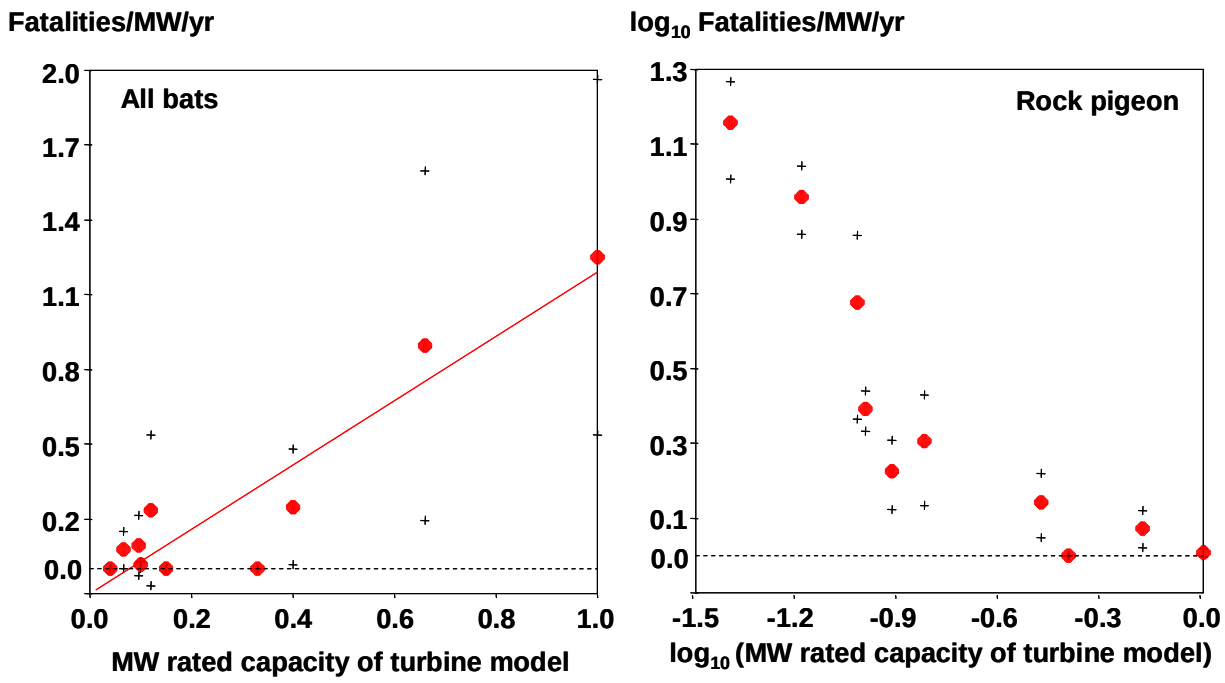



Figure 7C. Mean fatality rates (red circles) and lower and upper bounds of 80% confidence intervals (black crosses) by wind turbine size in the Altamont Pass Wind Resource Area, 2005-2009. Due to small sample size (3 turbine rows), 150-KW turbines were excluded from the comparisons.

Table 3. Least-squares regression models fit to relationships between fatality rates and wind turbine size in the Altamont Pass Wind Resource Area and used to project fatality rates at the 330-KW turbines comprising the Tres Vaqueros Wind Farm before the turbines declined to the low capacity factors observed over the past four years (2005-2009). Fatality rates were presented as means and lower (LB) and upper (UB) bounds of an 80% confidence interval. The LB and UB values were also projected from regression models fit to the data, though the model parameters for these regressions are not shown in the Table.

| | | **Model fit parameters** | | | | | **Fatalities/MW/year** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Model** | **a** | **b** | **$r^2$** | **SE** | **P** | **Mean** | **LB** | **UB** |
| Golden eagle | Y = a + b×MW for MW = 0.04-0.20 | -0.131 | 3.122 | 0.81 | 0.07 | 0.015 | --- | --- | --- |
| Golden eagle | Y = a + b×MW for MW = 0.25-1.00 | -0.034 | 0.166 | 0.90 | 0.02 | 0.014 | 0.021 | 0.002 | 0.039 |
| Red-tailed hawk | Y = a + b/MW | 0.332 | 0.052 | 0.53 | 0.37 | 0.011 | 0.490 | 0.294 | 0.687 |
| American kestrel | Y = a + b/MW | 0.283 | 0.031 | 0.21 | 0.44 | 0.152 | 0.375 | 0.129 | 0.623 |
| Burrowing owl | Y = a + b×MW for mid-east slope | 3.047 | -3.028 | 0.94 | 0.32 | 0.001 | 2.048 | 1.074 | 3.020 |
| All raptors | Y = a + b×ln(MW) | 0.718 | -1.424 | 0.74 | 0.88 | 0.001 | 2.296 | 1.521 | 3.072 |
| All small endemic nonraptors | $Log_{10}(Y + 1) = a + b \times log_{10}(MW)$ excluding 40 KW and 250 KW turbines (outliers) | 0.515 | -0.536 | 0.95 | 0.05 | 0.001 | 4.930 | 3.342 | 6.451 |
| All birds | $Log_{10}(Y + 1) = a + b \times log_{10}(MW)$ excluding 250 KW turbines (outlier) | 0.677 | -0.598 | 0.95 | 0.06 | 0.001 | 8.224 | 5.942 | 10.350 |
| All bats | Y = a + b×MW | -0.125 | 1.303 | 0.85 | 0.17 | 0.001 | 0.305 | 0.080 | 0.531 |

Table 4. Estimated annual fatalities at Tres Vaqueros Wind Farm prior to the decline in capacity factors of the Howden 330 KW wind turbines, based on regressions models fit to relationships between fatality rates and turbine size (see Table 2).

| | Fatalities per year and 80% CI | | |
|---|---|---|---|
| **Species/Group** | **Mean** | **LB** | **UB** |
| Golden eagle | 0.525 | 0.050 | 0.975 |
| Red-tailed hawk | 12.250 | 7.350 | 17.175 |
| American kestrel | 9.375 | 3.225 | 15.575 |
| Burrowing owl | 51.200 | 26.850 | 75.500 |
| All raptors | 57.400 | 38.025 | 76.800 |
| All small endemic nonraptors | 123.250 | 83.550 | 161.275 |
| All birds | 205.600 | 148.550 | 258.750 |
| All bats | 7.625 | 2.000 | 13.275 |

**Patterns of fatalities at Buena Vista**

Mean fatality rates of all birds as a group and all raptors as a group were highest at wind turbines located in notches of ridges at the Buena Vista Wind Energy project (Figure 8A). Mean fatality rates of all bats as a group were highest amongst wind turbines on ridgelines and ridge saddles (Figure 8A). All golden eagle fatalities were at turbines located on ridge saddles and notches, and red-tailed hawk fatality rates were highest on notches, plateaus, and hill peaks (Figure 8B). American kestrel fatalities occurred on ridgelines, ridge crests, and ridge saddles (Figure 8B).

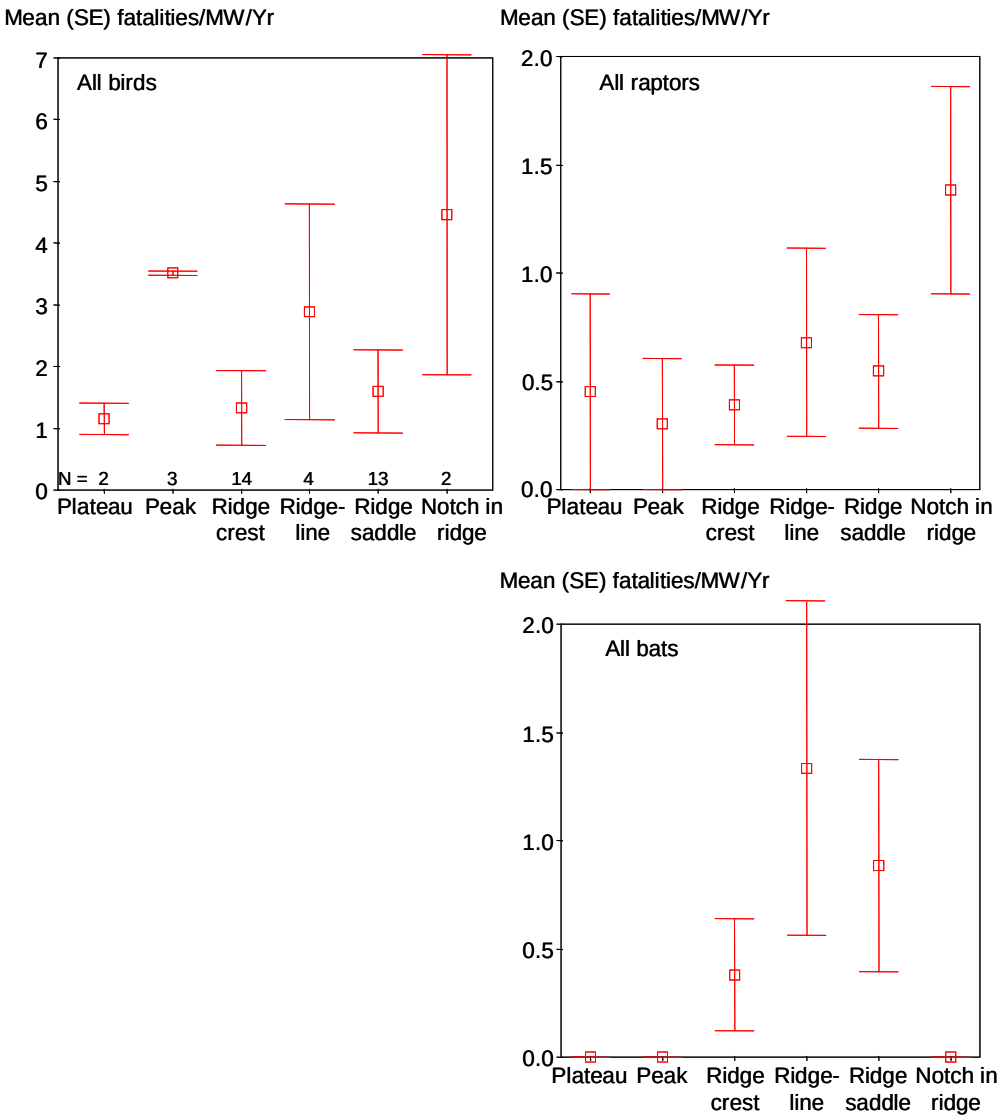



Figure 8A. Adjusted mean fatalities/MW/year among topographic features where 1-MW Mitsubishi wind turbines were sited at the Buena Vista Wind Energy project, where the adjustments were for scavenger removal and searcher detection rates (Smallwood et al. 2010).

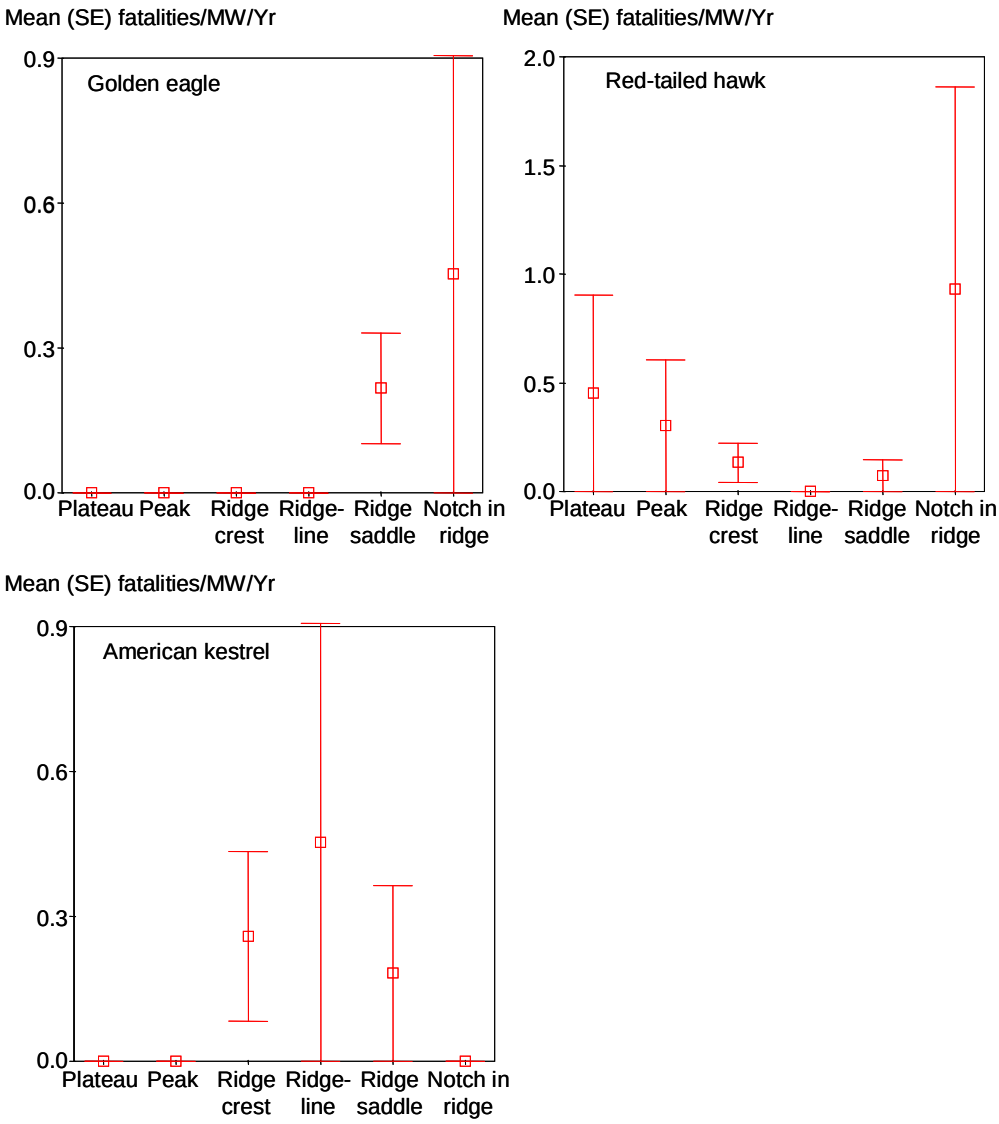



Figure 8B. Adjusted mean fatalities/MW/year among topographic features where 1-MW Mitsubishi wind turbines were sited at the Buena Vista Wind Energy project, where the adjustments were for scavenger removal and searcher detection rates (Smallwood et al. 2010).

## DISCUSSION

I recommend the fatality rates in Tables 3 and 4 should be considered the baseline fatality rates for the Tres Vaqueros repowering project. These rates more robustly represent fatality rates at Tres Vaqueros before the turbines declined in capacity factor. Of course, it will be useful to compare post-repowered fatality rates to the actual fatality rates at Tres Vaqueros during 2005-2009, as well as to the fatality rates at the repowered Buena Vista Wind Energy project and all of the other projects in the APWRA, so all of those rates are reported herein.

Although the estimates of fatality rates presented herein were more comprehensive and better prepared than any previous estimates in the APWRA (see Smallwood and Thelander 2004, 2005, 2008; Smallwood et al. 2007; Smallwood and Karas 2009; Smallwood et al. 2010), I nevertheless regard them as conservative. I still cannot account for the effects of crippling bias (Smallwood 2007, Smallwood et al. 2010), and I suspect that scavenger removal rates have been faster than characterized so far. The estimates are especially conservative for bats, for which I have used small birds as the surrogate species group when calculating scavenger removal and searcher detection rates. Bats are likely removed faster than small birds and are likely more often missed by searchers when they are still present.

Estimating baseline fatality rates expressed as fatalities per GWH proved to be complicated, perhaps due to small sample size and very low energy production amongst the Howden turbines during the fatality monitoring period. For example, 0-values are obtained if no power was produced by a turbine, even if a bird or bat was found dead at that turbine. Also, GWH can vary substantially from turbine to turbine, whereas the range of variation in numbers of fatalities within a four-year period will barely affect the metric unless the fatalities fall to 0. Therefore, dividing a relatively constant value (fatalities) by a highly variable value (GWH) will force an inverse relationship between fatality rates and GWH generated per turbine or per turbine row. This relationship can be misleading, especially if the sample size is relatively small, as was the case at Tres Vaqueros. Using GWH as the basis of a fatality rate metric would make sense if the fatality rates measured this way related positively to power generation, but the reverse pattern was apparent for at least some species (Figure 6). For these reasons, fatalities per GWH may be of limited usefulness in predicting future fatality rates or for establishing baseline rates, at least among wind turbines that achieve very low capacity factors. The capacity factors of modern wind turbines will likely be much greater, however, and their relationship to fatality rates may also differ.

### Opportunities to minimize or reduce fatalities

Because monthly patterns of fatality rates vary among species, no particular seasonal shutdown of turbines will uniformly benefit all species. However, August and September is when wind turbines in the APWRA kill larger numbers of bats, disproportionately more golden eagles, and most raptors. The downside to shutting down wind turbines at this time of the year is that wind power generation is near to its annual peak, so much more wind energy would need to be sacrificed to minimize bird and bat fatalities. Also, compared to previous years of monitoring (i.e., 1998-2002), red-tailed hawk fatalities were reduced during APWRA turbine shutdowns over the past four years, only to increase during the several months following the shutdown,

indicating that red-tailed hawks tend to stay long enough in the APWRA to get killed after periods of shutdown (unpublished data). In other words, the shutdowns may not have resulted in a net reduction of red-tailed hawk fatalities.

Fatality rates related strongly to wind turbine size, which declined with increasing turbine size for most species. The exceptions to this trend were for golden eagle and bats, which increased with turbine size. Thus, repowering may pose equal or greater threats to golden eagles and bats, unless effective mitigation measures can be formulated. For golden eagles, a scientific basis exists to more safely site the wind turbines by avoiding favored golden eagle flight paths. The same is true for bats (see Fig. 7A), though the more hazardous terrain for bats at Buena Vista was generally where turbine siting would minimize impacts to raptors (Figure 7A).

The first nearly two years of fatality monitoring at Buena Vista Wind Energy project revealed ridge saddles and notches in ridges or slopes to be the most hazardous turbine locations for golden eagle and most raptors. On the other hand, bats were more vulnerable to modern turbines on ridgelines and ridge saddles. It appears that no siting guidelines will uniformly benefit all bird and bat species, so tradeoffs will be necessary when making siting decisions at Tres Vaqueros. However, I only crudely categorized topographic features at wind turbine locations in the Buena Vista project, so a more refined study of topography and wind patterns at Buena Vista might reveal different patterns.

**Immediate research needs**

There is an urgent need for additional data and analysis of golden eagle flight patterns and for burrowing owl spatial distribution and fatality patterns. An analysis is underway, as Lee Neher and I are working under contract to EBRPD to relate golden eagle flight data and burrowing owl burrow location data to slope and wind data obtained in a portion of the Tres Vaqueros project area. Additional data are being processed APWRA-wide, but no results are anticipated from that effort within the next year. Flight behavior data can be more informative than fatality data (Smallwood et al. 2009c), especially when replacing old-generation turbines with much larger modern turbines. A result of this type of research should be species-specific collision hazard maps for the purpose of guiding wind turbine siting, similar to the maps produced for burrowing owl (Smallwood and Neher 2004, 2009; Smallwood et al. 2009a).

There is a need to direct research toward bat fatalities, as well as toward local bat ecology so that wind turbine-caused impacts can be assessed. Furthermore, research needs to be directed toward on-site scavenger removal and searcher detection errors. Scavenger removal and searcher detection trials should be sufficient to detect seasonal differences, since the last study performed at Tres Vaqueros hinted at slow removal rates during winter and fast removal rates during summer (Smallwood et al. 2009b, Smallwood et al. 2010).

Additional research should be directed toward avoidance effects, which can result in habitat loss to some species. The most effective way to perform this research would be to obtain data on behavior and distribution patterns prior to the installation of the proposed new wind turbines. Standardized observation data should be obtained as early as possible before project construction is underway, along with mapping of prey distributions of raptor species, so that pre-construction

use patterns can be characterized robustly and later compared to post-construction use patterns. The opportunity to learn from this type of research is especially great in the case of Tres Vaqueros because the rest of the APWRA will likely soon begin repowering. What is learned at Tres Vaqueros can benefit the rest of the APWRA as well as wind power development worldwide.

Finally, there is need for formulating offsite compensatory mitigation measures for the adverse project impacts that cannot be avoided. Fatality rates have been so high prior to repowering that there has been little hope of finding a nexus between fatalities and benefits gained through compensatory mitigation. Repowering should lessen collision-caused impacts of most bird species, and as a result the remaining collision-caused impacts might be more reasonably compensated. As repowering progresses in the APWRA, there is urgent need to establish the biological basis for compensatory mitigation measures.

**Acknowledgments**

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Appendix 1. Mean and upper and lower bounds of 80% confidence interval (LB, UB) of estimated fatalities per year of birds and bats in the Altamont Pass Wind Resource Area and in the Tres Vaqueros project in particular, adjusted for searcher detection and scavenger removal rates based on Smallwood (2007) and Smallwood et al. (2010).

| | Fatalities/year and 80% CI, 2005-2009 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted by Smallwood (2007) | | | | | | Adjusted by Smallwood et al. (2010) | | | | | |
| | APWRA-wide | | | Tres Vaqueros | | | APWRA-wide | | | Tres Vaqueros | | |
| **Species** | **Mean** | **LB** | **UB** | **Mean** | **LB** | **UB** | **Mean** | **LB** | **UB** | **Mean** | **LB** | **UB** |
| Mallard | 37.9 | 11.2 | 64.6 | 0.0 | 0.0 | 0.0 | 55.3 | 19.0 | 91.6 | 0.0 | 0.0 | 0.0 |
| Ring-necked duck | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Puddle duck | 0.9 | -0.3 | 2.1 | 0.0 | 0.0 | 0.0 | 1.3 | -0.4 | 3.1 | 0.0 | 0.0 | 0.0 |
| Duck spp. | 4.8 | 0.6 | 9.0 | 0.0 | 0.0 | 0.0 | 7.0 | 1.1 | 12.8 | 0.0 | 0.0 | 0.0 |
| Wild turkey | 0.6 | -0.2 | 1.5 | 0.0 | 0.0 | 0.0 | 0.9 | -0.3 | 2.1 | 0.0 | 0.0 | 0.0 |
| Pied-billed grebe | 3.4 | -1.9 | 8.6 | 0.0 | 0.0 | 0.0 | 3.8 | -1.5 | 9.1 | 0.0 | 0.0 | 0.0 |
| Brown pelican | 5.7 | 1.6 | 9.9 | 0.0 | 0.0 | 0.0 | 4.7 | -1.3 | 10.7 | 0.0 | 0.0 | 0.0 |
| Double-crested cormorant | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Great blue heron | 0.5 | -0.2 | 1.3 | 0.0 | 0.0 | 0.0 | 0.8 | -0.2 | 1.8 | 0.0 | 0.0 | 0.0 |
| Great egret | 3.2 | -1.0 | 7.4 | 0.0 | 0.0 | 0.0 | 4.7 | -1.3 | 10.7 | 0.0 | 0.0 | 0.0 |
| Cattle egret | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Black-crowned night-heron | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turkey vulture | 8.9 | 2.8 | 14.9 | 0.0 | 0.0 | 0.0 | 15.2 | 5.0 | 25.4 | 0.0 | 0.0 | 0.0 |
| White-tailed kite | 0.3 | -0.1 | 0.6 | 0.0 | 0.0 | 0.0 | 0.5 | -0.1 | 1.0 | 0.0 | 0.0 | 0.0 |
| Northern harrier | 5.0 | 2.0 | 8.1 | 0.0 | 0.0 | 0.0 | 8.6 | 3.4 | 13.7 | 0.0 | 0.0 | 0.0 |
| Red-shouldered hawk | 0.3 | -0.1 | 0.6 | 0.0 | 0.0 | 0.0 | 0.5 | -0.1 | 1.1 | 0.0 | 0.0 | 0.0 |
| Swainson's hawk | 0.4 | -0.1 | 0.9 | 0.0 | 0.0 | 0.0 | 0.7 | -0.2 | 1.6 | 0.0 | 0.0 | 0.0 |
| Red-tailed hawk | 253.4 | 195.9 | 310.9 | 6.1 | 2.2 | 9.9 | 433.4 | 347.4 | 519.4 | 10.4 | 3.9 | 16.9 |
| Ferruginous hawk | 2.8 | -0.6 | 6.1 | 1.4 | -0.3 | 3.2 | 4.7 | -1.0 | 10.3 | 2.4 | -0.6 | 5.4 |
| Buteo spp. | 16.8 | 9.5 | 24.1 | 0.0 | 0.0 | 0.0 | 28.7 | 16.6 | 40.7 | 0.0 | 0.0 | 0.0 |
| Hawk spp. | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.2 | -0.1 | 0.5 | 0.0 | 0.0 | 0.0 |
| Golden eagle | 55.0 | 37.8 | 72.2 | 0.4 | 0.0 | 0.9 | 94.0 | 66.5 | 121.5 | 0.7 | 0.0 | 1.5 |
| American kestrel | 475.3 | 315.8 | 634.9 | 2.2 | 0.1 | 4.3 | 477.2 | 239.0 | 715.3 | 2.2 | 0.0 | 4.4 |
| Peregrine falcon | 1.2 | -0.4 | 2.8 | 0.0 | 0.0 | 0.0 | 2.1 | -0.6 | 4.8 | 0.0 | 0.0 | 0.0 |
| Prairie falcon | 1.3 | 0.3 | 2.2 | 0.0 | 0.0 | 0.0 | 2.2 | 0.5 | 3.8 | 0.0 | 0.0 | 0.0 |

| Species | Fatalities/year and 80% CI, 2005-2009 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted by Smallwood (2007) | | | | | | Adjusted by Smallwood et al. (2010) | | | | | |
| | APWRA-wide | | | Tres Vaqueros | | | APWRA-wide | | | Tres Vaqueros | | |
| | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB |
| Falcon spp. | 7.9 | -3.6 | 19.3 | 0.0 | 0.0 | 0.0 | 8.3 | -3.4 | 20.0 | 0.0 | 0.0 | 0.0 |
| Raptor | 9.0 | 5.3 | 12.8 | 0.0 | 0.0 | 0.0 | 15.4 | 9.2 | 21.6 | 0.0 | 0.0 | 0.0 |
| Large raptor | 1.0 | 0.1 | 1.9 | 0.0 | 0.0 | 0.0 | 1.6 | 0.1 | 3.2 | 0.0 | 0.0 | 0.0 |
| Small raptor | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 |
| American coot | 0.4 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | -0.1 | 0.8 | 0.0 | 0.0 | 0.0 |
| Sandhill crane | 0.4 | -0.1 | 0.9 | 0.0 | 0.0 | 0.0 | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 |
| Killdeer | 9.7 | -0.3 | 19.7 | 0.0 | 0.0 | 0.0 | 10.6 | 1.3 | 20.0 | 0.0 | 0.0 | 0.0 |
| Black-necked stilt | 5.5 | -1.6 | 12.7 | 0.0 | 0.0 | 0.0 | 8.1 | -2.3 | 18.5 | 0.0 | 0.0 | 0.0 |
| American avocet | 2.9 | 1.4 | 4.5 | 0.0 | 0.0 | 0.0 | 2.4 | 0.2 | 4.6 | 0.0 | 0.0 | 0.0 |
| Lesser yellowlegs | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bonaparte's gull | 0.4 | -0.1 | 0.9 | 0.0 | 0.0 | 0.0 | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 |
| Ring-billed gull | 0.8 | -0.2 | 1.7 | 0.0 | 0.0 | 0.0 | 1.1 | -0.3 | 2.5 | 0.0 | 0.0 | 0.0 |
| Western gull | 1.2 | -0.4 | 2.7 | 0.0 | 0.0 | 0.0 | 1.7 | -0.5 | 3.9 | 0.0 | 0.0 | 0.0 |
| California gull | 44.2 | 10.9 | 77.4 | 0.0 | 0.0 | 0.0 | 64.2 | 18.6 | 109.9 | 0.0 | 0.0 | 0.0 |
| Herring gull | 1.2 | -0.4 | 2.7 | 0.0 | 0.0 | 0.0 | 1.7 | -0.5 | 3.9 | 0.0 | 0.0 | 0.0 |
| Gull spp. | 116.1 | 62.5 | 169.8 | 2.9 | 0.0 | 5.8 | 169.5 | 106.3 | 232.8 | 4.2 | 0.1 | 8.3 |
| Rock pigeon | 475.6 | 359.3 | 591.8 | 4.8 | 1.1 | 8.5 | 1039.7 | 779.0 | 1300.3 | 9.9 | 1.9 | 18.0 |
| Mourning dove | 186.9 | 41.6 | 332.3 | 1.5 | -0.7 | 3.7 | 206.4 | 92.7 | 320.0 | 1.6 | -0.6 | 3.9 |
| Dove spp. | 87.1 | 14.8 | 159.4 | 3.3 | -0.7 | 7.2 | 96.4 | 36.8 | 156.1 | 3.6 | -0.3 | 7.5 |
| Cockatiel | 1.3 | -0.6 | 3.1 | 0.0 | 0.0 | 0.0 | 1.4 | -0.5 | 3.3 | 0.0 | 0.0 | 0.0 |
| Barn owl | 72.6 | 50.0 | 95.2 | 6.6 | 2.7 | 10.5 | 124.1 | 88.0 | 160.2 | 11.2 | 4.7 | 17.8 |
| Great-horned owl | 19.0 | 11.1 | 26.9 | 0.0 | 0.0 | 0.0 | 32.5 | 19.5 | 45.6 | 0.0 | 0.0 | 0.0 |
| Burrowing owl | 713.9 | 467.4 | 960.3 | 35.1 | 12.5 | 57.7 | 718.3 | 354.0 | 1082.6 | 40.2 | 11.7 | 68.6 |
| Common poorwill | 1.0 | -0.4 | 2.4 | 0.0 | 0.0 | 0.0 | 1.1 | -0.4 | 2.5 | 0.0 | 0.0 | 0.0 |
| White-throated swift | 7.5 | -1.9 | 16.9 | 0.0 | 0.0 | 0.0 | 8.3 | -1.0 | 17.6 | 0.0 | 0.0 | 0.0 |
| Northern flicker | 18.2 | -1.8 | 38.2 | 0.0 | 0.0 | 0.0 | 19.9 | 0.8 | 39.1 | 0.0 | 0.0 | 0.0 |
| Hammond's flycatcher | 1.8 | -0.9 | 4.6 | 0.0 | 0.0 | 0.0 | 2.1 | -0.8 | 4.9 | 0.0 | 0.0 | 0.0 |
| Pacific-slope flycatcher | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Say's phoebe | 8.5 | -4.1 | 21.1 | 0.0 | 0.0 | 0.0 | 9.4 | -3.4 | 22.2 | 0.0 | 0.0 | 0.0 |

| Species | Fatalities/year and 80% CI, 2005-2009 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted by Smallwood (2007) | | | | | | Adjusted by Smallwood et al. (2010) | | | | | |
| | APWRA-wide | | | Tres Vaqueros | | | APWRA-wide | | | Tres Vaqueros | | |
| | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB |
| Western kingbird | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Flycatcher spp. | 10.1 | -2.7 | 22.8 | 0.0 | 0.0 | 0.0 | 11.1 | -1.6 | 23.7 | 0.0 | 0.0 | 0.0 |
| Loggerhead shrike | 94.5 | 15.2 | 173.7 | 0.0 | 0.0 | 0.0 | 104.5 | 38.6 | 170.4 | 0.0 | 0.0 | 0.0 |
| Warbling vireo | 6.7 | -3.1 | 16.5 | 0.0 | 0.0 | 0.0 | 7.4 | -2.6 | 17.4 | 0.0 | 0.0 | 0.0 |
| Vireo spp. | 1.2 | -0.5 | 2.9 | 0.0 | 0.0 | 0.0 | 1.4 | -0.6 | 3.4 | 0.0 | 0.0 | 0.0 |
| Western scrub-jay | 4.1 | -2.2 | 10.5 | 3.7 | -2.0 | 9.4 | 4.7 | -1.8 | 11.1 | 4.2 | -1.6 | 10.0 |
| American crow | 38.9 | 21.4 | 56.3 | 0.0 | 0.0 | 0.0 | 34.9 | 11.1 | 58.7 | 0.0 | 0.0 | 0.0 |
| Common raven | 95.4 | 53.1 | 137.7 | 2.5 | -0.2 | 5.3 | 139.4 | 91.0 | 187.8 | 3.7 | -0.2 | 7.6 |
| Horned lark | 225.1 | 44.5 | 405.7 | 0.0 | 0.0 | 0.0 | 251.0 | 97.4 | 404.7 | 0.0 | 0.0 | 0.0 |
| Corvid spp. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tree swallow | 0.5 | -0.2 | 1.1 | 0.0 | 0.0 | 0.0 | 0.5 | -0.2 | 1.2 | 0.0 | 0.0 | 0.0 |
| Violet-green swallow | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cliff swallow | 8.8 | -8.0 | 25.6 | 5.2 | -6.6 | 17.1 | 8.2 | -8.6 | 25.1 | 4.5 | -7.6 | 16.5 |
| Barn swallow | 2.3 | -1.0 | 5.7 | 0.0 | 0.0 | 0.0 | 2.6 | -0.9 | 6.0 | 0.0 | 0.0 | 0.0 |
| Swallow spp. | 2.5 | -1.1 | 6.1 | 0.0 | 0.0 | 0.0 | 2.7 | -0.9 | 6.4 | 0.0 | 0.0 | 0.0 |
| Rock wren | 6.1 | -2.7 | 14.8 | 0.0 | 0.0 | 0.0 | 6.6 | -2.2 | 15.5 | 0.0 | 0.0 | 0.0 |
| House wren | 5.2 | -0.8 | 11.1 | 0.0 | 0.0 | 0.0 | 5.7 | -0.1 | 11.4 | 0.0 | 0.0 | 0.0 |
| Western bluebird | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mountain bluebird | 19.6 | 1.5 | 37.7 | 0.0 | 0.0 | 0.0 | 21.6 | 5.5 | 37.7 | 0.0 | 0.0 | 0.0 |
| Bluebird spp. | 26.1 | -3.4 | 55.6 | 0.0 | 0.0 | 0.0 | 29.0 | 0.9 | 57.1 | 0.0 | 0.0 | 0.0 |
| Swainson's thrush | 3.2 | -1.6 | 8.0 | 0.0 | 0.0 | 0.0 | 3.6 | -1.3 | 8.4 | 0.0 | 0.0 | 0.0 |
| Northern mockingbird | 9.1 | -1.6 | 19.7 | 0.0 | 0.0 | 0.0 | 9.9 | -0.5 | 20.3 | 0.0 | 0.0 | 0.0 |
| European starling | 1742.5 | 487.5 | 2997.5 | 25.7 | -0.8 | 52.3 | 1933.9 | 1040.4 | 2827.4 | 27.9 | 3.6 | 52.2 |
| American pipit | 11.1 | -3.1 | 25.3 | 0.0 | 0.0 | 0.0 | 12.4 | -1.6 | 26.3 | 0.0 | 0.0 | 0.0 |
| Yellow warbler | 2.7 | -1.1 | 6.6 | 0.0 | 0.0 | 0.0 | 3.2 | -1.4 | 7.8 | 0.0 | 0.0 | 0.0 |
| Black-throated gray warbler | 1.2 | -0.5 | 2.9 | 0.0 | 0.0 | 0.0 | 1.4 | -0.6 | 3.4 | 0.0 | 0.0 | 0.0 |
| Wilson's warbler | 5.6 | -2.6 | 13.8 | 0.0 | 0.0 | 0.0 | 6.2 | -2.2 | 14.5 | 0.0 | 0.0 | 0.0 |
| Western tanager | 18.3 | -5.3 | 41.9 | 0.0 | 0.0 | 0.0 | 20.7 | -5.3 | 46.6 | 0.0 | 0.0 | 0.0 |
| Spotted towhee | 0.7 | -0.4 | 1.7 | 0.0 | 0.0 | 0.0 | 0.8 | -0.3 | 1.8 | 0.0 | 0.0 | 0.0 |

| Species | Fatalities/year and 80% CI, 2005-2009 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adjusted by Smallwood (2007) | | | | | | Adjusted by Smallwood et al. (2010) | | | | | |
| | APWRA-wide | | | Tres Vaqueros | | | APWRA-wide | | | Tres Vaqueros | | |
| | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB | Mean | LB | UB |
| Savannah sparrow | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 | 0.6 | -0.2 | 1.4 | 0.0 | 0.0 | 0.0 |
| Fox sparrow | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lincoln sparrow | 0.7 | -0.3 | 1.8 | 0.0 | 0.0 | 0.0 | 0.8 | -0.3 | 1.8 | 0.0 | 0.0 | 0.0 |
| Golden-crowned sparrow | 3.3 | -1.3 | 8.0 | 0.0 | 0.0 | 0.0 | 3.8 | -1.5 | 9.2 | 0.0 | 0.0 | 0.0 |
| Sparrow spp. | 3.5 | -1.5 | 8.5 | 0.0 | 0.0 | 0.0 | 4.0 | -1.7 | 9.8 | 0.0 | 0.0 | 0.0 |
| Red-winged blackbird | 60.8 | 7.2 | 114.5 | 5.0 | -2.2 | 12.2 | 66.7 | 20.4 | 113.1 | 5.5 | -1.8 | 12.8 |
| Tricolored blackbird | 3.4 | -1.5 | 8.2 | 0.0 | 0.0 | 0.0 | 3.7 | -1.2 | 8.6 | 0.0 | 0.0 | 0.0 |
| Western meadowlark | 1412.1 | 410.5 | 2413.6 | 45.3 | 8.9 | 81.6 | 1559.0 | 847.0 | 2271.0 | 48.9 | 19.7 | 78.1 |
| Brewer's blackbird | 51.9 | 3.1 | 100.7 | 0.0 | 0.0 | 0.0 | 57.4 | 12.2 | 102.5 | 0.0 | 0.0 | 0.0 |
| Brown-headed cowbird | 3.0 | -1.3 | 7.3 | 0.0 | 0.0 | 0.0 | 3.3 | -1.1 | 7.6 | 0.0 | 0.0 | 0.0 |
| Blackbird spp. | 148.7 | 26.3 | 271.2 | 6.1 | -2.4 | 14.6 | 164.7 | 65.0 | 264.4 | 6.9 | -1.6 | 15.4 |
| House finch | 1.1 | -0.6 | 2.9 | 0.0 | 0.0 | 0.0 | 1.3 | -0.5 | 3.0 | 0.0 | 0.0 | 0.0 |
| Lesser goldfinch | 1.2 | -0.5 | 2.9 | 0.0 | 0.0 | 0.0 | 1.4 | -0.6 | 3.4 | 0.0 | 0.0 | 0.0 |
| House sparrow | 0.3 | -0.2 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | -0.1 | 0.9 | 0.0 | 0.0 | 0.0 |
| Unknown bird | 938.9 | 296.2 | 1581.6 | 29.7 | -11.6 | 70.9 | 1115.4 | 591.0 | 1639.7 | 37.0 | -11.0 | 85.0 |
| Mexican free-tailed bat | 18.1 | -2.5 | 38.7 | 0.0 | 0.0 | 0.0 | 20.9 | -1.0 | 42.8 | 0.0 | 0.0 | 0.0 |
| Hoary bat | 41.4 | 0.9 | 81.9 | 0.0 | 0.0 | 0.0 | 48.8 | 0.6 | 97.0 | 0.0 | 0.0 | 0.0 |
| Western red bat | 21.2 | -5.7 | 48.1 | 0.0 | 0.0 | 0.0 | 23.2 | -3.4 | 49.9 | 0.0 | 0.0 | 0.0 |
| Unknown bat | 3.1 | -0.6 | 6.8 | 0.0 | 0.0 | 0.0 | 3.5 | -0.1 | 7.1 | 0.0 | 0.0 | 0.0 |
| All bats | 83.9 | -7.8 | 175.6 | 0.0 | 0.0 | 0.0 | 96.5 | -3.9 | 196.8 | 0.0 | 0.0 | 0.0 |
| All native small birds | 3201.1 | 683.7 | 5718.5 | 88.1 | -14.3 | 190.6 | 3538.7 | 1562.2 | 5515.2 | 95.1 | -1.0 | 191.2 |
| All native medium/large birds | 577.0 | 275.0 | 879.0 | 17.1 | -3.0 | 37.2 | 814.8 | 440.6 | 1189.0 | 25.0 | -3.8 | 53.8 |
| All native nonraptors | 3778.1 | 958.7 | 6597.6 | 105.3 | -17.3 | 227.8 | 4353.5 | 2002.8 | 6704.2 | 120.1 | -4.8 | 245.0 |
| All exotic birds | 2220.3 | 845.9 | 3594.7 | 30.6 | 0.3 | 60.8 | 2976.3 | 1818.5 | 4134.1 | 37.9 | 5.5 | 70.2 |
| All target raptors | 1497.6 | 1016.9 | 1978.3 | 43.9 | 14.9 | 72.8 | 1722.9 | 1006.9 | 2438.8 | 53.5 | 15.6 | 91.4 |
| All raptors | 1644.6 | 1092.9 | 2196.4 | 51.9 | 17.3 | 86.5 | 1968.6 | 1143.5 | 2793.7 | 67.1 | 19.7 | 114.6 |
| All birds | 7643.1 | 2897.5 | 12388.7 | 187.8 | 0.3 | 375.2 | 9298.4 | 4964.8 | 13632.0 | 225.1 | 20.3 | 429.8 |

Appendix 2. Mean (SE) fatality rates of birds and bats in the Altamont Pass Wind Resource Area, and in the Tres Vaqueros project in particular, adjusted for searcher detection and scavenger removal errors based on Smallwood (2007).

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood (2007) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Mallard | 0.164 | 0.116 | 0.069 | 0.034 | 0.000 | 0.000 | 0.041 | 0.043 | 0.000 | 0.000 | 0.000 | 0.000 |
| Ring-necked duck | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Puddle duck | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Duck spp. | 0.000 | 0.000 | 0.011 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Wild turkey | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pied-billed grebe | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.164 | 0.200 | 0.000 | 0.000 | 0.000 | 0.000 |
| Brown pelican | 0.127 | 0.072 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Double-crested cormorant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Great blue heron | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.021 | 0.000 | 0.000 | 0.000 | 0.000 |
| Great egret | 0.071 | 0.072 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Cattle egret | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Black-crowned night-heron | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Turkey vulture | 0.001 | 0.001 | 0.019 | 0.009 | 0.004 | 0.004 | 0.029 | 0.030 | 0.000 | 0.000 | 0.000 | 0.000 |
| White-tailed kite | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern harrier | 0.009 | 0.007 | 0.011 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Red-shouldered hawk | 0.003 | 0.003 | 0.000 | 0.000 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swainson's hawk | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Red-tailed hawk | 0.547 | 0.114 | 0.477 | 0.068 | 0.168 | 0.076 | 0.400 | 0.111 | 0.200 | 0.126 | 0.237 | 0.116 |
| Ferruginous hawk | 0.011 | 0.011 | 0.001 | 0.001 | 0.035 | 0.033 | 0.010 | 0.010 | 0.000 | 0.000 | 0.056 | 0.053 |
| Buteo spp. | 0.016 | 0.014 | 0.037 | 0.011 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hawk spp. | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden eagle | 0.043 | 0.017 | 0.112 | 0.022 | 0.018 | 0.009 | 0.029 | 0.021 | 0.084 | 0.063 | 0.017 | 0.013 |
| American kestrel | 1.340 | 0.380 | 0.913 | 0.224 | 0.249 | 0.119 | 0.069 | 0.055 | 0.228 | 0.112 | 0.087 | 0.064 |
| Peregrine falcon | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood (2007) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Prairie falcon | 0.000 | 0.000 | 0.002 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 | 0.006 | 0.000 | 0.000 |
| Falcon spp. | 0.000 | 0.000 | 0.018 | 0.021 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Raptor | 0.000 | 0.000 | 0.021 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Large raptor | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Small raptor | 0.014 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| American coot | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.021 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sandhill crane | 0.009 | 0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Killdeer | 0.012 | 0.014 | 0.021 | 0.017 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Black-necked stilt | 0.000 | 0.000 | 0.013 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| American avocet | 0.000 | 0.000 | 0.007 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lesser yellowlegs | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Bonaparte's gull | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Ring-billed gull | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western gull | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| California gull | 0.004 | 0.005 | 0.085 | 0.042 | 0.000 | 0.000 | 0.021 | 0.022 | 0.180 | 0.185 | 0.000 | 0.000 |
| Herring gull | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Gull spp. | 0.028 | 0.021 | 0.253 | 0.086 | 0.071 | 0.056 | 0.130 | 0.065 | 0.000 | 0.000 | 0.113 | 0.088 |
| Rock pigeon | 4.067 | 0.749 | 0.661 | 0.121 | 0.118 | 0.072 | 0.084 | 0.051 | 0.008 | 0.008 | 0.187 | 0.111 |
| Mourning dove | 0.752 | 0.435 | 0.327 | 0.191 | 0.185 | 0.182 | 0.178 | 0.147 | 0.000 | 0.000 | 0.059 | 0.066 |
| Dove spp. | 0.131 | 0.088 | 0.180 | 0.114 | 0.080 | 0.076 | 0.000 | 0.000 | 0.000 | 0.000 | 0.127 | 0.120 |
| Cockatiel | 0.028 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Barn owl | 0.227 | 0.065 | 0.123 | 0.023 | 0.174 | 0.078 | 0.014 | 0.015 | 0.026 | 0.026 | 0.256 | 0.119 |
| Great-horned owl | 0.047 | 0.021 | 0.036 | 0.010 | 0.033 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Burrowing owl | 1.734 | 0.455 | 1.322 | 0.328 | 0.891 | 0.465 | 1.247 | 0.457 | 0.000 | 0.000 | 1.364 | 0.685 |
| Common poorwill | 0.022 | 0.024 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| White-throated swift | 0.050 | 0.056 | 0.012 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern flicker | 0.018 | 0.021 | 0.040 | 0.034 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood (2007) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Hammond's flycatcher | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.055 | 0.067 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pacific-slope flycatcher | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Say's phoebe | 0.000 | 0.000 | 0.017 | 0.020 | 0.000 | 0.000 | 0.055 | 0.067 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western kingbird | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Flycatcher spp. | 0.000 | 0.000 | 0.023 | 0.023 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Loggerhead shrike | 0.199 | 0.136 | 0.189 | 0.120 | 0.037 | 0.042 | 0.109 | 0.101 | 0.000 | 0.000 | 0.000 | 0.000 |
| Warbling vireo | 0.000 | 0.000 | 0.000 | 0.000 | 0.147 | 0.168 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vireo spp. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.031 | 0.035 | 0.000 | 0.000 |
| Western scrub-jay | 0.000 | 0.000 | 0.000 | 0.000 | 0.091 | 0.109 | 0.000 | 0.000 | 0.000 | 0.000 | 0.145 | 0.173 |
| American crow | 0.074 | 0.027 | 0.072 | 0.018 | 0.000 | 0.000 | 0.000 | 0.000 | 0.120 | 0.123 | 0.000 | 0.000 |
| Common raven | 0.224 | 0.088 | 0.186 | 0.058 | 0.062 | 0.053 | 0.123 | 0.090 | 0.000 | 0.000 | 0.099 | 0.083 |
| Horned lark | 0.618 | 0.371 | 0.396 | 0.242 | 0.000 | 0.000 | 0.109 | 0.101 | 0.642 | 0.472 | 0.000 | 0.000 |
| Corvid spp. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Tree swallow | 0.010 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Violet-green swallow | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Cliff swallow | 0.041 | 0.032 | 0.000 | 0.000 | 0.128 | 0.226 | 0.054 | 0.066 | 0.000 | 0.000 | 0.204 | 0.359 |
| Barn swallow | 0.036 | 0.040 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swallow spp. | 0.000 | 0.000 | 0.006 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Rock wren | 0.135 | 0.151 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| House wren | 0.000 | 0.000 | 0.012 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western bluebird | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mountain bluebird | 0.018 | 0.020 | 0.044 | 0.031 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Bluebird spp. | 0.101 | 0.092 | 0.042 | 0.035 | 0.074 | 0.085 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swainson's thrush | 0.000 | 0.000 | 0.006 | 0.007 | 0.000 | 0.000 | 0.033 | 0.039 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern mockingbird | 0.000 | 0.000 | 0.021 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| European starling | 3.855 | 2.132 | 3.527 | 1.963 | 0.829 | 0.594 | 0.534 | 0.487 | 0.000 | 0.000 | 1.000 | 0.805 |
| American pipit | 0.033 | 0.037 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood (2007) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Yellow warbler | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.072 | 0.079 | 0.000 | 0.000 |
| Black-throated gray warbler | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.031 | 0.035 | 0.000 | 0.000 |
| Wilson's warbler | 0.000 | 0.000 | 0.013 | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western tanager | 0.000 | 0.000 | 0.020 | 0.018 | 0.000 | 0.000 | 0.000 | 0.000 | 0.250 | 0.276 | 0.000 | 0.000 |
| Spotted towhee | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.033 | 0.039 | 0.000 | 0.000 | 0.000 | 0.000 |
| Savannah sparrow | 0.012 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fox sparrow | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lincoln sparrow | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden-crowned sparrow | 0.028 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.053 | 0.058 | 0.000 | 0.000 |
| Sparrow spp. | 0.018 | 0.020 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.072 | 0.079 | 0.000 | 0.000 |
| Red-winged blackbird | 0.310 | 0.200 | 0.096 | 0.062 | 0.123 | 0.137 | 0.000 | 0.000 | 0.000 | 0.000 | 0.195 | 0.218 |
| Tricolored blackbird | 0.049 | 0.055 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western meadowlark | 3.401 | 1.905 | 2.682 | 1.462 | 1.509 | 0.910 | 1.485 | 0.943 | 0.107 | 0.116 | 1.760 | 1.101 |
| Brewer's blackbird | 0.380 | 0.240 | 0.070 | 0.052 | 0.000 | 0.000 | 0.000 | 0.000 | 0.122 | 0.132 | 0.000 | 0.000 |
| Brown-headed cowbird | 0.066 | 0.074 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Blackbird spp. | 0.406 | 0.300 | 0.287 | 0.173 | 0.150 | 0.162 | 0.000 | 0.000 | 0.000 | 0.000 | 0.239 | 0.257 |
| House finch | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.055 | 0.067 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lesser goldfinch | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.031 | 0.035 | 0.000 | 0.000 |
| House sparrow | 0.008 | 0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Unknown bird | 2.219 | 1.177 | 1.807 | 0.908 | 0.980 | 0.909 | 0.298 | 0.278 | 0.244 | 0.265 | 1.152 | 1.249 |
| Mexican free-tailed bat | 0.037 | 0.033 | 0.000 | 0.000 | 0.000 | 0.000 | 0.479 | 0.448 | 0.176 | 0.143 | 0.000 | 0.000 |
| Hoary bat | 0.000 | 0.000 | 0.000 | 0.000 | 0.042 | 0.048 | 0.312 | 0.255 | 0.872 | 0.636 | 0.000 | 0.000 |
| Western red bat | 0.022 | 0.024 | 0.045 | 0.044 | 0.016 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Unknown bat | 0.000 | 0.000 | 0.007 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| All bats | 0.059 | 0.057 | 0.053 | 0.051 | 0.058 | 0.067 | 0.791 | 0.703 | 1.048 | 0.779 | 0.000 | 0.000 |
| All native small birds | 8.586 | 5.368 | 5.925 | 3.470 | 3.210 | 2.730 | 2.525 | 2.044 | 1.656 | 1.580 | 3.424 | 3.105 |
| All native medium and large birds | 1.183 | 0.589 | 1.122 | 0.402 | 0.426 | 0.385 | 0.458 | 0.323 | 0.301 | 0.308 | 0.666 | 0.609 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood (2007) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| All native nonraptors | 9.769 | 5.957 | 7.047 | 3.872 | 3.636 | 3.115 | 2.983 | 2.367 | 1.957 | 1.888 | 4.090 | 3.714 |
| All exotic birds | 7.958 | 2.922 | 4.190 | 2.086 | 0.946 | 0.666 | 0.618 | 0.537 | 0.008 | 0.008 | 1.187 | 0.917 |
| All target raptors | 3.664 | 0.965 | 2.824 | 0.641 | 1.326 | 0.669 | 1.745 | 0.645 | 0.512 | 0.301 | 1.705 | 0.877 |
| All raptors | 3.994 | 1.103 | 3.098 | 0.735 | 1.579 | 0.811 | 1.798 | 0.699 | 0.544 | 0.333 | 2.017 | 1.049 |
| All birds | 21.721 | 9.982 | 14.335 | 6.693 | 6.162 | 4.592 | 5.399 | 3.603 | 2.509 | 2.230 | 7.294 | 5.680 |

Appendix 3. Mean (SE) fatality rates of birds and bats in the Altamont Pass Wind Resource Area, and in the Tres Vaqueros project in particular, adjusted for searcher detection and scavenger removal errors based on Smallwood et al. (2010).

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood et al. (2010) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista, 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Mallard | 0.239 | 0.163 | 0.101 | 0.046 | 0.000 | 0.000 | 0.059 | 0.061 | 0.000 | 0.000 | 0.000 | 0.000 |
| Ring-necked duck | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Puddle duck | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Duck spp. | 0.000 | 0.000 | 0.016 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Wild turkey | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pied-billed grebe | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.186 | 0.203 | 0.000 | 0.000 | 0.000 | 0.000 |
| Brown pelican | 0.104 | 0.104 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Double-crested cormorant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Great blue heron | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.030 | 0.031 | 0.000 | 0.000 | 0.000 | 0.000 |
| Great egret | 0.104 | 0.104 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Cattle egret | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Black-crowned night-heron | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Turkey vulture | 0.002 | 0.002 | 0.032 | 0.015 | 0.006 | 0.006 | 0.050 | 0.050 | 0.000 | 0.000 | 0.000 | 0.000 |
| White-tailed kite | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern harrier | 0.016 | 0.011 | 0.018 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Red-shouldered hawk | 0.004 | 0.004 | 0.000 | 0.000 | 0.006 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swainson's hawk | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Red-tailed hawk | 0.936 | 0.179 | 0.815 | 0.096 | 0.286 | 0.127 | 0.683 | 0.182 | 0.338 | 0.218 | 0.404 | 0.196 |
| Ferruginous hawk | 0.019 | 0.019 | 0.002 | 0.001 | 0.059 | 0.057 | 0.016 | 0.017 | 0.000 | 0.000 | 0.093 | 0.090 |
| Buteo spp. | 0.028 | 0.023 | 0.063 | 0.019 | 0.007 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hawk spp. | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden eagle | 0.073 | 0.028 | 0.192 | 0.034 | 0.031 | 0.016 | 0.050 | 0.036 | 0.143 | 0.107 | 0.029 | 0.022 |
| American kestrel | 1.320 | 0.533 | 0.916 | 0.346 | 0.248 | 0.137 | 0.073 | 0.058 | 0.267 | 0.133 | 0.086 | 0.067 |
| Peregrine falcon | 0.000 | 0.000 | 0.005 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood et al. (2010) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista, 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Prairie falcon | 0.000 | 0.000 | 0.004 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.010 | 0.000 | 0.000 |
| Falcon spp. | 0.000 | 0.000 | 0.019 | 0.021 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Raptor | 0.000 | 0.000 | 0.036 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Large raptor | 0.000 | 0.000 | 0.004 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Small raptor | 0.013 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| American coot | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.018 | 0.018 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sandhill crane | 0.013 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Killdeer | 0.014 | 0.014 | 0.023 | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Black-necked stilt | 0.000 | 0.000 | 0.019 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| American avocet | 0.000 | 0.000 | 0.006 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lesser yellowlegs | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Bonaparte's gull | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Ring-billed gull | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western gull | 0.000 | 0.000 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| California gull | 0.007 | 0.007 | 0.124 | 0.057 | 0.000 | 0.000 | 0.030 | 0.031 | 0.259 | 0.272 | 0.000 | 0.000 |
| Herring gull | 0.000 | 0.000 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Gull spp. | 0.041 | 0.030 | 0.369 | 0.099 | 0.103 | 0.079 | 0.189 | 0.086 | 0.000 | 0.000 | 0.164 | 0.124 |
| Rock pigeon | 8.916 | 1.681 | 1.444 | 0.272 | 0.243 | 0.158 | 0.183 | 0.111 | 0.018 | 0.019 | 0.386 | 0.244 |
| Mourning dove | 0.822 | 0.335 | 0.362 | 0.145 | 0.204 | 0.180 | 0.201 | 0.135 | 0.000 | 0.000 | 0.064 | 0.067 |
| Dove spp. | 0.143 | 0.076 | 0.200 | 0.092 | 0.087 | 0.074 | 0.000 | 0.000 | 0.000 | 0.000 | 0.139 | 0.118 |
| Cockatiel | 0.031 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Barn owl | 0.388 | 0.107 | 0.211 | 0.035 | 0.296 | 0.131 | 0.025 | 0.025 | 0.044 | 0.045 | 0.437 | 0.200 |
| Great-horned owl | 0.080 | 0.035 | 0.061 | 0.017 | 0.057 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Burrowing owl | 1.707 | 0.664 | 1.319 | 0.501 | 1.014 | 0.575 | 1.311 | 0.598 | 0.000 | 0.000 | 1.560 | 0.863 |
| Common poorwill | 0.024 | 0.025 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| White-throated swift | 0.054 | 0.056 | 0.014 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern flicker | 0.020 | 0.021 | 0.044 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood et al. (2010) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista, 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Hammond's flycatcher | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.062 | 0.068 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pacific-slope flycatcher | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Say's phoebe | 0.000 | 0.000 | 0.019 | 0.020 | 0.000 | 0.000 | 0.062 | 0.068 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western kingbird | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Flycatcher spp. | 0.000 | 0.000 | 0.026 | 0.023 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Loggerhead shrike | 0.217 | 0.119 | 0.210 | 0.098 | 0.041 | 0.043 | 0.123 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 |
| Warbling vireo | 0.000 | 0.000 | 0.000 | 0.000 | 0.162 | 0.171 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vireo spp. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.036 | 0.041 | 0.000 | 0.000 |
| Western scrub-jay | 0.000 | 0.000 | 0.000 | 0.000 | 0.102 | 0.110 | 0.000 | 0.000 | 0.000 | 0.000 | 0.162 | 0.175 |
| American crow | 0.061 | 0.038 | 0.059 | 0.023 | 0.000 | 0.000 | 0.000 | 0.000 | 0.173 | 0.181 | 0.000 | 0.000 |
| Common raven | 0.327 | 0.110 | 0.271 | 0.062 | 0.091 | 0.075 | 0.179 | 0.126 | 0.000 | 0.000 | 0.144 | 0.119 |
| Horned lark | 0.677 | 0.295 | 0.439 | 0.190 | 0.000 | 0.000 | 0.123 | 0.096 | 0.760 | 0.596 | 0.000 | 0.000 |
| Corvid spp. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Tree swallow | 0.011 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Violet-green swallow | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Cliff swallow | 0.045 | 0.030 | 0.000 | 0.000 | 0.109 | 0.230 | 0.061 | 0.067 | 0.000 | 0.000 | 0.173 | 0.365 |
| Barn swallow | 0.039 | 0.041 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swallow spp. | 0.000 | 0.000 | 0.006 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Rock wren | 0.147 | 0.153 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| House wren | 0.000 | 0.000 | 0.013 | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western bluebird | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mountain bluebird | 0.019 | 0.020 | 0.048 | 0.027 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Bluebird spp. | 0.111 | 0.089 | 0.047 | 0.032 | 0.082 | 0.086 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Swainson's thrush | 0.000 | 0.000 | 0.006 | 0.007 | 0.000 | 0.000 | 0.037 | 0.040 | 0.000 | 0.000 | 0.000 | 0.000 |
| Northern mockingbird | 0.000 | 0.000 | 0.023 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| European starling | 4.214 | 1.567 | 3.923 | 1.377 | 0.902 | 0.516 | 0.604 | 0.463 | 0.000 | 0.000 | 1.085 | 0.737 |
| American pipit | 0.036 | 0.038 | 0.025 | 0.021 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood et al. (2010) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista, 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| Yellow warbler | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.083 | 0.094 | 0.000 | 0.000 |
| Black-throated gray warbler | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.036 | 0.041 | 0.000 | 0.000 |
| Wilson's warbler | 0.000 | 0.000 | 0.014 | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western tanager | 0.000 | 0.000 | 0.022 | 0.018 | 0.000 | 0.000 | 0.000 | 0.000 | 0.290 | 0.330 | 0.000 | 0.000 |
| Spotted towhee | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.037 | 0.040 | 0.000 | 0.000 | 0.000 | 0.000 |
| Savannah sparrow | 0.014 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fox sparrow | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lincoln sparrow | 0.000 | 0.000 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden-crowned sparrow | 0.031 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.064 | 0.071 | 0.000 | 0.000 |
| Sparrow spp. | 0.020 | 0.021 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.083 | 0.094 | 0.000 | 0.000 |
| Red-winged blackbird | 0.339 | 0.169 | 0.105 | 0.051 | 0.134 | 0.140 | 0.000 | 0.000 | 0.000 | 0.000 | 0.213 | 0.222 |
| Tricolored blackbird | 0.053 | 0.055 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Western meadowlark | 3.726 | 1.412 | 2.964 | 1.019 | 1.639 | 0.710 | 1.680 | 0.735 | 0.128 | 0.143 | 1.900 | 0.886 |
| Brewer's blackbird | 0.416 | 0.199 | 0.077 | 0.047 | 0.000 | 0.000 | 0.000 | 0.000 | 0.146 | 0.163 | 0.000 | 0.000 |
| Brown-headed cowbird | 0.072 | 0.075 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Blackbird spp. | 0.444 | 0.272 | 0.318 | 0.135 | 0.168 | 0.162 | 0.000 | 0.000 | 0.000 | 0.000 | 0.267 | 0.257 |
| House finch | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.062 | 0.068 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lesser goldfinch | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.036 | 0.041 | 0.000 | 0.000 |
| House sparrow | 0.008 | 0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Unknown bird | 2.604 | 0.971 | 2.147 | 0.698 | 1.188 | 1.007 | 0.371 | 0.304 | 0.293 | 0.326 | 1.438 | 1.454 |
| Mexican free-tailed bat | 0.041 | 0.032 | 0.000 | 0.000 | 0.000 | 0.000 | 0.541 | 0.430 | 0.211 | 0.180 | 0.000 | 0.000 |
| Hoary bat | 0.000 | 0.000 | 0.000 | 0.000 | 0.046 | 0.049 | 0.354 | 0.233 | 1.039 | 0.805 | 0.000 | 0.000 |
| Western red bat | 0.024 | 0.025 | 0.050 | 0.044 | 0.018 | 0.019 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Unknown bat | 0.000 | 0.000 | 0.008 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| All bats | 0.064 | 0.056 | 0.058 | 0.050 | 0.064 | 0.068 | 0.895 | 0.663 | 1.249 | 0.985 | 0.000 | 0.000 |
| All native small birds | 9.400 | 4.331 | 6.551 | 2.601 | 3.489 | 2.515 | 2.857 | 1.823 | 1.957 | 1.942 | 3.693 | 2.912 |
| All native medium and large birds | 1.601 | 0.786 | 1.589 | 0.475 | 0.621 | 0.552 | 0.655 | 0.452 | 0.432 | 0.453 | 0.972 | 0.873 |

| | Fatalities/MW/year, 2005-2009 (2008-2009 at Buena Vista), adjusted based on Smallwood et al. (2010) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All small turbines, 40-65 KW | | Randomly selected turbines, 95-200 KW | | All large old-generation turbines, 250-400 KW | | Diablo Winds, 660 KW | | Buena Vista, 1 MW | | Tres Vaqueros old-generation turbines, 330 KW | |
| **Species** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** | **Mean** | **SE** |
| All native nonraptors | 11.000 | 5.117 | 8.140 | 3.077 | 4.111 | 3.067 | 3.512 | 2.275 | 2.389 | 2.395 | 4.665 | 3.786 |
| All exotic birds | 13.169 | 3.289 | 5.369 | 1.651 | 1.145 | 0.674 | 0.788 | 0.575 | 0.018 | 0.019 | 1.471 | 0.981 |
| All target raptors | 4.035 | 1.404 | 3.243 | 0.977 | 1.579 | 0.855 | 2.117 | 0.875 | 0.748 | 0.459 | 2.078 | 1.147 |
| All raptors | 4.591 | 1.625 | 3.700 | 1.117 | 2.010 | 1.095 | 2.208 | 0.967 | 0.803 | 0.513 | 2.608 | 1.437 |
| All birds | 28.760 | 10.032 | 17.209 | 5.845 | 7.266 | 4.835 | 6.507 | 3.816 | 3.210 | 2.927 | 8.743 | 6.204 |

# APPENDIX D3
# Literature Review of Avian and Bat Collision Impacts Information

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# Technical memorandum

date January 10, 2011

to Tres Vaqueros Wind Energy Project Team

from Natasha Dvorak

subject Literature Review in Support of the EIR for Tres Vaqueros Wind Energy Project, Avian and Bat Collision Impacts

### Research and Implications for the Project

Significant avian mortality rates at wind energy facilities in the Altamont Pass Wind Resource Area (APWRA) prompted a multitude of studies exploring the relationship between avian mortality and one or more of the following: turbine characteristics, turbine arrangements within wind farms, avian use (e.g. flight behavior), avian perception of turbines, avian abundance, seasonal presence, and the effectiveness of mitigation measures. Studies in the APWRA have wrangled with identifying causes and effects of avian mortality against a heterogeneous background of turbine type; turbines going in and out of operation; repowering; varied site access; variable turbine power-output; changing weather and seasons; varied land uses, ownership, and grazing management; and very limited information about avian populations, migration patterns, and fluctuating prey densities. The regional landscape is connected, with each wind farm affected by the operations of its neighbors, so even more difficult is the task of extracting site-specific causes and effects from one's neighbor, i.e., those that are APWRA-wide. As a consequence, study results are often unclear, and sometimes inconclusive or conflicting, making it difficult to identify causes of, and implement effective strategies for, reducing avian fatality.

In 1998, the *Repowering a Portion of the APWRA* EIR (Alameda County, 1998) provided a review and summary of then-contemporary research including Howell and DiDonato, 1991; Howell, et al., 1991; Orloff and Flannery, 1992; Hunt, 1994; Hunt, 1996; Orloff and Flannery, 1996; Howell, 1995; Colson and Associates, 1995; Tucker, 1996a; Tucker, 1996b; Howell, 1997; and Curry and Kerlinger, 1998. As a plethora of more recent studies has been conducted in the APWRA, the reader is referred to that EIR for those summaries.

Contra Costa County's Buena Vista Wind Energy Project repowering EIR (ICF International, 2004) provided an updated review and summary of research including Erickson, et. al. 2001; Curry and Kerlinger, 2001; Rugge, 2001; Hunt, 2002; Anderson, et al., 2004; and Smallwood and Thelander, 2004. Curry and Kerlinger (2001) found that high raptor/vulture use at the nearby High Winds Wind Project in Solano County, California was related to high raptor/vulture abundance. Rugge (2001) found that collision risk may be greater at lattice towers due to the increased perching opportunities that such structures offer. Erickson (2001) found that raptor use is higher in the APWRA than at other sites evaluated in their report. Hunt (2002) also found that collision risk may be higher with

lattice towers versus tubular towers, and that blade reaches close to the ground put more eagles at risk of collision. Anderson (2004) found that perching occurred more frequently at shorter towers than taller towers. Smallwood and Thelander (2004) found that red-tailed hawk and American kestrel are commonly-observed fatalities at wind farms, and along with barn owl, burrowing owl, and golden eagle comprise the majority of raptor fatalities in the APWRA; that most perching occurs on defunct turbines; that it is not clear whether perching increases the risk for collision; that tower type is not a major factor related to raptor collision risk; that a large rotor diameter and slow-to-intermediate blade-tip speed killed more raptors in the APWRA; that turbines arranged in a wind-wall configuration are safer for birds, along with turbines arranged in dense clusters and those forming the interior of strings, while those most dangerous were at the ends of strings, gaps, edges of clusters, and isolated turbines; that raptor use is higher near strings than away from them; and that blade reaches close to the ground put more eagles at risk for collision because of their flight-height characteristics. Perhaps most importantly, Smallwood and Thelander (2004) hypothesized that repowering, especially with turbines on taller towers, should reduce raptor mortality levels because avian use data showed that most raptor flights occur below the rotor planes of new-generation turbines.

Additional studies have been conducted in the APWRA since the publishing of the Buena Vista repowering EIR. The following list is not inclusive of them all, but provides a pertinent and informative representation of the types of studies performed in the APWRA. Though previously discussed in the Buena Vista EIR and related summary above, Smallwood and Thelander's (2004) report to the California Energy Commission is included here for its summary of recommendations to discontinue or modify some management actions, implement other ones immediately, and to experiment with yet others. A title and brief summary for each identified report is provided below.

- *Developing Methods to Reduce Bird Mortality in the APWRA, (Smallwood and Thelander, 2004).* This report summarized a five-year research effort focused on better understanding the causes of bird mortality at the world's largest wind farm (the APWRA). The researchers identified and evaluated possible measures to mitigate bird mortality in the APWRA. They concluded that rodent control programs, installing perch guards on wind turbines, providing alternative perches, and barricading the rotor planes of turbines should be abandoned as options for reducing bird mortality. They concluded that the following measures should be applied experimentally with the understanding that they might not substantially reduce bird mortality: reduce vertical and lateral edge in slope cuts and nearby roads, exclude cattle from around wind turbines, install flight diverters, paint blades using the Hodos et al. scheme, and experiment with devices that will identify when problem turbines can be operated with the least effect on birds. Finally, they concluded that the following measures should be immediately implemented: relocate selected highly dangerous turbines, move rock piles away from wind turbines, retrofit tower pads to prevent under-burrowing by small mammals, remove defunct wind turbines, install wind turbine designs that minimize avian fatality, retrofit power poles to be APLIC-compliant, and implement the means to effectively monitor each turbine's output.
- *Assessment to Support an Adaptive Management Plan for the APWRA, (Smallwood and Spiegel, 2005).* This report identified adaptive management as the ultimate mitigation strategy that should be implemented throughout the APWRA, with some measures implemented immediately and others implemented conditionally if desired reductions in avian fatality are not achieved. The authors recommend immediate and permanent shutdown of some existing, old-generation turbines and seasonal shutdown of others along with cessation of rodent control programs, retrofitting of electric

- *The Trend Of Golden Eagle Territory Occupancy in The Vicinity of the APWRA: 2005 Survey, (California Energy Commission, 2006).* This study built on a former report (Hunt, 2002) that found blade-strike mortality prevented the maintenance of substantial reserves of non-breeding adult golden eagles characteristic of healthy populations elsewhere. This suggested the possibility of a population decline, which was explored in this report. Results showed that all territories occupied by eagle pairs in 2000 were occupied by eagle pairs in 2005. A higher proportion of subadult eagles as pair members was not observed, a condition that would have suggested the population was declining. However, the authors cautioned that the number of eagle pairs required to support the estimated levels of blade-strike mortality in the APWRA is large (for example, 167 breeding pairs to support a blade-strike mortality of 50 eagles per year), and is additive to other causes of eagle mortality. The authors report the most effective way to minimize an eventual population decline is to mitigate sources of current mortality and preserve foraging areas.
- *Estimating Wind-Turbine Caused Bird Mortality, (Smallwood, 2007).* This study explains that turbine-related mortality estimates are based on the number of carcasses found beneath turbines plus the number *not* found- those overlooked by searchers or carried off-site by scavengers, and known as *scaling factors* that are used to adjust limited observations into estimates of total fatality. The author finds that searcher detection trials can be biased by the species used in the trial, the number of carcasses intentionally placed for a given fatality test-search, and the state of the carcass on the ground. Scavenger removal trials can be biased by the metric representing the removal rate, the number of carcasses placed at once (scavenger swamping), the duration of the trial, whether carcasses were frozen, whether carcasses included injuries consistent with wind turbine collisions, and by season, distance from the wind turbines, and general location. The author refines the scaling factors, points out that such factors can be used to adjust previous and future estimates of mortality to improve comparability, and identifies research directions that would help to better understand scaling factors and other adjustments needed to compare mortality estimates among wind farms.
- *Wind Power Company Compliance with Mitigation Plans in the APWRA (Smallwood, 2008).* This report evaluated various mitigation strategies to be implemented in the APWRA, and identified if wind power companies complied with the mitigation and whether such mitigation effectively reduced fatalities of the four focal raptor species. The author reports that the only highly effective mitigation strategy implemented by wind power companies in the Altamont was a monitoring plan. Seasonal shutdown, also predicted to be highly effective, was only partially implemented and therefore it remains unknown whether such mitigation is effective. The cessation of rodent control and retrofitting of distribution poles were implemented, but are of low-to-medium value for reducing raptor fatality. Relocation of select turbines, moving of rock piles, retrofitting of turbine pads, moving of parts and equipment, removal of defunct turbines, grazing management, blade painting, and

- *Range Management Practices To Reduce Wind Turbine Impacts On Burrowing Owls And Other Raptors In The APWRA, (California Energy Commission, 2009).* This study evaluated whether vegetation height could be managed to affect the distribution of small mammals near turbines to reduce raptor attraction and risk; the effectiveness of seasonal turbine shutdowns to reduce raptor collisions with wind turbines; if burrowing owl population size relates to mortality; what factors affect raptor behavior and spatial distribution; estimates for scavenger removal rates of bird carcasses; and wind turbine repowering scenarios.

  Authors found that the impact of turbine-related fatalities on the local burrowing owl and golden eagle populations could represent a population sink; that pocket gophers are more prevalent on upper reaches of slopes and ground squirrel colonies on lower reaches; that ground squirrels are vulnerable to mammalian predation where vegetation is tall but to raptor predation where vegetation is bare, and fared best in grasses 5 to 50 cm high; over the last decade the detection of golden eagles declined 56 percent, while red-tailed hawk detection increased 19 percent and northern harriers by 80 percent; golden eagles were the only raptor species that appeared to ignore the presence of turbines; flight behaviors associated with the greatest risk for collision occurred more on the upper reaches of south- and southwest-facing slopes where favorable winds were strongest and most prevalent; each avian species exhibited unique suites of behavior under varying conditions, precluding turbine micromanagement efforts (e.g., wind-speed-based or time-of-day shutdowns) that would benefit all species; raptor flight patterns appear to be more related to topography when prey populations are evenly distributed; scavenger swamping can mask scavenger removal rates, and scavenger removal was documented to be much faster than previously believed; a large percentage of bird carcasses were found farther from turbines than typical search radii encompass; and among existing old-generation turbines, those identified as Tier 1 or 2 (those most dangerous for birds) were associated with all burrowing owl fatalities, 94 percent of raptor fatalities, and 86 percent of all bird fatalities even though they comprised only 14 percent of studies turbines.

  Study authors also observed that avian mortality declined with increasing electric power output because the number of fatalities at each turbine were relatively constant compared to the variation in power output; dividing a relatively constant number by a highly variable denominator yields a ratio- used to express mortality- that is inversely related to its denominator, and this should be considered when interpreting mortality data. As for the grazing treatment experiment, severe drought followed by heavy rains masked grazing pressure, and a subsequent wildfire ultimately compromised the grazing treatment design; thus results were not obtained for the grazing management aspect of the study. The study also confirmed that repowering is generally assumed to decrease overall turbine-related mortality, with potentially fewer burrowing owls and American kestrels experiencing mortality because of increased tower height, but repowered areas could experience continued high mortality if

- *Map-Based Repowering of the APWRA Based on Burrowing Owl Burrows, Raptor Flights, and Collisions with Wind Turbines, (Smallwood and Neher, 2009).* This study sought to identify areas within the APWRA where wind turbine operations might be safer for burrowing owls and other raptors by developing a computer model that predicts burrowing owl suitable locations. Two successful models were developed and validated by ground surveys. The authors concluded that moving wind turbines away from likely burrowing owl burrow locations should help reduce burrowing owl mortality in the APWRA.
- *Map-Based Repowering and Reorganization of a Wind Power Resource Area as Tools to Minimize Burrowing Owl and Other Bird Fatalities, (Smallwood, et al., 2009).* Similar to the study described above, and based on the same research, this study found that "fuzzy logic" modeling corresponded more with burrowing owl fatalities and "discriminant function analysis" corresponded more with other raptor fatalities. The authors identified that it would be difficult to implement the micrositing recommendations that would benefit burrowing owls while still implementing the micrositing recommendations that would benefit other species, but predicted that all careful repowering would still reduce burrowing owl fatalities to some degree (due, at least in part, to the increased blade heights associated with repowering). The authors also caution that the environmental cost resulting from the cumulative impacts of wind farms may far exceed the benefits that renewable energy brings if extensive investigations into wind farm sitings are not developed ahead of wind turbine installation, considering the base areas of wildlife habitat needed to generate even a fraction of projected future energy demand.
- *An Assessment of Three Proposed Adaptive Management Plans for Reducing Raptor Fatalities in the APWRA, (Smallwood, 2010a).* This report provides an evaluation of three adaptive management plans (AMPs) proposed for implementation in Alameda County portions of the APWRA. All plans are proposed by parties to the Altamont Settlement Agreement– one by the wind energy companies; the second by Alameda County; and the third by Audubon Society/Californians for Renewable Energy (CARE). The author compares proposed mitigation measures, implementation time frames, and effectiveness of management measures across all plans, and finds that none of the AMPs can achieve the stated goal of collectively reducing target raptor fatalities in the APWRA by 50% over the next three years because implementation schedules are too slow, repowering is given insufficient weight, turbine relocations slated to reduce overall raptor mortality are projected to increase burrowing owl fatalities, non-participating companies and turbines obstruct the goal by dragging collective achievement downward (through continued high fatalities at their wind farms), and there are no consequences for non-compliance. Lastly, the author emphasizes that no more effort should be directed toward measuring the effectiveness of individual management measures, but rather that fatality monitoring should be used to assess the effectiveness of the program as a whole and to inform repowering so that siting is more effectively planned to minimize bird fatalities.
- *Baseline Avian and Bat Fatality Rates at The Tres Vaqueros Wind Project, (Smallwood, 2010b).* This report presents baseline avian and bat fatality rates at the Tres Vaqueros Wind Energy Project based on four methods, with two sets of numbers recommended as being the most representative of baseline fatality. The first method estimates total annual fatalities caused by the existing wind farm. As the first method does not provide a number that is useful for comparisons to other projects, the second

- *Preliminary Recommendations of Independent Science Advisors for the APWRA Conservation Plan, (Conservation Biology Institute, 2009).* This letter to the APWRA Steering Committee and Interested Parties summarized preliminary recommendations for the APWRA HCP/NCCP. Such recommendations include: the HCP/NCCP should be developed incrementally on an adaptive management foundation given the large amount of uncertainty about mortality rates, population-level impacts, and the various factors that interact to influence these under both current and potential future conditions; determine the geographic area over which populations of particularly well-studied species (e.g., golden eagle and prairie falcon) are being impacted by turbine mortalities; careful consideration of whether a 35-year permit duration is an effective time period for adaptive management; including species that could be significantly impacted by turbine mortality, regardless of their conservation status; the tracking of "surrogate" species for analysis, such as rock pigeons (*Columba livia*); and better defining when repowering impacts occur and under what environmental conditions (e.g., time of day, season, wind speed, and temperature).
- *Fatality Rates in the APWRA from 1998-2009, (Smallwood, 2010c).* This study compared APWRA-wide fatality rates between baseline and current study periods to estimate monthly (seasonal) and annual fatalities, and examined the data for signs of mitigation effectiveness and differences between existing (old-generation) and repowered facilities. The author found that APWRA-wide fatality rates were not reduced between baseline and current study periods; the ability to confirm the effectiveness of seasonal turbine shutdowns was limited because shutdowns were too brief, inconsistent among

- *Novel Scavenger Removal Trials Increase Wind Turbine-Caused Avian Fatality Estimates, (Smallwood, et al., 2010).* Study authors suspected that scavenger removal rates were artificially affected by the process of establishing them– by "swamping" the area with so many carcasses that scavengers could not remove them all, resulting in a biased removal rate that would not apply under natural conditions. To avoid swamping, the authors placed fewer carcasses in the survey area and monitored each with a motion-activated camera. By 15 days, scavengers had removed 27 percent more large raptor carcasses compared to conventional trials, and 10 percent more small birds. This increased estimated fatality rates to nearly three times higher for red-tailed hawk and barn owl, and increased raptor and all-bird fatality estimates by 68 percent and 67 percent, respectively. The study also found that collision hazard increased with greater intermittency in turbine operations (whereas if all turbines operated at the same speed all the time, fewer birds would collide with them, though this doesn't happen in the real world).
- *Siting Repowered Wind Turbines to Minimize Raptor Collisions at the Tres Vaqueros Wind Project, Contra Costa County, California (Smallwood and Neher, 2010a); Siting Repowered Wind Turbines to Minimize Raptor Collisions at Vasco Winds, (Smallwood and Neher, 2010b) .* These micrositing reports established micrositing recommendations for the projects' repowering efforts. Raptor flight observations were related to a digital elevation model of the project site, and used to predict the locations of burrowing owl colonies, and golden eagle, red-tailed hawk, and American kestrel flight paths. The computer model was also refined to identify ridge saddles, notches, and benches where turbine locations have been identified as more hazardous to raptors. Risky areas defined by the topography and avian flight behavior generally correspond with areas where turbines should be restricted or more carefully considered.

In addition to these APWRA-specific studies, a number of broader studies have since been published that have implications for avian mortality in the APWRA, as well as the publishing of several documents from regulatory agencies that provide guidance and recommendations during wind farm establishment and repowering.

- *Variation in Bat and Bird Fatalities at Wind Energy Facilities: Assessing the Effects of Rotor Size and Tower Height, (Barclay, et al., 2007).* This study found that across North American wind energy facilities, the diameter of the turbine rotor (the blade swept area) did not influence the rate of bird or bat fatality. Turbine height had no effect on bird fatalities per turbine, but bat fatalities increased exponentially with tower height.
- *Environmental Impacts of Wind-Energy Projects, (National Academy of Sciences, 2007).* This study reviews the effects of wind-energy development on ecosystem structure and functioning, on landscapes through alteration and displacement, and the direct effects of turbines on organisms, and recommends a research and monitoring framework for reducing these impacts. Study authors concluded that an understanding of the ecological effects of wind-energy development is limited by

- *Avian and Bat Fatality Rates at Old-Generation and Repowered Wind Turbines in California, (Smallwood and Karas, 2009).* This study evaluated data for Years 1 and 2 of a three-year study. Comparing fatality rate estimates for the period of 1998-2003 against the period of 2005-2007, the authors found that APWRA-wide fatality rates had increased by 85 percent for all raptors and by 51 percent for all birds during the period 2005-2007. Authors suggested that fatality rates may have tracked increases in avian abundance (but there was no data on avian abundance to compare to); or that fatality rates only appeared to increase because the more frequent search interval during 2005-2007 found more carcasses; or that fatality rates might have increased due to inadequate or even counterproductive implementation of the Alameda County Avian Protection Plan.

  The study also compared fatality rates for a repowered wind project (Diablo Winds) against the APWRA's old-generation turbines, and found that while repowered fatality rates were not lower than pre-repowering rates at the same location, when compared to other old-generation turbines operating in the APWRA, the repowering project fatality rates were 54 percent lower for raptors and 66 percent lower for all birds. Study authors conclude that restricting APWRA-wide repowering to its existing nameplate capacity (209 MW for a 700 GW/hr energy output) could reduce mean annual fatalities by 83 percent for raptors and 87 percent for all birds. They additionally conclude that in lieu of repowering, avian fatalities could be reduced by County enforcement of operating permit conditions, enforcement of environmental laws by State and Federal regulatory agencies, and by County enforcement of APWRA scientific recommendations.

- *Service Interim Guidelines on Avoiding and Minimizing Wildlife Impacts from Wind Turbines, (USFWS, 2003).* This guidance was prepared as technical assistance to the wind energy industry to avoid and minimize impacts on wildlife and their habitats through proper evaluation of potential wind energy development sites, proper location and design of turbines and associated structures within wind farms, and pre- and post-construction research and monitoring to identify and/or assess impacts on wildlife. Post-construction monitoring was expected to require three years of data in order to detect major impacts, defined as a statistically-significant increase in mortality of any wildlife species and/or a statistically-significant decrease in use by a sensitive species. Monitoring efforts should be based on results of preconstruction use and mortality studies.

- *Proceedings of the Wind Energy and Birds/Bats Workshop: Understanding and Resolving Bird and Bat Impacts, (AWEA and ABC, 2004).* These proceedings reported on the workshop output of a meeting attended by wind energy stakeholders including energy companies, regulatory agencies, avian and bat experts, and wildlife groups. The workshop objective was to facilitate the discussion and exchange of information related to wind power development status and potential, strategies and techniques employed to mitigate avian impacts, avian risk assessment methods, wind impacts on wildlife, habitat fragmentation and species displacement, lessons learned, and guidelines for the siting, construction, and operation of wind energy facilities. Also identified was a list of existing science gaps and research questions.

- *California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development, (California Energy Commission, 2007).* The California Energy Commission and CDFG encourage the use of this comprehensive set of guidelines and protocols to assess, evaluate, and determine the

- *Towers, Turbines, Power Lines and Buildings- Steps Being Taken by the USFWS to Avoid or Minimize Take of Migratory Birds at These Structures (Manville, 2008).* This study evaluates avian collisions with commercial wind turbines, among other structures, and finds that with the exponential growth of industrial wind development the issue of avian mortality has become one of cumulative impacts and additive mortality. The author argues for more research independence and transparency among wind farm researchers, whose studies are funded by wind energy companies, as well as for a consistent, scientifically-defensible monitoring protocol that can be compared across projects, regions, and the nation. The author recommends early consultation with USFWS during project design that carries throughout the environmental review process and operational monitoring.
- *Wind Turbine Interactions with Birds, Bats, and their Habitats: A Summary of Research Results and Priority Questions, (National Wind Coordinating Collaborative, 2010).* This fact sheet summarizes what is known about bird and bat interactions with wind turbines in North America, including habitat impacts, and identifies remaining questions and knowledge gaps. Authors identified indirect impacts as including area avoidance, habitat disruption, reduced nesting/breeding density, habitat abandonment, loss of refugia, habitat unsuitability, and behavioral effects. Fatality rates are found to vary widely both regionally and across wind resource areas. Of more than 28 evaluated North American wind farms, the APWRA's Diablo Winds wind energy facility experienced the highest raptor mortality. Studies indicate that the level of bird use at the site, and their behavior, are two significant risk factors related to avian mortality. Siting turbines in areas of low prey density may reduce raptor collision rates at wind facilities; and newer, larger turbines (>500 kW) turbines may reduce raptor collision rates compared to old generation turbines (40 kW to 330 kW), but have uncertain effects on songbirds.

- *Wind Turbine Guidelines Advisory Committee Recommendations, (USFWS, 2010).* This document provides policy recommendations and voluntary recommended guidelines for wind siting and operations, to avoid or minimize potential impacts to wildlife and habitat from wind energy development. The USFWS seeks to reduce ecological impacts, reduce regulatory risk, and improve the predictability of wildlife and habitat impacts through compliance with the guidelines. The guidelines provide a tiered approach for wildlife assessment and siting decisions, not all of which are applicable to the repowering Project. Applicable portions include designing studies to: (1) identify if species of concern are present; (2) to document their distribution, relative abundance, behavior, and site use and define the extent to which these expose them to risk; and (3) identify the potential risks and appropriate mitigation measures. Suggested tools include diurnal avian activity surveys, raptor nest searches, population assessments, mist-netting, acoustic monitoring, and radar. The guidelines state that the number of years of post-construction fatality monitoring should follow discussions with relevant resource agencies (e.g., USFWS, CDFG), and that studies should cover all seasons of occupancy for the species being monitored. The number of seasons and total study length may be determined separately for birds and bats, and should depend on pre-construction surveys, area data (e.g., APWRA), and results of the first year of post-construction fatality studies. If a site experiences levels of fatalities beyond those predicted, more intensive studies should be conducted.

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# APPENDIX D4
# Micrositing Reports

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# Siting Repowered Wind Turbines to Minimize Raptor Collisions at the Tres Vaqueros Wind Project, Contra Costa County, California

**Draft Report to the East Bay Regional Park District**

K. Shawn Smallwood and Lee Neher

19 March 2010

**ABSTRACT**: In support of a proposal to repower the Tres Vaqueros Wind Energy project, we related raptor flight observations to a digital elevation model (DEM) of the Vasco Caves Regional Preserve. Simple models were developed to predict the locations of golden eagle flights, red-tailed hawk and American kestrel hovering and kiting flights, and burrowing owl nest burrows. These models were then extrapolated to the entire Tres Vaqueros project area. We also used geoprocessing steps to help identify ridge saddles, notches, and benches where wind turbine locations have been found to be more hazardous to raptors. The combinations of zones defined by topography and highest concentrations of raptor flights and of burrowing owl nest burrows generally correspond with zones where new wind turbine installations should be restricted or more carefully considered.

## INTRODUCTION

In recent years, wind power generation in the Altamont Pass Wind Resource Area (APWRA) annually provided about 700 gigawatt-hours (GWH) of renewable energy to California but also while causing the deaths of an estimated 2,230 raptors and 9,300 total birds per year (Smallwood and Karas 2009). Given the poor success of mitigation measures applied to the old-generation wind turbines, and given the substantial reductions in avian fatality rates at a repowered wind project in the APWRA (Diablo Winds), repowering the nearly 5,000 old-generation wind turbines to a much smaller number of modern wind turbines was recommended by Smallwood and Karas (2009). Furthermore, modern wind turbines operate at higher capacity factors than the APWRA's deteriorating, old-generation wind turbines, and so can generate much more electricity. This increased power generation can be balanced against even fewer avian fatalities by carefully siting the new wind turbines to avoid portions of the landscape that are more intensively used by raptors (and other birds), and more importantly, that are more frequently associated with certain behaviors thought to increase a bird's vulnerability to wind turbine collision.

Wind turbine siting to minimize avian collision hazard requires an understanding of how birds use the airspace over the landscape where new wind turbines are proposed or planned. This understanding can come from monitoring of bird activity and specific flight behaviors under various wind conditions and landscape settings, and by relating utilization rates and flight behaviors to fatality rates (Smallwood et al. 2009b,c). In the 543-ha Vasco Caves Regional Preserve, Smallwood et al. (2009b,c) monitored raptors from 15 observation stations for 774 hours total from June 2006 through September 2007. These observation data can be related to a digital elevation model (DEM) to derive predictive models of locations where raptors more often

fly or perform certain behaviors. The predictive models can then be extrapolated to adjacent areas where new wind turbines are planned.

Bird monitoring in Vasco Caves Regional Preserve generally followed guidelines recommended by Gauthreaux (1996), Anderson et al. (1999), U.S. Fish and Wildlife Service (2003), and the California Energy Commission and California Department of Fish and Game (CEC & CDFG 2007). However, even though these guidelines have been applied many times in California and across the USA, no effort was made to adjust utilization rates for potentially substantial biases in use and interpretation of rates of utilization and behaviors. When relating bird observations to a DEM, interpretation of flight patterns can be confounded by relationships between bird detection rates and (1) distance of the bird from the observer, (2) the airspace visible from each observation station, and (3) duration of the observation session. For most species, detection rates should be expected to decline with increasing distance from the observer, decreasing visible airspace within the maximum survey radius due to obstructing hills and slopes, and increasing session duration as observers lose their concentration. The bias from session duration should not have been a problem for the observation data collected in Vasco Caves Regional Preserve because all sessions were of equal duration (1 hour), but the maximum survey radius of 600 m and the variation in complexity of terrain among observation stations provided ample opportunity for detection rates to vary for reasons other than decisions made by raptors about where to fly.

Based on newly available LIDAR data, we developed a new, more resolute DEM compared to Smallwood et al. (2009c). The new DEM has a 2-foot grid cell resolution instead of the 10-meter resolution used previously (Figure 1), though we used a 10-foot grid cell resolution when analyzing bird utilization data because the accuracy of the bird data did not warrant 2-foot resolution. We developed map-based predictive models of where raptors more often fly and perform specific hazardous behaviors, and we extended these models to the proposed Tres Vaqueros repowering project area to assist an effort to carefully site new wind turbine locations intended to cause the least harm to wildlife while also serving the power generation objectives of the project owner. We also explored biases in the observation data caused by distance from the observer and variation in visible air space among observation stations, though for the most part we did not adjust our predictive models for these biases because we felt more investigation of these biases is needed. Our specific study objectives were the following:

1. Develop predictive models of raptor flights and flight behaviors that relate to wind turbine collision hazard;

2. Extend map-based model predictions to the Tres Vaqueros project area to assist with planning exact wind turbine locations to minimize raptor collisions; and,

3. Characterize potential biases in raptor detection rates due to distance from the observer and variation in visible airspace among observation stations.

Due to relatively small sample sizes of bird observations relative to the number of grid cells within the Vasco Caves study area, we developed predictive models based on presence of bird

observations within grid cells, but for model validation we also used utilization rates that were crudely adjusted for visible airspace and distance from the observer.

## METHODS

### Study Site

*APWRA*.--The Altamont Pass Wind Resource Area encompasses about 165 $km^2$ (16,500 ha) of ridges and hills generally extending northwest to southeast in eastern Alameda and southeastern Contra Costa Counties, California. Located in the Inner Coast Range geomorphic province and bordering the Central Valley province, slopes are steep above intermittent streams, springs, and stock ponds. Elevations range 78 m to 470 m above mean sea level. Slopes are covered mostly by non-native, annual grasses, which grow mostly during January through March and are dead or dormant by June. Cattle grazers hold most of the land, leasing out wind energy rights to wind power companies. Wind turbines in the APWRA are arranged in rows of 2 to 62 turbines, typically along ridge crests (i.e., peaks of the ridge features) and ridgelines extending down toward ephemeral streams. Wind turbine rows also occupy slopes, valleys, and hill peaks, and all operate in winds from any direction, although most winds originate from the southwest or northwest. Old-generation wind turbine models are listed in Smallwood and Thelander (2008).

*Tres Vaqueros*.—The proposed repowering project site for Tres Vaqueros Windfarms LLC (Tres Vaqueros) is located within the northern portion of the APWRA, where elevations range 70 m to 300 m. The site is about 6 km southwest of Byron. The land encompassed by Tres Vaqueros includes a portion of the 2,983.35 acre Vasco Caves Regional Preserve, which is owned and managed by the East Bay Regional Park District (EBRPD) and a portion of the Los Vaqueros Reservoir watershed, which is owned and operated by the Contra Costa Water District (CCWD). However, no wind turbines are currently situated on CCWD land. Wind right ownership is complex. Blackhawk Nunn Partners and Vaquero Farms, Inc. retain wind rights to all of the land encompassed by Tres Vaqueros Windfarms LLC except for a 249.7 ha parcel within Vasco Caves Regional Preserve. The EBRPD retains the wind rights over this parcel, known as Souza 1. Pattern Energy owns the 86 330-KW Howden wind turbine addresses on Tres Vaqueros and has wind leases with EBRPD, Blackhawk Nunn Partners and Vaquero Farms, Inc. The original total rated capacity of the project was 28.8 MW, but only 25 MW were operational at any level between 2000 and 2008.

### Utilization data

*Raptor flights*.—B. Karas, H. Snively, and S. Smallwood collected bird utilization data from 15 observation stations weekly from June 2006 through September 2007, totaling 774 1-hour sessions (Smallwood et al. 2009b). Birds were recorded out to 600 m from each station. Birds recorded during these sessions were also mapped onto hand-held hard-copy maps depicting aerial images of the area under observation and including prominent features and blue lines highlighting ridge crests. Observers wrote symbols onto the maps where they estimated raptors and corvids were located at one-minute intervals, totaling 7,699 recorded observations. Mapped locations were then digitized as point features in ArcMap GIS layered onto a digital elevation model (DEM).

Bird attribute data were recorded into digital audio recorders and later transcribed to electronic spreadsheets. Attributes included species, number of individuals, flight behavior if flying, perch structure if perching, and height above ground. We also recorded interactions with other birds, and the number of minutes into the session. At the start of each session and at 15-min intervals we recorded temperature, wind speed, and wind direction.

*Burrowing owls*.—J. Barclay and L. Harmon searched for burrowing owls and their nest burrows from 33 observation points in 2006 and 39 points in 2007, using 10 x 40 binoculars and a 25 x 60 spotting scope from both inside and outside an automobile. They performed 15 surveys (54 hours) from 24 May to 2 August 2006, and 11 surveys (44 hours) from 3 April to 27 June 2007. In both years, 11 surveys were initiated during morning, generally spanning 08:00 hours to 13:00 hours. Nest burrows had a breeding pair in attendance during repeat surveys. To represent nest productivity, the maximum number of emergent juveniles between 2 and 4 weeks old was recorded. Burrowing owl burrows were characterized as point features in ArcMap GIS and layered onto our DEM of the study area. The analytical grid for the burrowing owl burrow model development consisted of 582,068 grid cells, which were within the property boundaries of the original Vasco Caves parcel and the Souza parcel.

**Digital Elevation Model**

We utilized two separate digital elevation model (DEM) grids for this project. The majority of geoprocessing tasks were performed using a 10 foot cell size DEM obtained from Contra Costa County. This data set was produced using Lidar data and ARC TIN software by Mapcon Mapping Inc. during 2007-2008. We also obtained 2 foot contour interval vector GIS data from Contra Costa County and produced by the same contractor. We then created a 2 foot DEM from the contours using ESRI software. The 2 foot DEM was used for slope and aspect modeling.

All derived parameters were calculated for the entire EBRPD property area, plus an aggregated 2,000 foot buffer around 15 bird observation points, to ensure that all bird observations would be covered. The aggregated 600-m buffer served as our mask for analyzing previously collected bird data against the higher resolution DEM. The 600-m radius was converted to a 2,000 foot radius and an additional 200 feet was added to buffer modeling data for geoprocessing.

Within the Tres Vaqueros project area, we limited (masked) statistical analyses to data within the areas searched for raptors and corvids. The resulting analytical grid was composed of 908,297 10x10-foot cells, each cell assigned a unique membership number. The analytical grid was used to develop and test predictive models, which were later projected across the 147,073,509 two foot grid cells composing the EBRPD buffered area and the 5,460,000 ten foot grid cell size expanded area grid.

**Slope Attributes**

The same geoprocessing steps were used to characterize slope attributes as reported in Smallwood and Neher (2004, 2009) and Smallwood et al. (2009a,c), but this time we refined some steps to differentiate grid cells between ridge-like (convex) and valley-like (concave)

tendencies. We used the Curvature function in the Spatial Analysis extension of ArcGIS 9.2 to calculate the curvature of a surface at each cell centroid. A positive curvature indicated the surface was upwardly convex at that cell, a negative curvature indicated the surface was upwardly concave, and a value of zero indicated the cell surface was flat. The curvature data (-51 to 38) were classified using the Natural Breaks (Jenks) function with 3 classes of curvature – convex, concave and mid-range. The break values were visually adjusted to minimize the size of the mid-range class. We used a series of geoprocessing steps called 'expand,' 'shrink,' and 'region group,' as well as 'majority filter tools' to enhance the primary slope curvature trend of a location. The result was a surface almost exclusively defined as either convex or concave (Figure 2). The convex surface areas consisted primarily of ridge crests and peaks, hereafter referred to as ridges, and the concave surface areas consisted primarily of valleys, ravines, ridge saddles and basins, hereafter referred to as valleys.

Line features representing the estimated average centers of ridge crests and valley bottoms (Figure 3) were derived from the following steps. ESRI's Flow direction function was used to create a flow direction from each cell to its steepest down slope neighbor, and then the Flow accumulation function was used to create a grid of accumulated flow through each cell by accumulating the weight of all cells flowing into each down slope cell. A valley started where 50 upslope cells had contributed to it in the Flow accumulation function, and a ridge started where 55 cells contributed to it. The flow direction and flow accumulation functions were applied to the ridges by multiplying the DEM by -2 to reverse the flow. Line features that represented ridges and valley bottoms were derived from ESRI's gridline and thin functions, which feed a line through the centers of the cells composing the valley or ridge. Thinning put the line through the centers of groups of cells ≥40 in the case of valleys.

The two foot slope analysis grid was used to create polygons with a relatively gentle slope. A Standard Deviation classification was used to identify areas with < 7.4 % slope. These areas were then converted to polygons and intersected with the ridge/valley lines to determine polygons associated with either ridge or valley descriptions. The borders of these polygons were converted to lines and combined with the ridge/valley line datasets, respectively, and polygons in valley features were termed *valley polygons* and polygons on ridge tops were termed *ridge polygons* (Figure 3).

Horizontal distances (m) were then measured between each DEM grid cell and the nearest valley bottom boundary (in the valley line combined data set) and the nearest ridge top boundary or ridgeline (in the ridgeline combined data set), referred to as *distance to valley* and *distance to ridge*, respectively. These distances were measured from the DEM grid cell to the closest grid cell of a valley bottom or ridgeline, respectively, not including vertical differences in position. The *total slope distance* was the sum of *distance to valley* and *distance to ridge*, and expressed the size of the slope. The DEM grid cell's position in the slope was also expressed as the ratio of *distance to valley* and *distance to ridge*, referred to as the *distance ratio*. This expression of the grid cell's position on the slope removed the size of the slope as a factor.

The vertical differences between each DEM grid cell and the nearest valley bottom boundary and nearest ridge top boundary or ridgeline were referred to as *elevation difference*, and this measure also expressed the size of the slope. In addition to the trend in slope grade at each DEM grid

cell, the *gross slope* was measured as the ratio of *elevation difference* and *total slope distance*. The DEM grid cell's position on the slope was also expressed as the ratio of the elevation differences between the grid cell and the nearest valley and between the grid cell and the nearest ridge, referred to as *elevation ratio*. Additionally, we measured the grid cell's position on the slope as the average of the percentage distance and the percentage elevation to the ridge top. This mean percentage was named *upslope*, and provided a more robust expression of the grid cell's position on the slope (Figure 4).

Upslope did not distinguish a grid cell's position between slopes on large hills versus medium or small-sized hills, so we expressed the local topographic influence of the feature where each cell was located, where *hill size* was the elevation difference between the nearest valley bottom polygon and nearest prominent ridge top polygon (Figure 5).

Each DEM grid cell was classified by *slope aspect* according to whether it faced north, northeast, east, southeast, south, southwest, west, northwest, or if it was on flat terrain. Each grid cell was also categorized as to whether its center on the landscape was windward, leeward or perpendicular to the prevailing southwest and northwest wind directions as recorded during the behavior observation sessions.

**Steps to identify saddles, notches, and benches**

Because a growing body of evidence has linked disproportionate numbers of raptor fatalities to wind turbines located on aspects of the landscape that are lower than immediately surrounding terrain or that represent sudden changes in elevation, we made a special effort to identify ridge saddles, notches in ridges, and benches of slopes, which are where ridge features emerge from hill slopes that extend above the emerging ridge. These types of locations are where winds often compress to create stronger force, known as declivity winds, and where raptors typically cross hilly terrain or spend more time to forage for prey items. Compared to surrounding terrain, these types of features are often relatively flatter or shallower in slope and sometimes include lower elevations (e.g., saddles). We used geoprocessing steps to provide some objectively to the identification of these features, but we also had to also use judgment because conditions varied widely in how such features were formed and situated.

We used the same procedures as used in the ridge/valley selection. The two foot slope analysis grid was used to create polygons with a relative gentle slope. A Standard Deviation classification was used to identify areas with < 7.4 % slope. These areas were then converted to polygons. Those polygons not associated with ridge or valley polygons were examined manually. Where these polygons were visually associated with saddle and or step features, they were identified as polygons representing saddles, notches, or benches. We also examined maps depicting contours of the variable *upslope*, because these contours readily revealed sudden breaks in slope typical of saddles, notches, and benches, which we also represented with polygons.

**Visible and Hidden Volumes of Surveyed Airspace**

At each 10x10 foot grid cell, we extruded volumes of airspace upward at 10-foot increments to a 460-foot (140.2 m) ceiling above the observer at each observation station, and each cube of airspace was classified whether it was visible or hidden from each observation station by line of sight. Cubic volumes of air space were each 1000 feet$^3$ (28.31 m$^3$). Visible versus hidden volumes of airspace were summed within 20 equidistant radial bands extending laterally from each observation station, each band 100 feet (30.48 m) farther from the last and the outer survey boundary 2000 feet (610 m) from the observer.

We summed the first observations of raptors recorded during utilization surveys, and converted the sums to detection rates. The most basic detection rate was number of observations per hour (each session was an hour). We also calculated a detection rate as the number of observations per hour per km$^3$ of visible airspace within each sequentially larger outer survey boundary, where boundaries were increased in 100-foot radial increments. The detection rates calculated within sequentially larger boundaries were spatially correlated because the numbers of birds within inner radial bands contributed to the numbers within outer radial bands. To remove the effect of this spatial correlation, we also calculated a detection rate as the number of observations per hour per km$^3$ of visible airspace within a specific radial band, for which the numbers of observations closer to the observer did not contribute to the numbers observed within the band. In either case, we compared detection rates to distance intervals from the observer and fit regression models to the patterns in the data.

**Associations between bird utilization and slope attributes**

We characterized the location of each raptor or corvid by slope aspect, slope grade, rate of change in slope, direction of change in slope, and elevation. These variables were also used to generate raster layers of the study area, one raster expressing the aspect of the corresponding slope (hereafter referred to as 'slope aspect'), and the other expressing whether the landscape feature was tending toward convex versus concave orientation. These features were defined using geoprocessing.

$Log_{10}$ and natural log transformations were used to better fit normal distributions, and then chi-square tests for association and principal components analysis (PCA) were used to further understand how the variables related to raptor locations and to each other. To minimize the effects of confounding, no more than one predictor variable was selected from each principle component for any model developed to classify grid cells according to whether they associated with raptor locations. Simple models were fit to grid cells overlapping activity levels of each species based on data queries. The performance of each model was assessed by the magnitude of the ratio of the observed number to the expected number of observations occurring within the suite of conditions specified by the data queries, where consideration was also given to fewer numbers of predictor variables and smaller portions of the study area contributing to the ratios. Map-based predictive models were later projected across the entire Tres Vaqueros project area. We also extended our mapping of special landscape features to the entire Tres Vaqueros project area.

## RESULTS

### Bird detection rates

The volume of airspace that was visible from the observation station decreased with increasing distance from the observer in Vasco Caves Regional Preserve, though the change in the percentage of airspace that was visible also varied considerable among stations (Figure 6). The visible volume of airspace over unobstructed, flat terrain within a 600 m radius and 140 m ceiling would be 158,336,269.7 $m^3$, or 0.1583 $km^3$, but over the complex terrain of Vasco Caves Regional Preserve it ranged from 0.1299 to 0.1919 $km^3$ (Figure 7), due to hills rising above observation stations and valleys descending below. Relative to the airspace that would be expected of flat terrain, this variation in visible airspace due to complex terrain translated into an initial reduction of visible airspace with increasing distance from the observer to about 600 feet away, followed by a gradual increase until the volumes of airspace observable was about the same at 2,000 feet away. To account for the variation in visible airspace among stations, we calculated avian utilization rates as the number of birds/hr/$km^3$ of visible airspace within a 140 m ceiling.

The mean number of first detections per hour increased with increasing distance from the observer (Figure 8), but not at the exponential rates that would be expected of spatial distributions that were unrelated to the locations of observation stations (bottom right graph of Figure 8). Adjusted for the volume of visible airspace, the mean number of first detections per hour decreased with increasing distance from the observer (Figure 9, Table 1). Assuming birds were distributed randomly with respect to the observation stations and that detection accuracy was greatest within the closest 100 - 200 feet of airspace from the observer, then detection rates declined steeply with increasing distance from the observer (see horizontal dashed lines in Figure 9). An interesting exception to this pattern was for burrowing owls, which were most detectable either at 200 feet or between 700 and 800 feet from the observer, but the pattern of declining detection rates resumed for burrowing owl beyond 800 feet (Figure 9).

Detection rates within specific radial bands from the observer varied inter-specifically (Figure 10), revealing lower detection rates of some species nearby the observer, peaks in detection rates of some species at specific distances from the observer, and increasingly greater detection rates with distance for some species such as red-tailed hawk (Figure 10). However, again assuming birds were unaffected by the locations of observation stations, detection rates were increasingly lower than expected rates as the distance from the observer increased (see solid line in bottom right graph in Figure 10). Adjusted for the volume of visible airspace within specific radial bands, the mean number of first detections per hour again decreased with increasing distance from the observer (Figure 11, Table 2), though decreases were more rapid and nadir's were reached closer than when detection rates were adjusted for the cumulative volume of visible airspace with increasing distance from the observer (Figure 9).

For perspective, we compared detection rates within radial bands and cumulatively with increasing distance from the observer (Figure 12). Figure 12 illustrates how much faster detection rates decline with increasing distance when detection rates are restricted to within radial bands from the observer, even for large-bodied species such as golden eagle. The number

of birds seen nearby dominates detection rates attributed to increasingly greater distances from the observer.

Table 1. First detections/hr/km3 visible airspace within circle regressed on distance from observer.

| Species/Group | Model | Model parameters | | | | |
|---|---|---|---|---|---|---|
| | | a | b | $r^2$ | SE | P |
| Golden eagle | Power | 12.6915 | -0.7430 | 0.97 | 0.10 | 0.001 |
| Red-tailed hawk | Power | 90.0736 | -0.6041 | 0.96 | 0.10 | 0.001 |
| Turkey vulture | Power | 66.4367 | -0.7159 | 0.97 | 0.11 | 0.001 |
| Northern harrier | Logarithmic | 11.0526 | -3.2695 | 0.95 | 0.63 | 0.001 |
| Prairie falcon | Power | 21.8581 | -1.1817 | 0.98 | 0.14 | 0.001 |
| American kestrel | Power | 75.5038 | -1.0143 | 0.94 | 0.21 | 0.001 |
| Burrowing owl | None | | | | | |
| Raptors | Power | 281.1493 | -0.7349 | 0.97 | 0.10 | 0.001 |
| Common raven | Power | 306.0222 | -0.7777 | 0.97 | 0.12 | 0.001 |

Table 2. First detections/hr/km3 visible airspace within radial bands regressed on distance from observer.

| Species/Group | Model | Model parameters | | | | |
|---|---|---|---|---|---|---|
| | | a | b | $r^2$ | SE | P |
| Golden eagle | Inverse | 0.3842 | 10.5260 | 0.88 | 0.91 | 0.001 |
| Red-tailed hawk | Power | 86.3666 | -0.7585 | 0.91 | 0.20 | 0.001 |
| Turkey vulture | Power | 65.3069 | -0.9403 | 0.88 | 0.29 | 0.001 |
| Northern harrier | Logarithmic | 10.4761 | -3.6200 | 0.87 | 1.19 | 0.001 |
| Prairie falcon | Inverse | -1.1380 | 16.9745 | 0.96 | 0.83 | 0.001 |
| American kestrel | Inverse | -1.6516 | 54.0601 | 0.95 | 2.84 | 0.001 |
| Burrowing owl | None | | | | | |
| Raptors | Power | 295.2248 | -0.9994 | 0.96 | 0.18 | 0.001 |
| Common raven | Power | 369.0675 | -1.1663 | 0.91 | 0.31 | 0.001 |

**Landscape used to develop predictive models**

Principal components analysis, using a correlation matrix and varimax rotation, explained 65% of the variation in predictor variables measured among the grid cells in Vasco Caves (Table 3). Component 1 can be interpreted as position on the slope. Component 2 can be interpreted as the slope's rate of change, i.e., steepness. Component 3 can be interpreted as the slope's orientation and size. Only one variable with a high loading was used from each component for subsequent predictive model development, though all variables were tested for relationships with avian activity levels.

Table 3. Principal Components following varimax rotation in PCA, showing only those rotated factor loadings >0.1.

| Variable | Component 1 Position on slope | Component 2 Slope steepness | Component 3 Slope orientation & size |
|---|---|---|---|
| ln Distance ratio | 0.982 | | |
| ln Elevation ratio | 0.939 | | |
| $\log_{10}$ Distance to valley | 0.887 | 0.243 | |
| $\log_{10}$ Distance to ridge | -0.846 | 0.275 | |
| Elevation | 0.436 | | |
| Elevation difference | | 0.944 | -0.120 |
| Gross slope | | 0.835 | 0.206 |
| $\log_{10}$ Total slope distance | | 0.622 | -0.560 |
| Slope (percentage) | 0.107 | 0.607 | 0.369 |
| Aspect | | 0.127 | 0.722 |
| Percent upslope | 0.175 | | -0.216 |
| **Percent of variance** | **32.6** | **22.7** | **10.0** |

**Topographic associations**

The grid cell's position as a percentage up slope, represented by the variable *upslope*, strongly influenced the locations of burrowing owl burrows, golden eagle flight locations, and red-tailed hawk and American kestrel hovering and kiting locations (Figures 13 and 14). Whereas golden eagle flights did not relate with *upslope* over valley bottoms and lower slopes, they increased in frequency with increasing upslope values from halfway up the slopes, peaking at the tops of slopes (Figure 13). Hovering and kiting by red-tailed hawks and American kestrels was most commonly observed high on slopes, though American kestrel hovering/kiting flights peaked between 90% and <100% of the tops of slopes. Burrowing owl nest burrows were most numerous between about 10% and 25% of the way up slopes (Figure 14).

The explanatory power of *upslope* sufficed to keep predictive models simple. This variable in combination with one to a few other variables performed well, encompassing disproportionately larger numbers of observations relative to the land area delineated by each zone of the model (Figure 15), where each activity zone also included the land area and bird observations in all activity zones of higher value. For example, the golden eagle activity zone 2 included zones 3 and 4.

Golden eagle flights were most strongly associated with the upper 40% of slopes on the largest hills in the study area and on southwest- and west-facing slopes (Table 4, Figure 16). These slope conditions represented only 0.5% of the study area, but golden eagles were observed flying there 7.8 times other than expected. Red-tailed hawk hovering and kiting flights most strongly associated with the upper 10% of slopes on moderately large hills in the study area and on slopes facing southwest (Table 5, Figure 17). These slope conditions represented only 0.1% of the study area, but red-tailed hawks hovered and kited there 51 times other than expected. American kestrel hovering and kiting flights most strongly associated with the upper 30% of slopes on

moderately large hills in the study area and on slopes facing southwest (Table 6, Figure 18). These slope conditions represented only 0.8% of the study area, but American kestrels hovered and kited there 27 times other than expected. A combined model of golden eagle flights and of red-tailed hawk and American kestrel hovering and kiting was obviously similar to the species-specific models, since they were all influenced by the variable *upslope*, moderate to large sized hills, and southwest slopes (Table 7, Figure 19). The slope conditions associated with the highest combined zone of activity occupied 2.7% of the study area and these three species were seen flying there >10 times other than expected. Burrowing owl nest burrows most strongly associated with locations 5 to 25% of the way up the slope nearest valley polygons lower than 135 m elevation and on relatively smaller hills of less than 35 m elevation difference from nearest valley bottom to nearest ridge top (Table 8). These slope conditions represented only 5% of the burrowing owl study area, but burrowing owl nest burrows were found there 7.7 times other than expected.

Table 4. Predictive model of golden eagle flight locations in the masked study area. Obs / Exp represented the ratio of the observed to expected numbers of flight observations, where the expected number was the product of the total number of flight observations and the proportion of the area composed of the corresponding zone. This ratio informed of the performance of the model. Zones were not independent, as zones of smaller numbers included all those of larger numbers.

| Zone | Model | Cumulative observed | Percent of area | Obs / Exp |
|---|---|---|---|---|
| 0 | *Upslope* <60% | 259 | 57.4 | 1.00 |
| 1 | *Upslope* >60% | 164 | 27.4 | 1.49 |
| 2 | *Upslope* >60%, *hill size* > 55 m | 86 | 11.8 | 2.17 |
| 3 | *Upslope* >60%, *hill size* > 55 m, aspect = SW, W, NW | 43 | 2.9 | 4.83 |
| 4 | *Upslope* >60%, *hill size* > 85 m, aspect = SW, W | 11 | 0.5 | 7.82 |

Table 5. Predictive model of red-tailed hawk hovering and kiting locations in the masked study area. Obs / Exp represented the ratio of the observed to expected numbers of flight observations, where the expected number was the product of the total number of flight observations and the proportion of the area composed of the corresponding zone. This ratio informed of the performance of the model. Zones were not independent, as zones of smaller numbers included all those of larger numbers.

| Zone | Model | Cumulative observed | Percent of area | Obs / Exp |
|---|---|---|---|---|
| 0 | *Upslope* <50% | 382 | 50.3 | 1.00 |
| 1 | *Upslope* >50% | 331 | 24.6 | 1.74 |
| 2 | *Upslope* >50%, aspect = S, SW, W, NW, N | 283 | 15.4 | 2.94 |
| 3 | *Upslope* >60%, aspect = S, SW, W | 194 | 7.5 | 5.21 |
| 4 | *Upslope* >60%, aspect = SW | 92 | 1.9 | 10.93 |
| 5 | *Upslope* >60%, aspect = SW, *hill size* 75-90 m | 48 | 0.2 | 38.77 |
| 6 | *Upslope* ≥90% & <100%, aspect = SW, *hill size* 75-90 m | 21 | 0.1 | 50.90 |

Table 6. Predictive model of American kestrel hovering and kiting locations in the masked study area. Obs / Exp represented the ratio of the observed to expected numbers of flight observations, where the expected number was the product of the total number of flight observations and the proportion of the area composed of the corresponding zone. This ratio informed of the performance of the model. Zones were not independent, as zones of smaller numbers included all those of larger numbers.

| Zone | Model | Cumulative observed | Percent of area | Obs / Exp |
|---|---|---|---|---|
| 0 | *Upslope* <30% | 185 | 36.1 | 1.00 |
| 1 | *Upslope* >30% | 174 | 38.6 | 1.47 |
| 2 | *Upslope* >30%, *hill size* 50-130 m | 145 | 8.2 | 3.09 |
| 3 | *Upslope* >60%, *hill size* 50-130 m | 131 | 9.1 | 4.12 |
| 4 | *Upslope* >60%, *hill size* 50-130 m, aspect = S, SW, W, NW, N | 104 | 6.5 | 6.94 |
| 5 | *Upslope* >70% & <100%, *hill size* 70-100 m, aspect = S, SW, W | 53 | 0.8 | 18.14 |
| 6 | *Upslope* >70% & <100%, *hill size* 70-100 m, aspect = SW or W | 40 | 0.8 | 27.71 |

Table 7. Predictive model of combined golden eagle, red-tailed hawk, and American kestrel locations in the masked study area, where zones of activity were derived from composite zones, $Z_{COMP}$, calculated as:

$$Z_{COMP} = \frac{\left(\text{GOEA}\frac{\text{Zone}}{Z_{MAX}} + \text{RTHA}\frac{\text{Zone}}{Z_{MAX}} + \text{AMKE}\frac{\text{Zone}}{Z_{MAX}}\right)}{3} \times 100\% ,$$

where Zone = the activity zone membership of the grid cell for GOEA = golden eagle, RTHA = red-tailed hawk, and AMKE = American kestrel, and $Z_{MAX}$ was the maximum zone membership possible. Zones for use in a predictive model were derived from natural breaks in $Z_{COMP}$ values. Obs / Exp represented the ratio of the observed to the expected numbers of flight observations, where the expected number was the product of the total number of flight observations and the proportion of the area composed of the corresponding zone. This ratio informed of the performance of the model. Zones were not independent, as zones of smaller numbers included all those of larger numbers.

| Zone | Model | Cumulative observed | Percent of area | Obs / Exp |
|---|---|---|---|---|
| 0 | $Z_{COMP}$ = 0 | 822 | 36.1 | 1.00 |
| 1 | $Z_{COMP}$ = 1-15 | 726 | 16.2 | 1.38 |
| 2 | $Z_{COMP}$ = 16-24 | 659 | 17.2 | 1.68 |
| 3 | $Z_{COMP}$ = 25-35 | 580 | 12.8 | 2.31 |
| 4 | $Z_{COMP}$ = 36-40 | 446 | 9.6 | 3.06 |
| 5 | $Z_{COMP}$ = 41-60 | 341 | 5.4 | 5.12 |
| 6 | $Z_{COMP}$ = 61-100 | 224 | 2.7 | 10.15 |

Table 8. Predictive model of burrowing owl nest burrow locations on the 543-ha Vasco Caves and Souza parcels that were searched by Albion Environmental in 2006-2007. Obs / Exp represented the ratio of the observed to expected numbers of nest burrows, where the expected number was the product of the total number of nest burrows and the proportion of the area composed of the corresponding zone. This ratio informed of the performance of the model. Zones were not independent, as zones of smaller numbers included all those of larger numbers.

| Zone | Model | Cumulative observed | Percent of area | Obs / Exp |
|---|---|---|---|---|
| 0 | *Upslope* >60% | 46 | 44.5 | 1.00 |
| 1 | *Upslope* <60% | 39 | 23.6 | 1.53 |
| 2 | *Upslope* <60%, nearest *valley polygon* <160 m elevation | 36 | 12.4 | 2.45 |
| 3 | *Upslope* <60%, nearest *valley polygon* <135 m elevation | 31 | 14.4 | 3.45 |
| 4 | *Upslope* 5-26%, nearest *valley polygon* <135 m elevation, *elevation difference* <35 m | 18 | 5.1 | 7.65 |

**Predicted Hazard Zones in the Tres Vaqueros Project Area**

The predictive models developed in the masked study area were projected to the Tres Vaqueros project area, part of which included the masked study area and part of which was immediately adjacent to the study area to the west and northwest (Figures 20-24). A map of hazard polygons was developed separately from the predictive models based directly on bird utilization data, and this map is depicted in Figure 25.

## DISCUSSION

We produced simple models of golden eagle flights, red-tailed hawk and American kestrel hovering and kiting, and of burrowing owl nest burrow locations. These models can be used to guide wind turbine siting intended to minimize encounter frequencies between raptors and operating wind turbines, although significant uncertainties in the mechanisms of collisions could reduce the effectiveness of the models. For example, we suspect but we do not know that where golden eagles most often fly corresponds with where they get killed by wind turbines, nor do we know that where red-tailed hawks and American kestrels hover most often is also where they get killed (Smallwood et al. 2009b). We suspect but we do not know that the locations of burrowing owl nest burrows correspond with wind turbine-caused fatalities (Smallwood and Neher 2009, Smallwood et al. 2007, 2009a,c). It may be that rarely performed behaviors cause the majority of wind turbine collisions, and we may not have characterized those rare behaviors. However, until these uncertainties are eliminated, a reasonable first assumption is that our model predictions should correspond with increased hazard of wind turbine collisions should wind turbines be installed where our models predict highest activity levels.

We recommend that wind turbines not be located in the hazard zones defined by ridge saddles, notches, and benches, or where there are other breaks in the slope of the ridge or hill. We also

recommend that wind turbines are not located in the lowest terrain, such as in valley or ravine bottoms. We recommend that they not be located where the golden eagle flight prediction model scored 3 or 4 (orange or red in the map), and that caution be exercised where the model scored 2 (light green in the map). We recommend that wind turbines not be located where the red-tailed hawk hovering model scored 4, 5 or 6 (orange or red in the map), and that caution be used where the model scored 3 (yellow in the map). We recommend that wind turbines not be located where the American kestrel hovering model scored 4, 5 or 6 (orange or red in the map), and that caution be used where the model scored 2 or 3 (light green or yellow in the map). Or alternatively, we recommend that wind turbines not be located where the composite model scored 4, 5, or 6 (orange or red in the map), and that caution be exercised when the model scored 3 (yellow in the map). We recommend that wind turbines not be located where the burrowing owl nest burrow model scored 4 (red in the map), and that caution be exercised where the model scored 3 (orange in the map). We recommend that preference be given to locations where predictive models scored low or at the boundaries of two zones that scored relatively low. At boundaries between zones of high and low scores, we recommend that the wind turbines be located as far from the high-scored zone as practicable.

The models we developed were crude and can be improved upon. During the course of this study we thought of another approach to weighting observations based on distance from the observer, and another approach to model development. We did not have time to implement these other approaches, however, because we needed to produce model predictions in time to contribute to the environmental review of this wind power project. Nevertheless, our models represent significant improvements over previous efforts to predict raptor activity areas relevant to wind turbine impacts.

Although we only crudely adjusted raptor observations for declining detection rates with increasing distance from observation stations, we included our hypothesis tests between detection rates and distance from the observer. The results of these hypothesis tests will be used to improve our predictive models for the Tres Vaqueros and other wind power project sites. It was clear that visible airspace varies greatly from place to place, and that detection rates generally decline rapidly with increasing distance from the observer. Complicating this general pattern however, we also found evidence that some species avoid the observers, leading to lower detection rates at closer distances from the observer.

## ACKOWLEDGEMENTS

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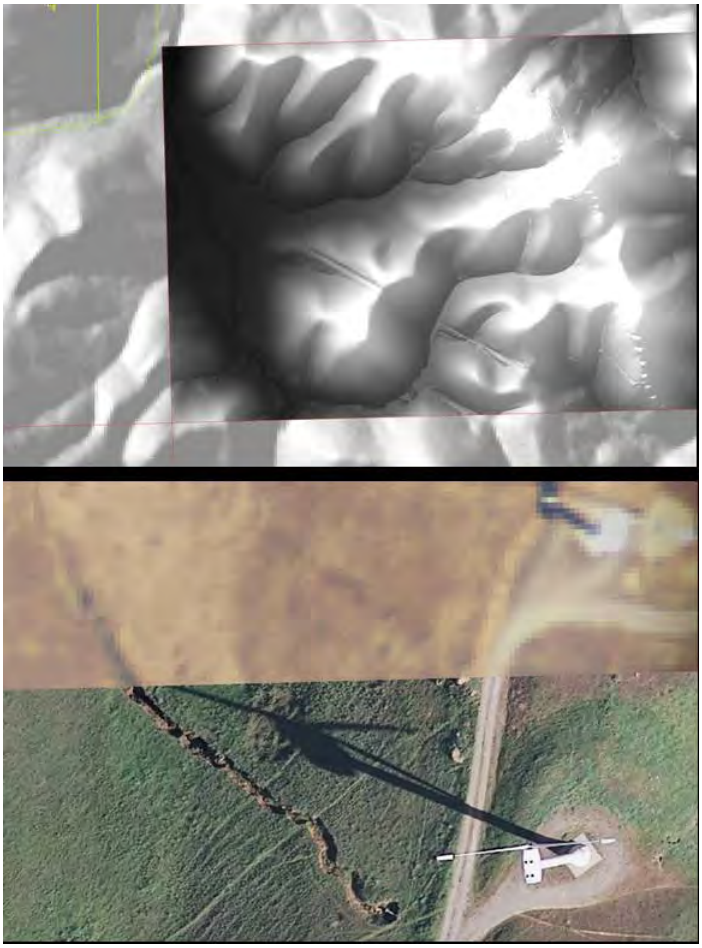

Figure 1. Example differences in imagery of the project area that is now available (hillshade above and photo below), in both cases comparing the 10-m resolution of the imagery that contributed to the Vasco Caves study of 2006-2007 (Smallwood et al. 2009) and the 2-foot imagery that contributed to this study.

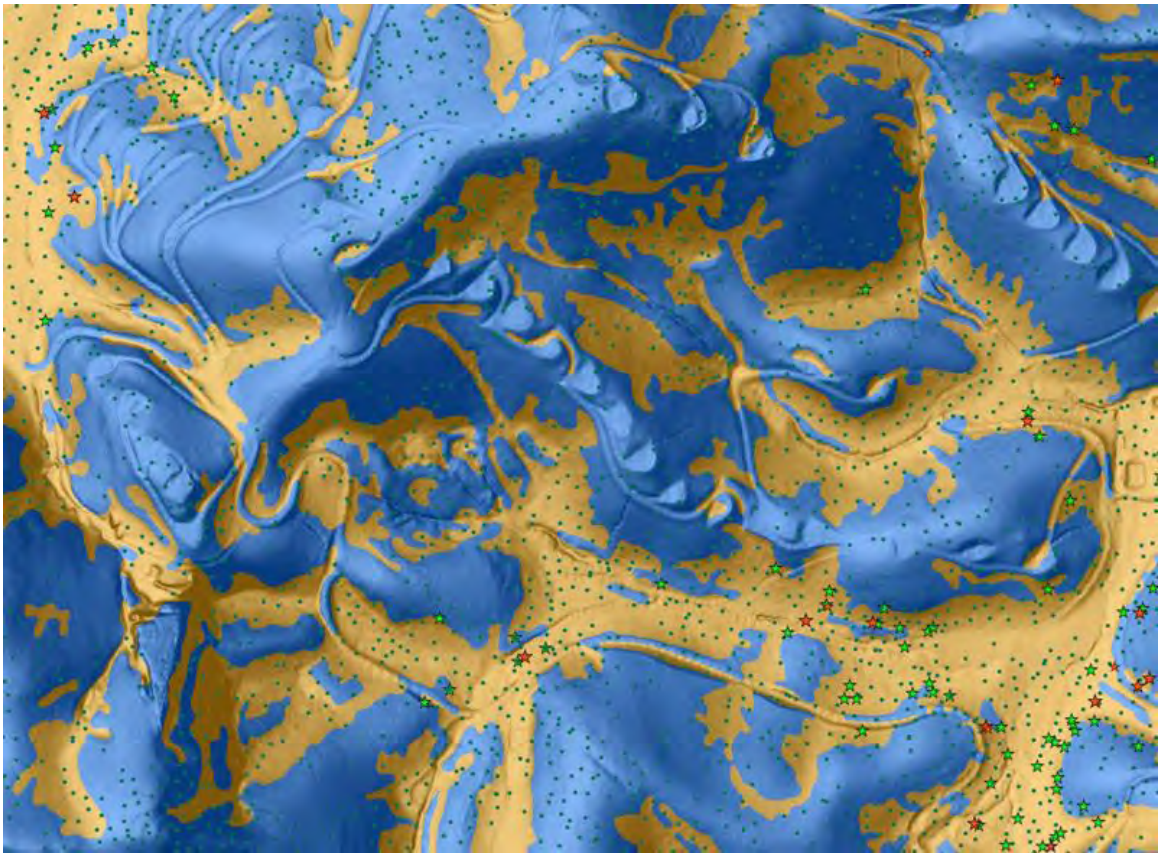

Figure 2. Example representation of differentiation between convex-trending ridge-like features (blue) and concave-trending valley-like features (gold) within the Vasco Caves Regional Preserve and overlain by mammal burros (greed dots) and burrowing owl nest burrows (stars) mapped in 2006-2007.

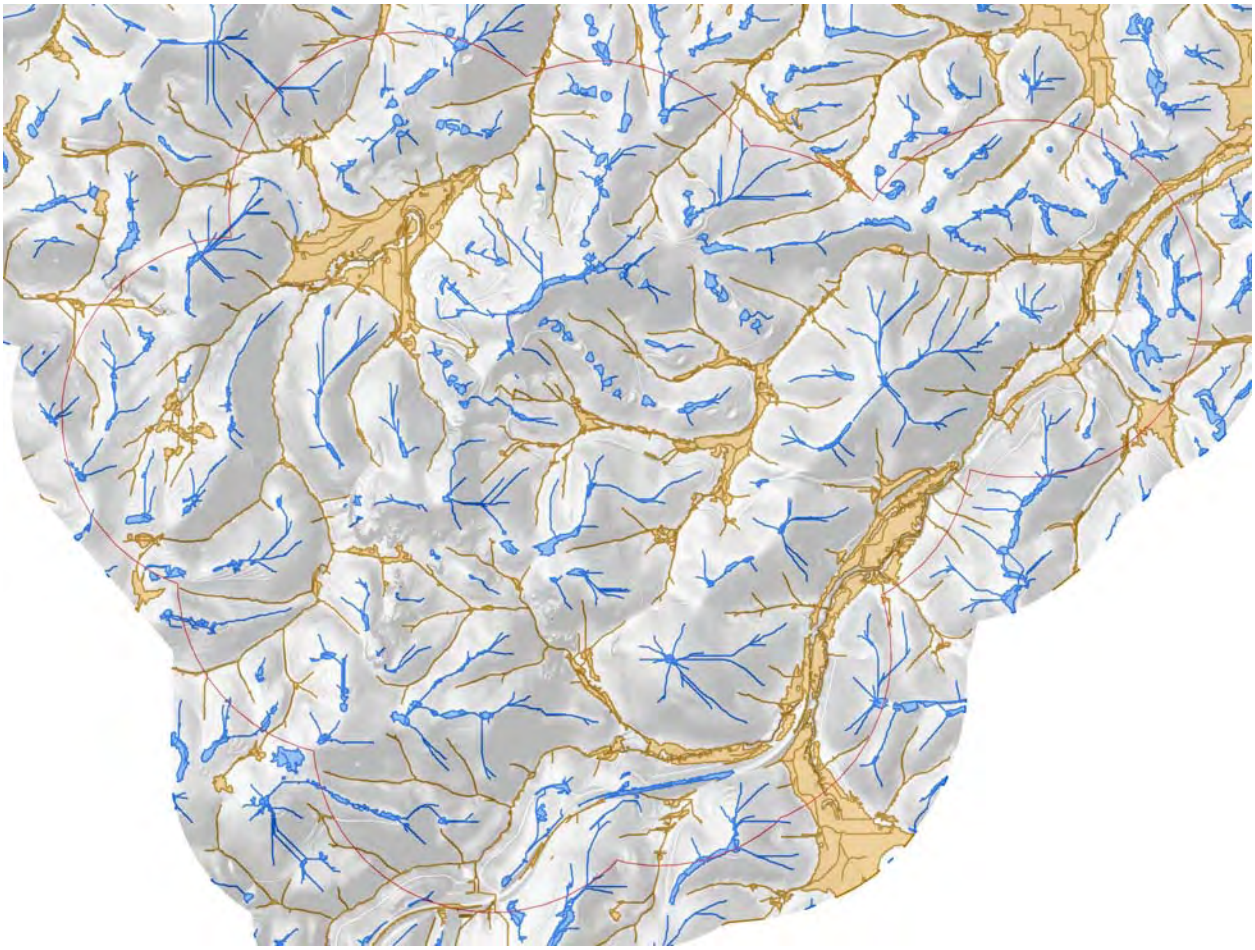

Figure 3. Line features representing ridges and valley bottoms, and significant ridge top and valley bottom polygons, from which revised slope measurements were made.

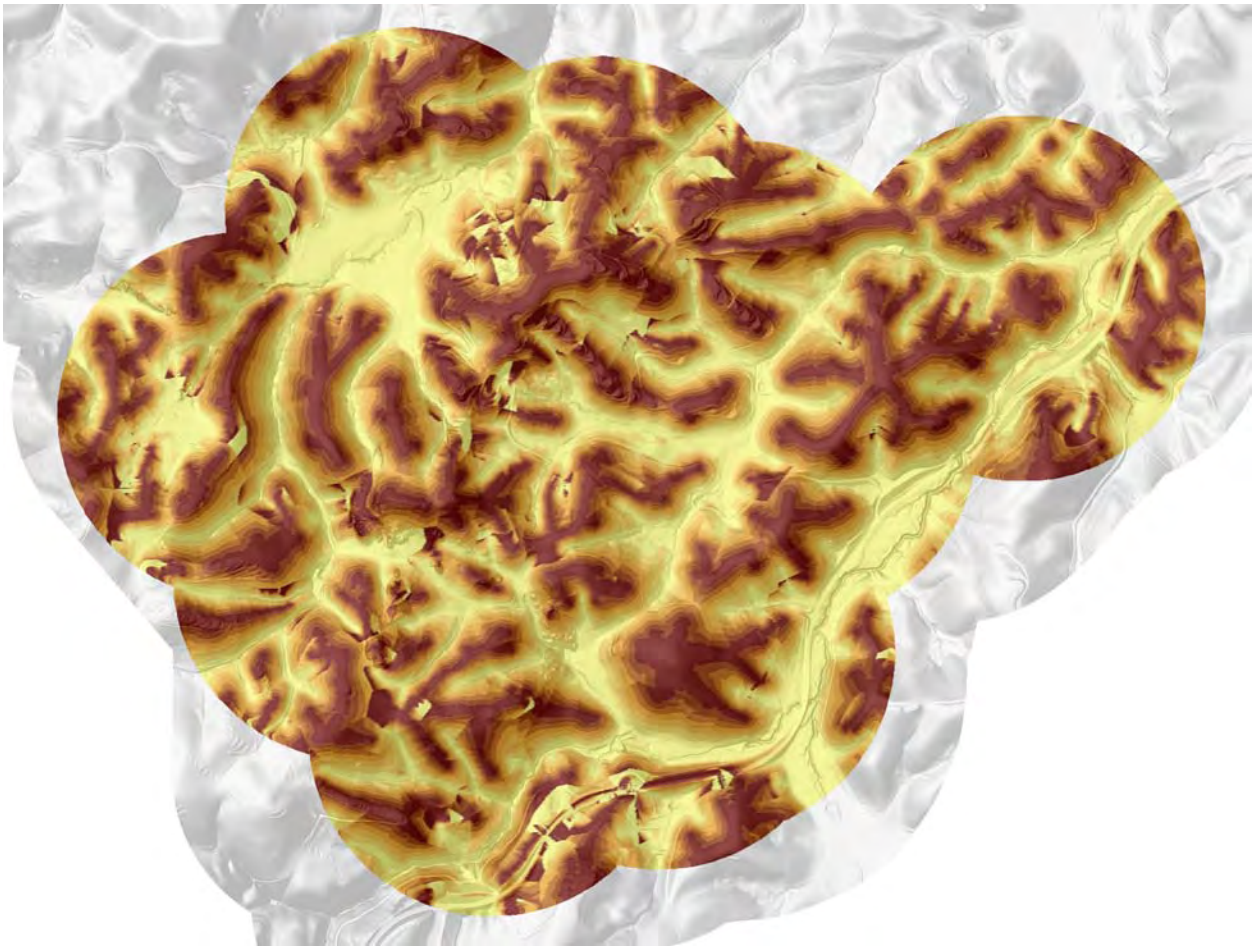

Figure 4. Position on the slope as a percentage of the way from bottom (yellow) to top (maroon) of the slope features in the analytical grid, including all areas surveyed fro birds by Smallwood et al. (2009).

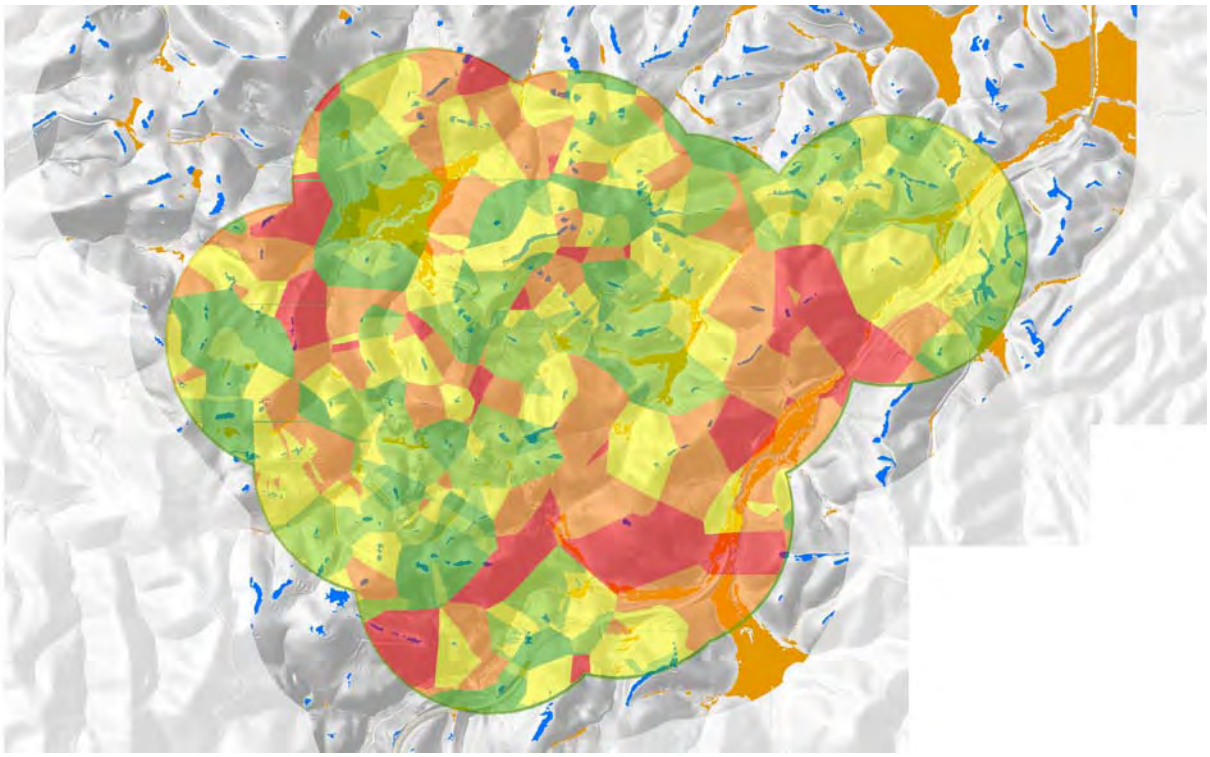

Figure 5. Local topographic influence of the underlying hill slopes, measured as the elevation difference between the nearest valley bottom (gold) and nearest crest of the most prominent hills and ridges in the area (blue), where red denoted largest hills, orange was second to largest, yellow was moderate, light green was second smallest, and dark green was smallest hill features.

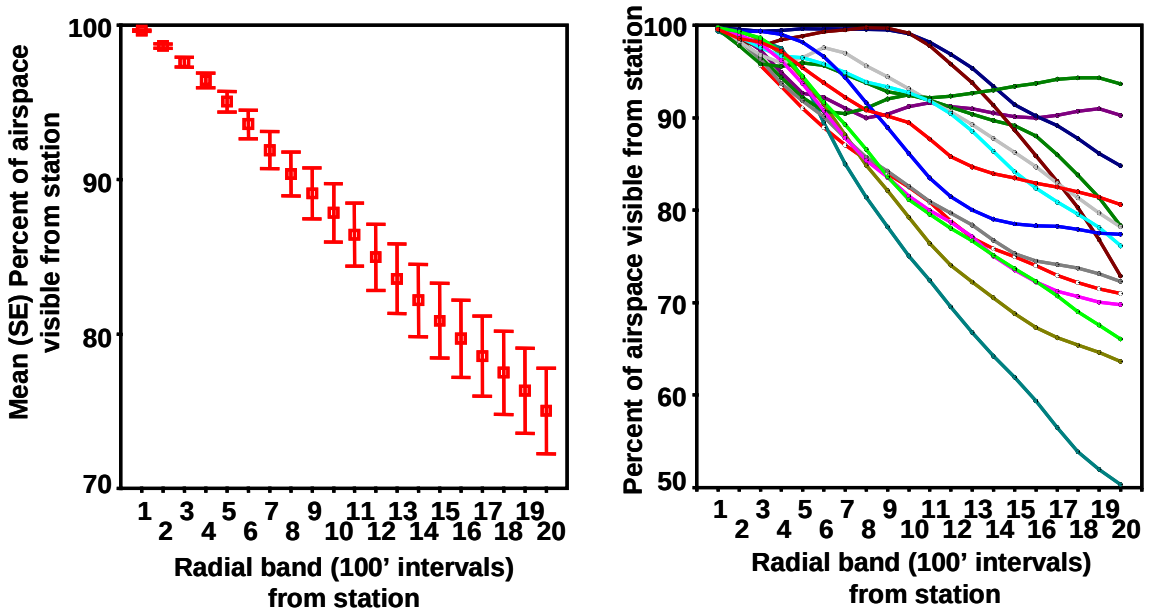


Figure 6. Change in mean (left graph) and station-specific (right graph) percentage of visible volume of airspace within 140-m ceiling and within specific radial bands from the observer (x-axis) among 15 observation stations at Vasco Caves Regional Preserve.

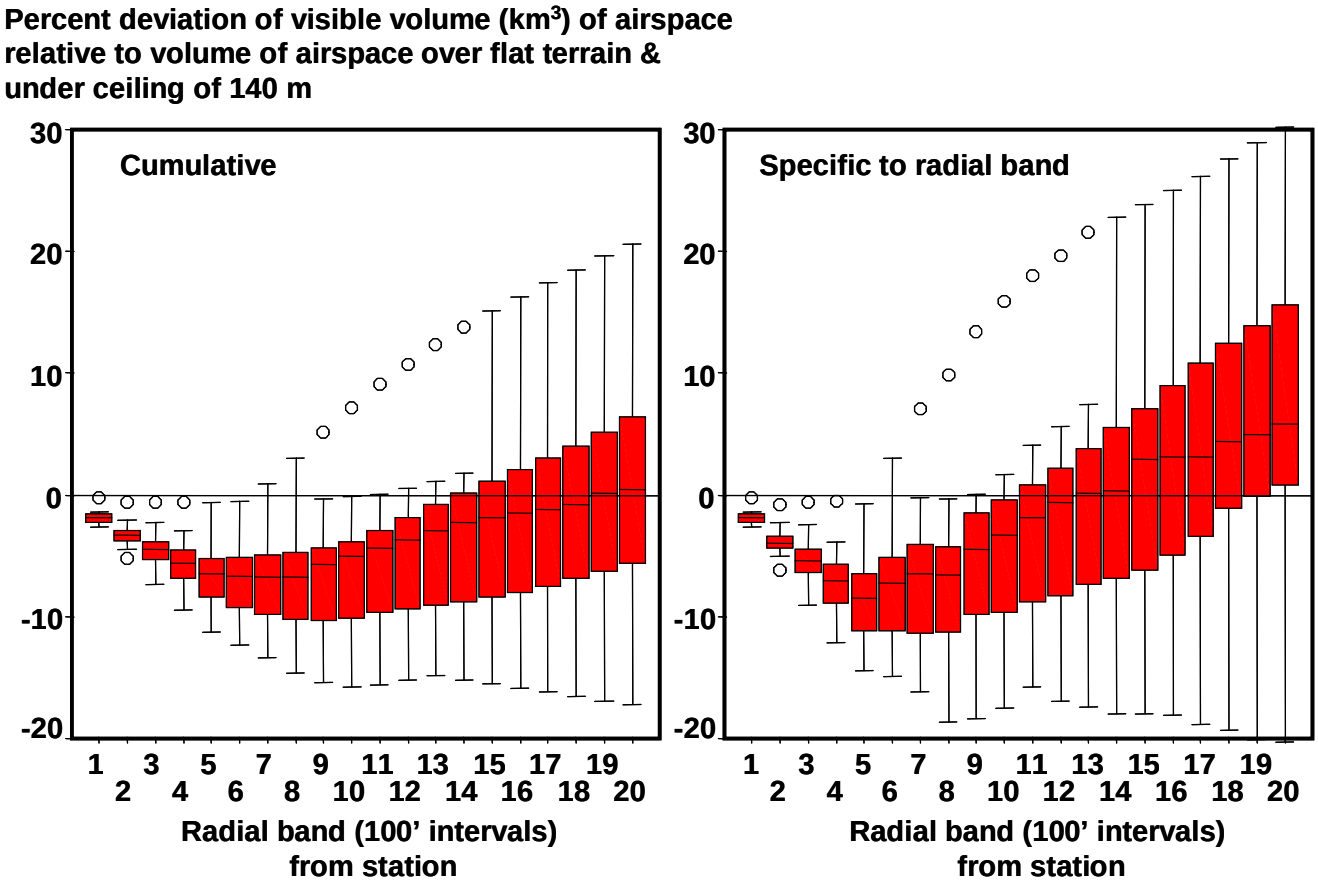


Figure 7. Differences in visible volume of airspace between flat and complex terrain as distance increases from the observer among 15 observation stations in Vasco Caves Regional Preserve, cumulatively (left graph) and specific to radial bands at 100-foot increments from the observer (right graph).

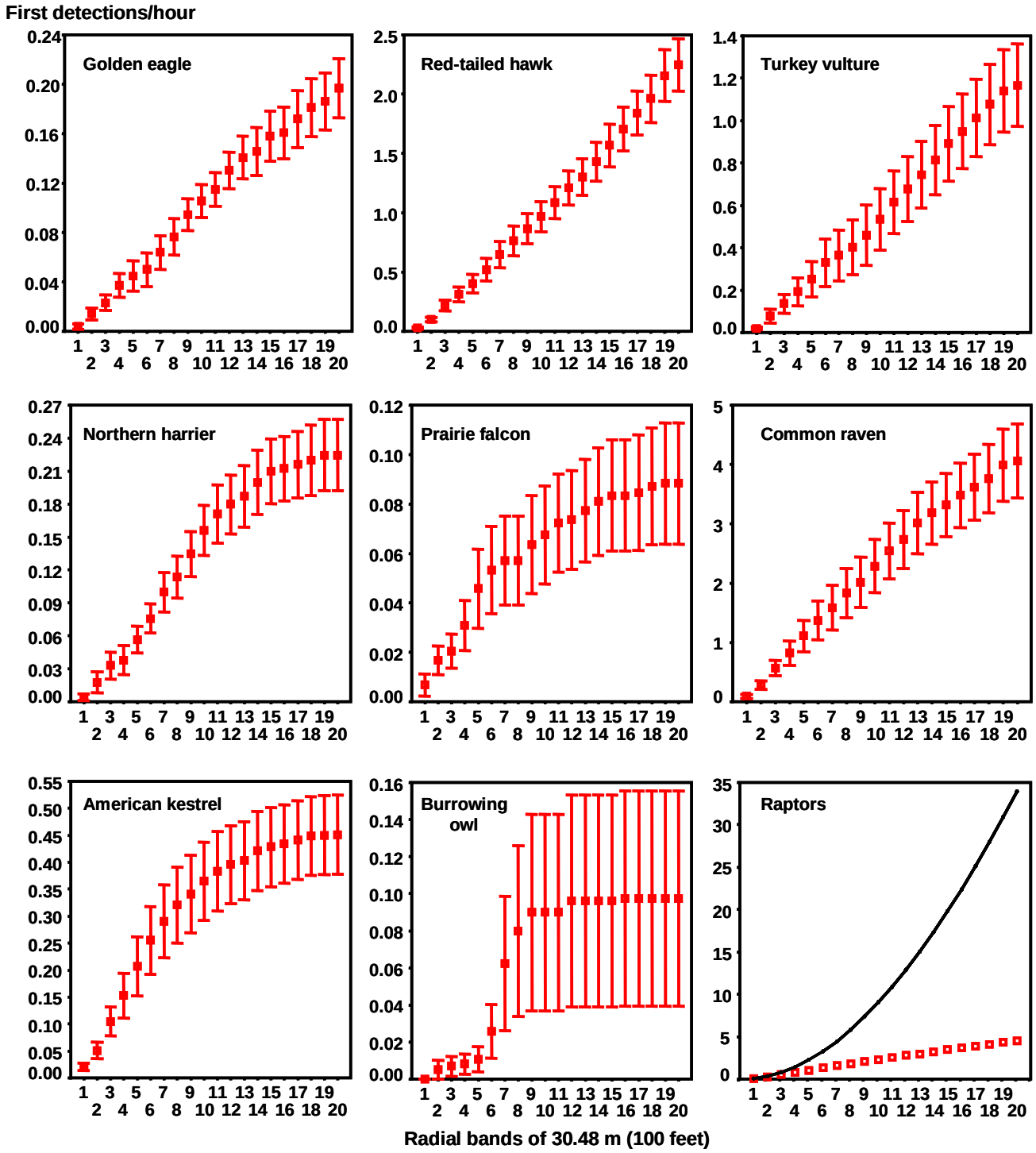


Figure 8. Cumulative mean first detections/hour increased with increasing distance from the observer for golden eagle, red-tailed hawk, turkey vulture, northern harrier, prairie falcon, common raven, American kestrel, burrowing owl, and all raptors as a group in Vasco Caves Regional Preserve, 2006-2007. The solid line in the lower right graph depicts the exponential increase in cumulative detections of raptors, assuming the spatial distribution of raptors was unaffected by the locations of observation stations and detection rate was most accurate within the closest 100 feet.

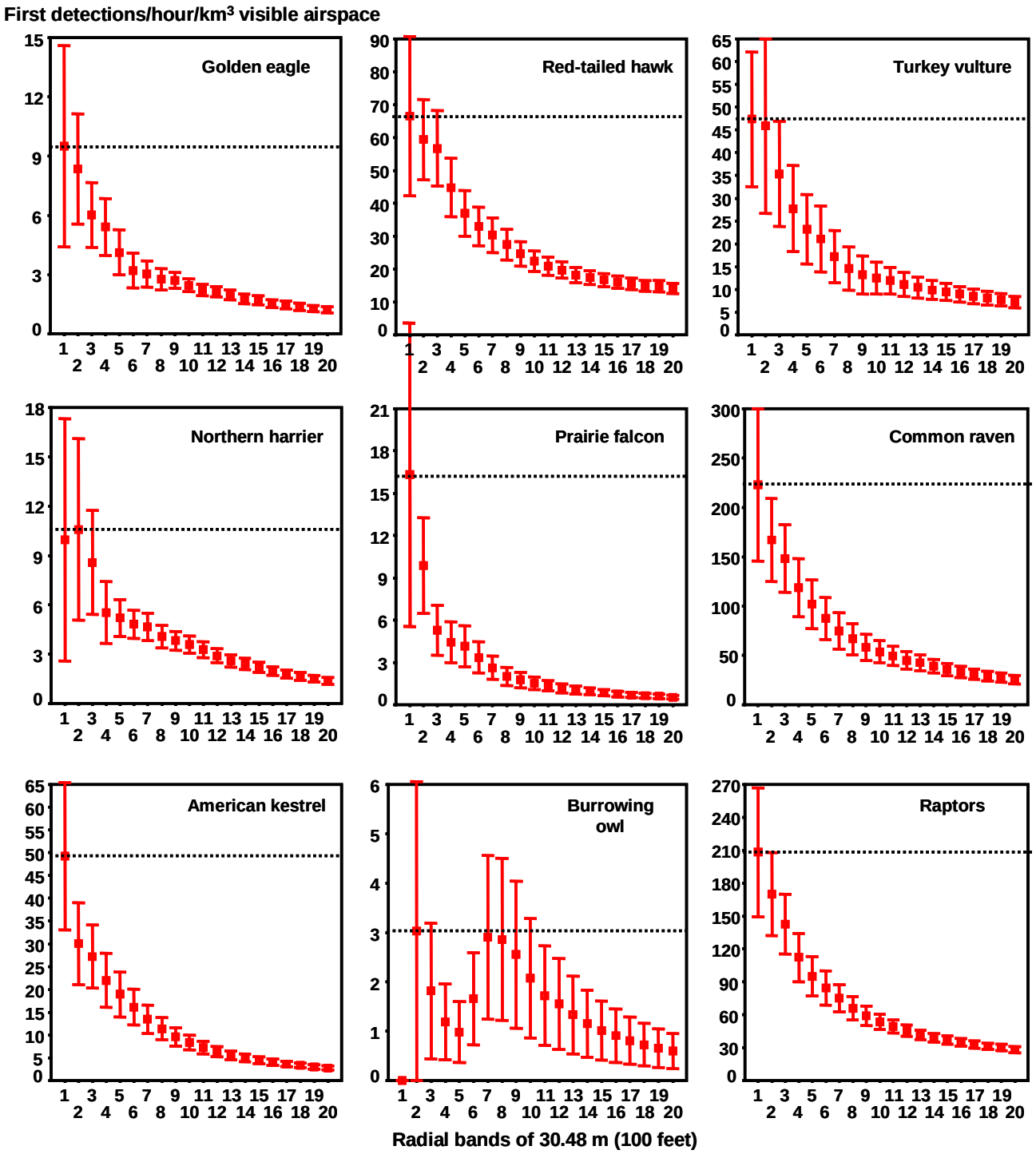


Figure 9. Cumulative mean first detections/hour/km$^3$ of visible airspace decreased with increasing distance from the observer for golden eagle, red-tailed hawk, turkey vulture, northern harrier, prairie falcon, common raven, American kestrel, burrowing owl, and all raptors as a group in Vasco Caves Regional Preserve, 2006-2007. The horizontal dashed line represented detection rates expected of each species assuming spatial distributions were unaffected by the locations of observation stations and were most accurate within the closest 100 or 200 feet.

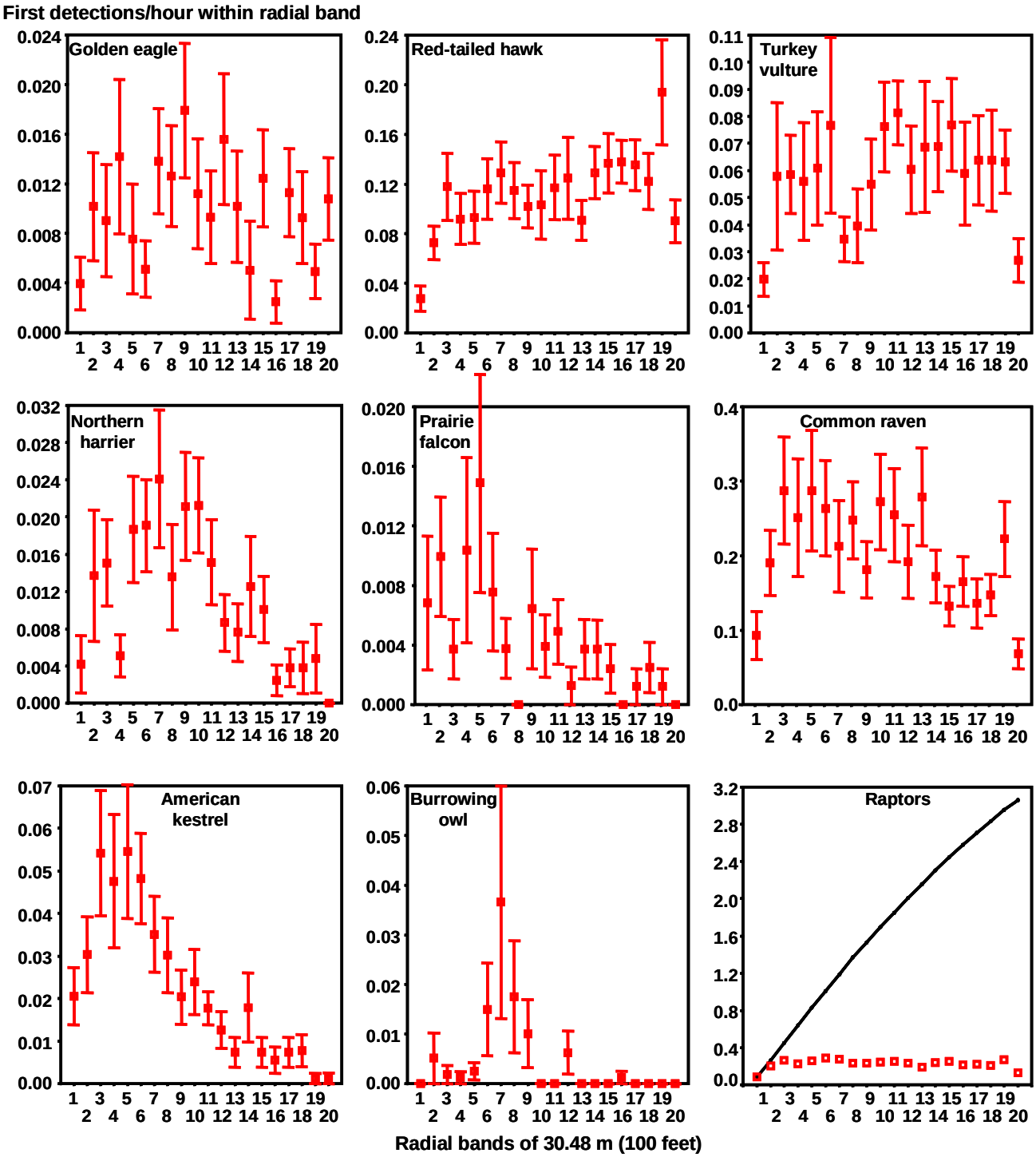


Figure 10. Specific to radial bands, mean first detections/hour changed with increasing distance from the observer for golden eagle, red-tailed hawk, turkey vulture, northern harrier, prairie falcon, common raven, American kestrel, burrowing owl, and all raptors as a group in Vasco Caves Regional Preserve, 2006-2007. The solid line in the lower right graph depicts the increase in detection rates of raptors assuming spatial distributions were unaffected by the locations of observation stations and were most accurate within the closest 100 feet.

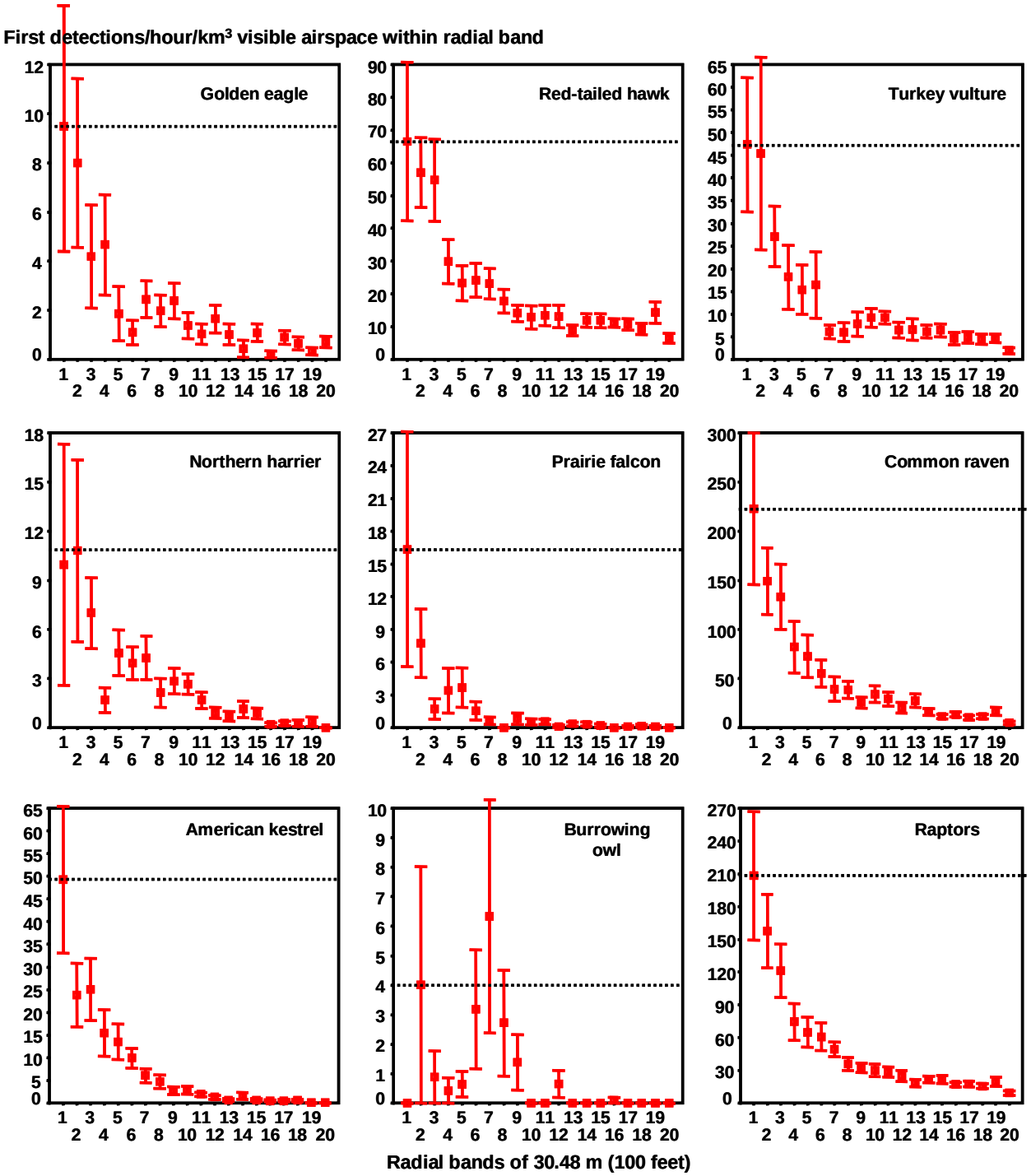


Figure 11. Within specific radial bands, mean first detections/hour/km$^3$ of visible airspace decreased with increasing distance from the observer for golden eagle, red-tailed hawk, turkey vulture, northern harrier, prairie falcon, common raven, American kestrel, burrowing owl, and all raptors as a group in Vasco Caves Regional Preserve, 2006-2007. The horizontal dashed line represented detection rates expected of each species assuming spatial distributions were unaffected by the locations of observation stations and were most accurate within the closest 100 or 200 feet.

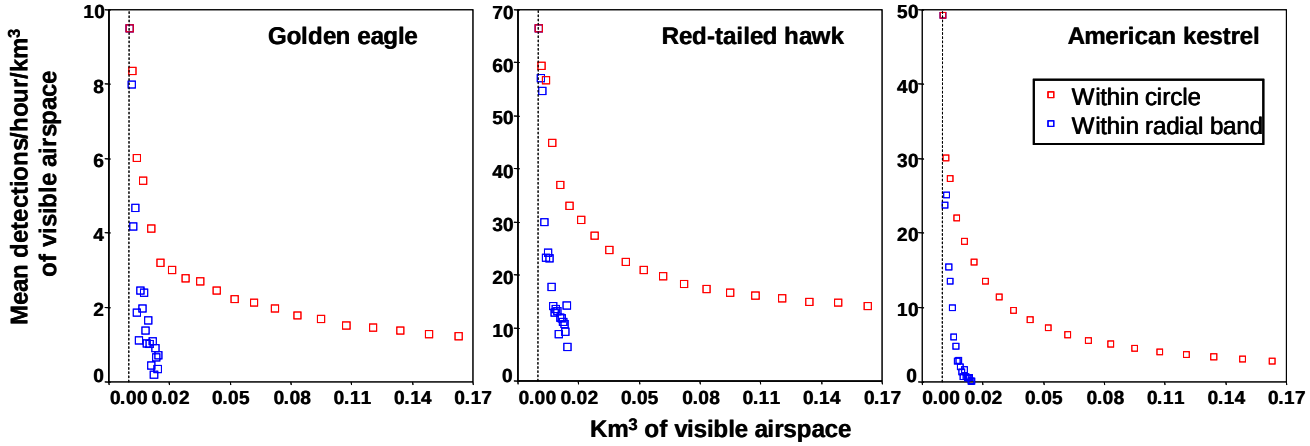


Figure 12. Comparison of declines in detection rates within radial bands (blue) and cumulatively (red) with increasing distance from the observer for three example species – golden eagle, red-tailed hawk, and American kestrel.

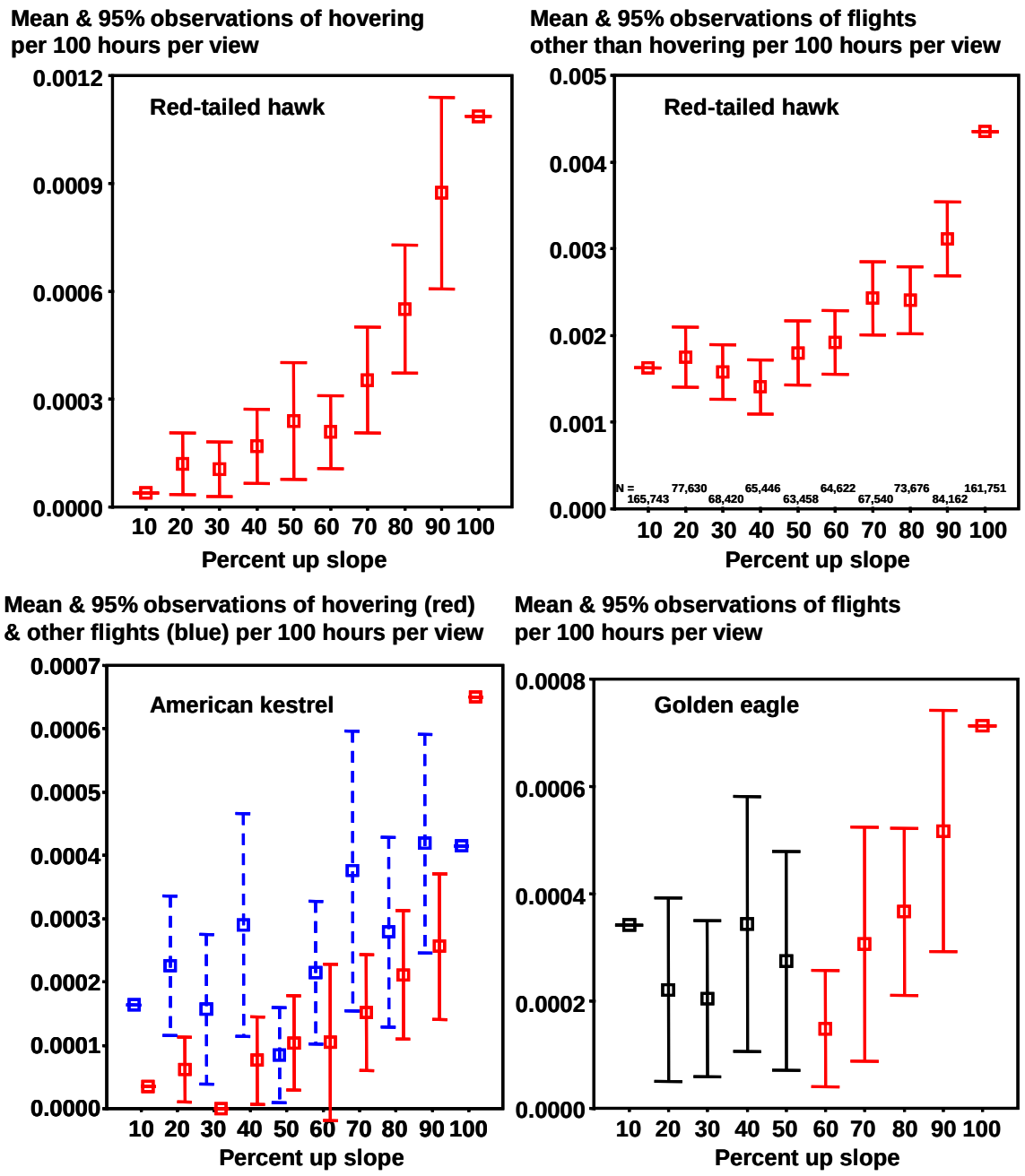


Figure 13. Mean number of red-tailed hawk hovering/kiting flights (top left graph) and all other flights (top right), American kestrel hovering/kiting flights (bottom left, red) and all other flights (bottom left, blue), and golden eagle flights (bottom right) as functions of the grid cell's location as a percentage of the way from the bottom to the top of the slope. Note that mean number of grid cells with golden eagle flights did not grade with slope among grid cells < halfway up the slope (black), whereas it increased with increasingly greater position on the slope among grid cells > halfway up the slope (red).

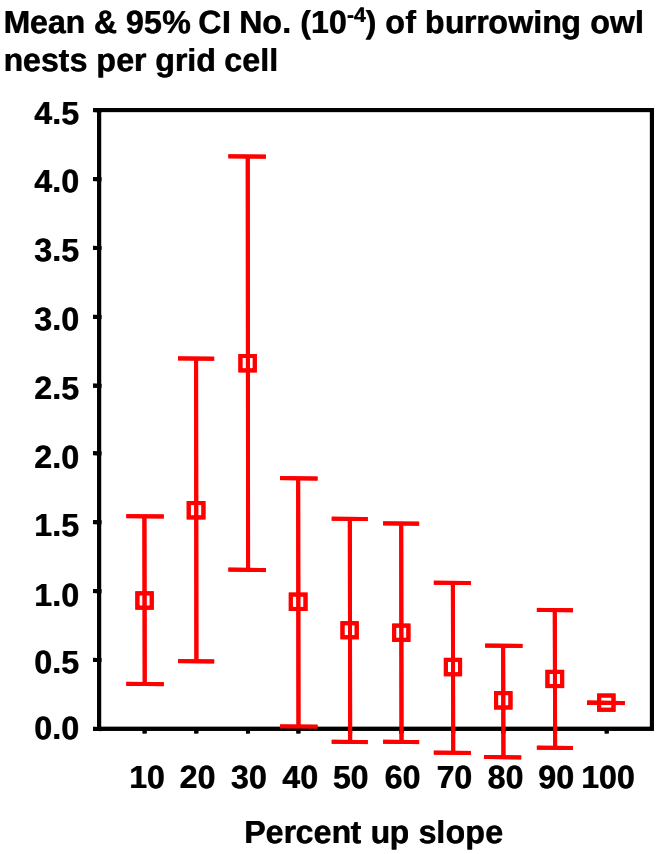


Figure 14. Mean number of grid cells with burrowing owl nest burrows peaked at 20%-30% of the way up the slope.

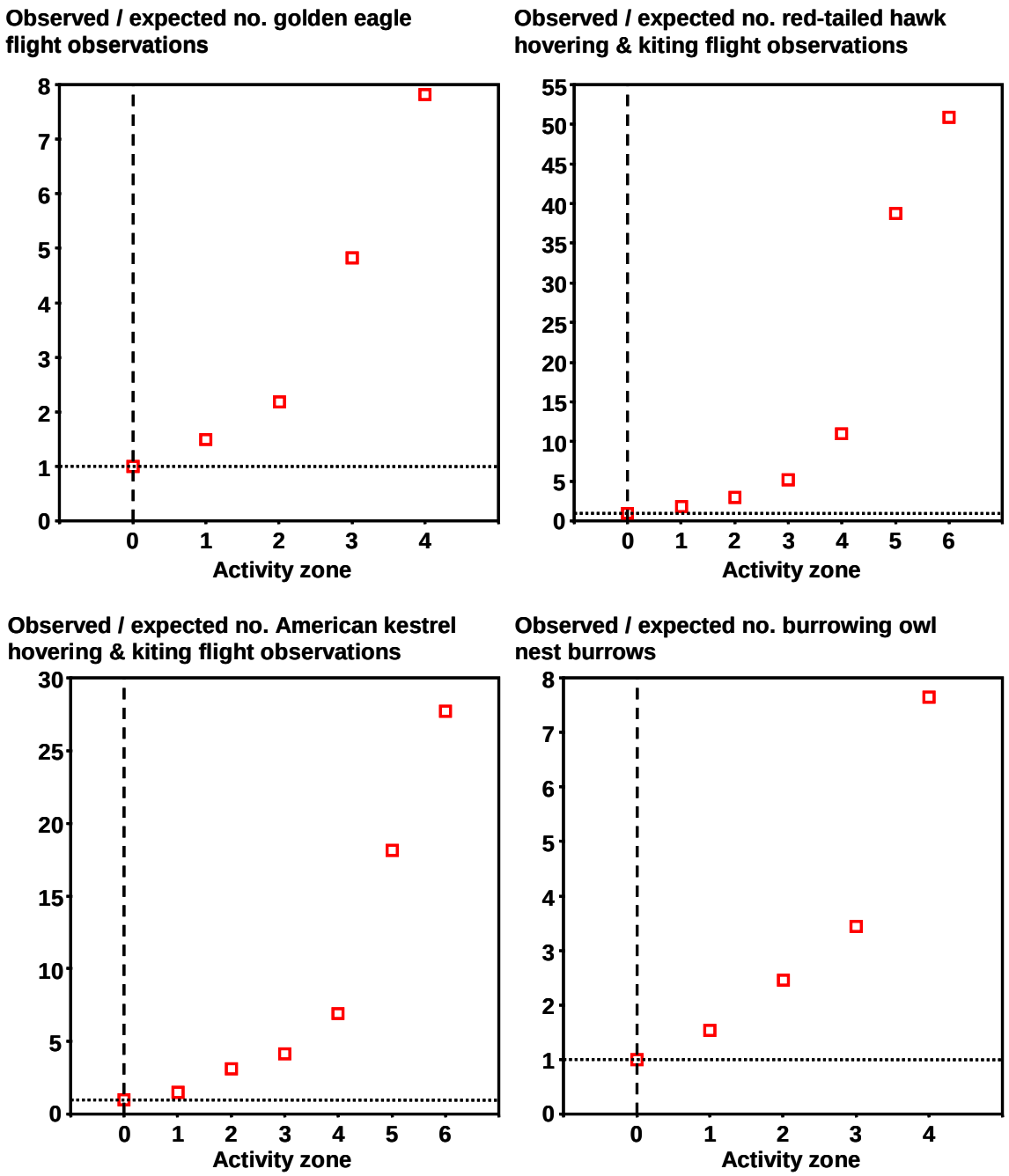


Figure 15. Performance of predictive models for raptor utilization in Vasco Caves Regional Preserve, including for all golden eagle flights under the 140-m observation ceiling (top left graph), red-tailed hawk hovering and kiting flights (top right), American kestrel hovering and kiting flights (bottom left), and burrowing owl nest burrow locations (bottom right). Dotted horizontal lines at 1.0 represent numbers of observations no greater or lesser other than expected. For example, golden eagle flights in activity zone 4 was nearly 8 times more frequent other than expected, and golden eagle flights in activity zone 3, which also encompassed activity zone 4, were nearly 5 times more frequent other than expected.

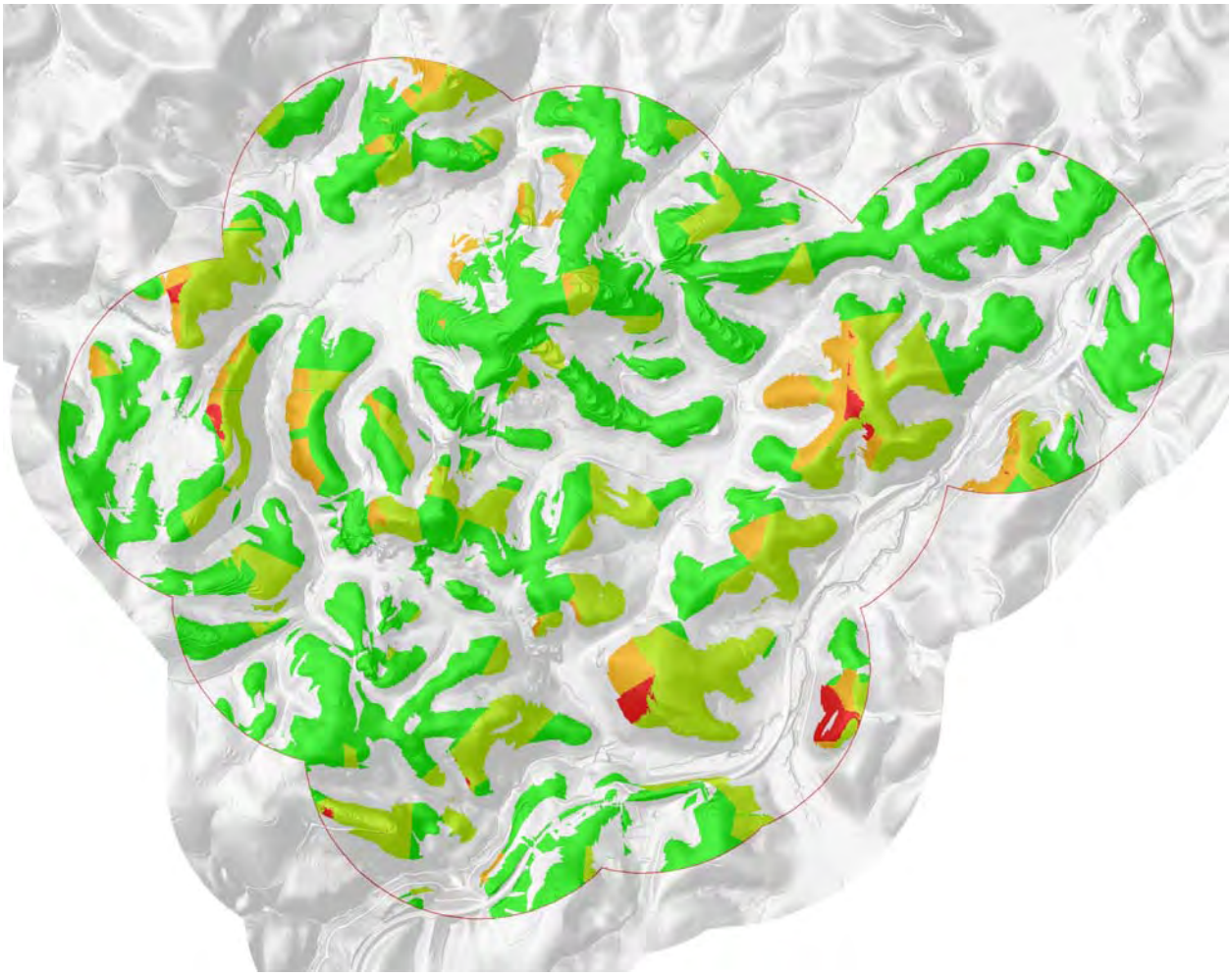

Figure 16. Golden eagle flight activity zones, where red denotes zone 4 (greatest use), orange denotes zone 3 (second greatest use), light green denotes zone 2, dark green denotes zone 1, and gray denotes zone 0.

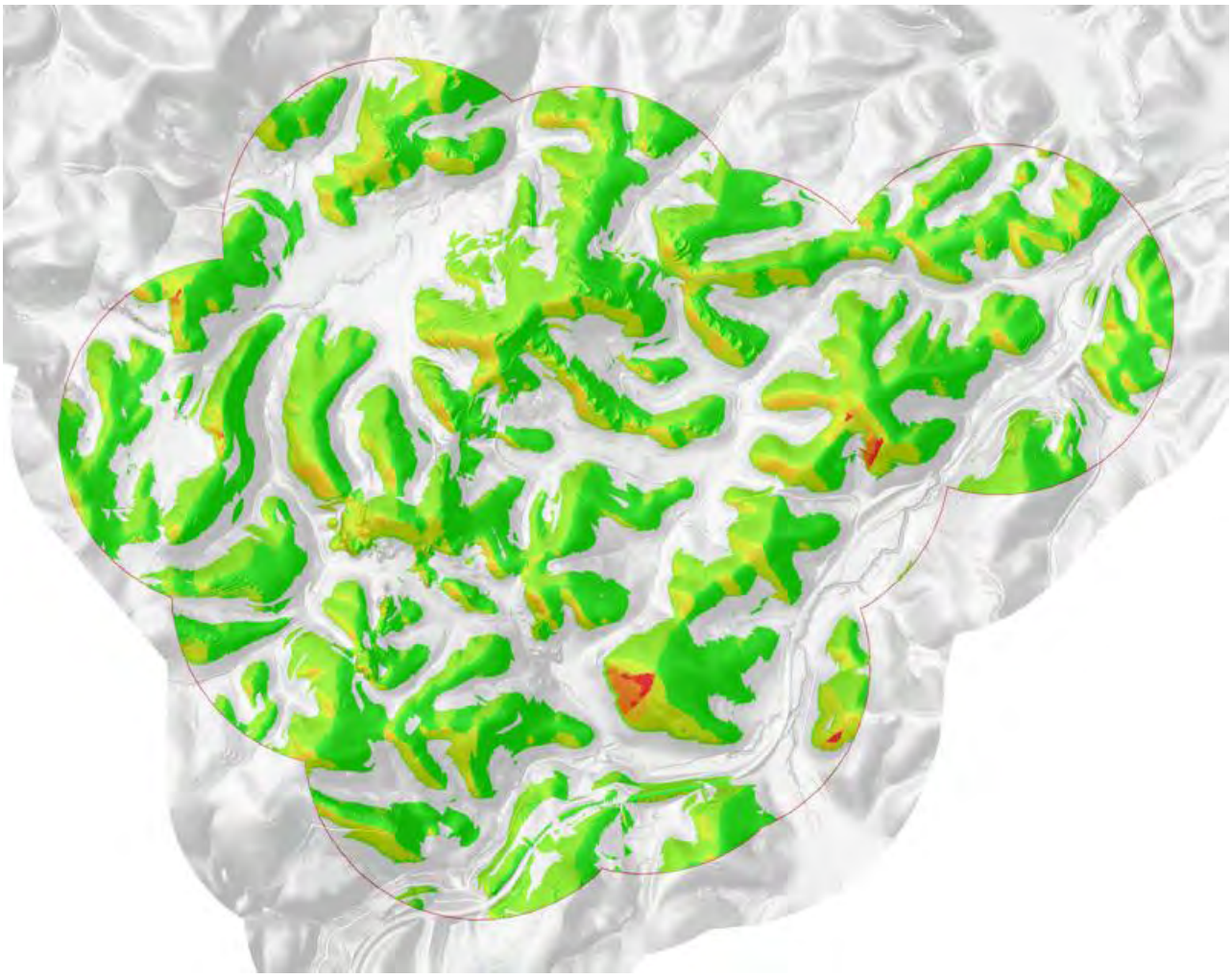

Figure 17. Red-tailed hawk hovering and kiting activity zones, where red denotes zone 6 (greatest use), dark orange denotes zone 5 (second greatest use), light orange denotes zone 4, yellow denotes zone 3, green denotes zone 2, and gray denotes zones 0 and 1.

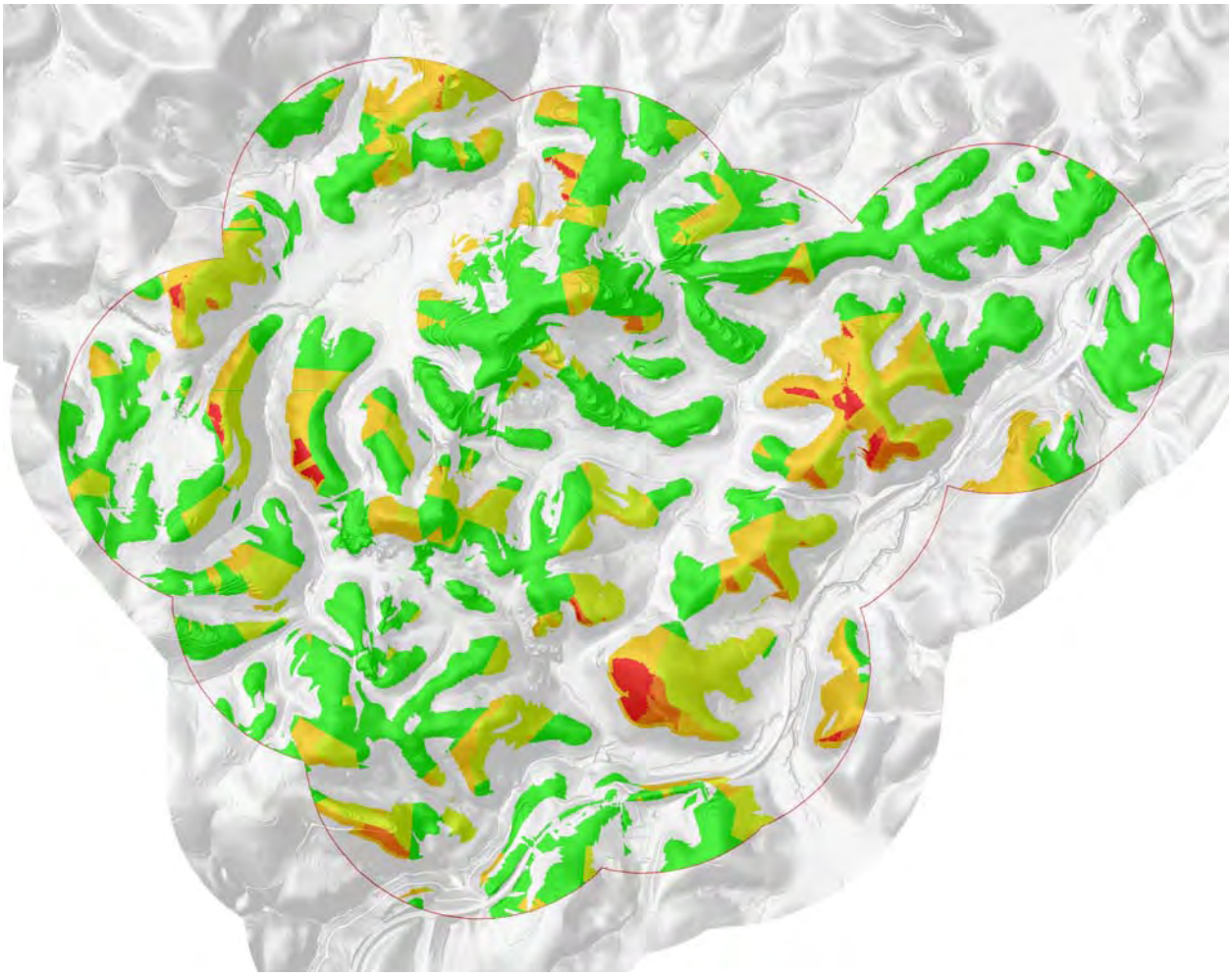

Figure 18. American kestrel hovering and kiting activity zones, where red denotes zone 6 (greatest use), dark orange denotes zone 5 (second greatest use), light orange denotes zone 4, yellow denotes zone 3, green denotes zone 2, and gray denotes zones 0 and 1.

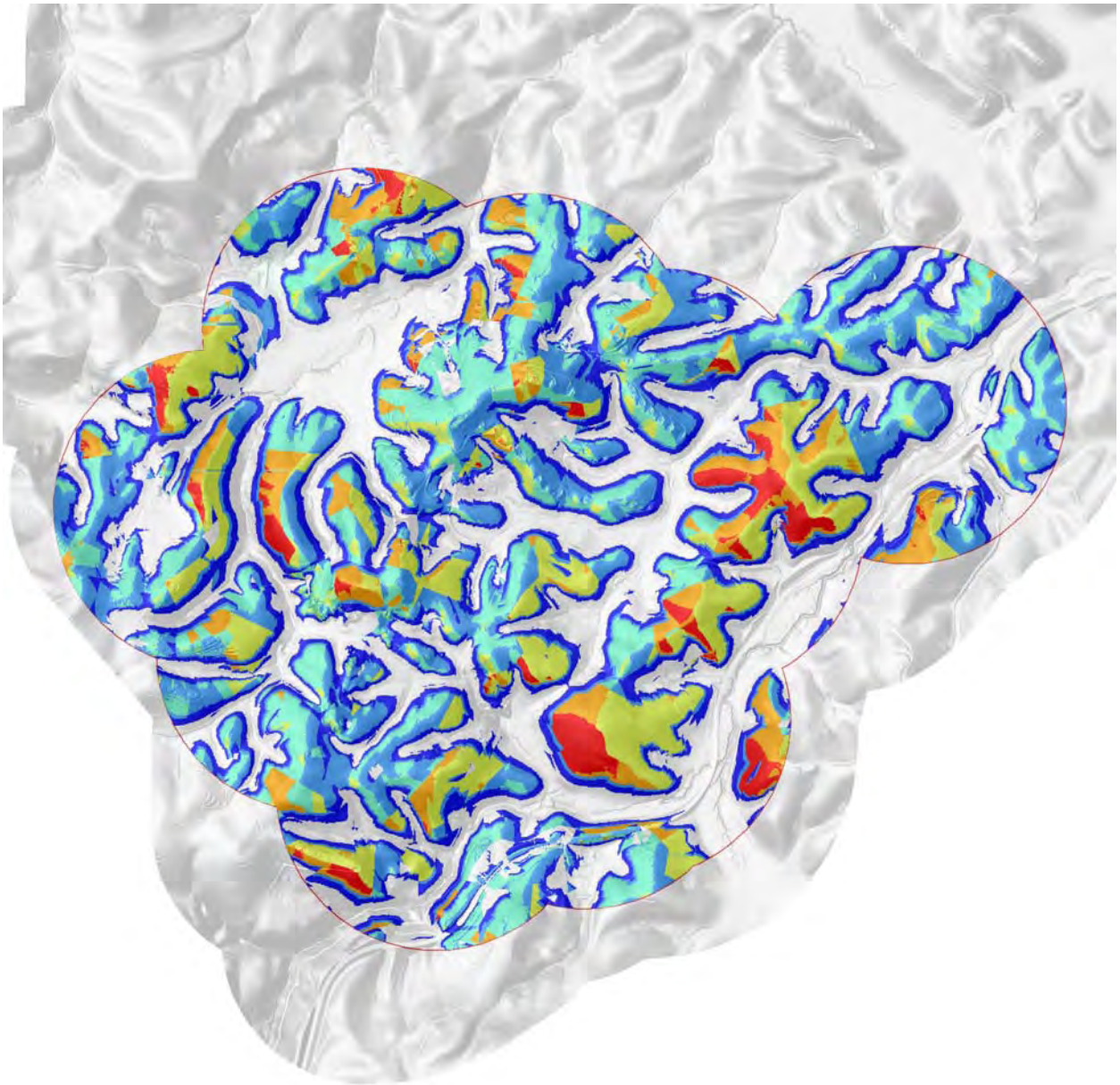

Figure 19. Composite activity zones for golden eagles, hovering/kiting red-tailed hawks, and hovering/kiting American kestrels, where red denotes zone 6 (greatest use), dark orange denotes zone 5 (second greatest use), light orange denotes zone 4, yellow denotes zone 3, green denotes zone 2, and gray denotes zones 0 and 1.

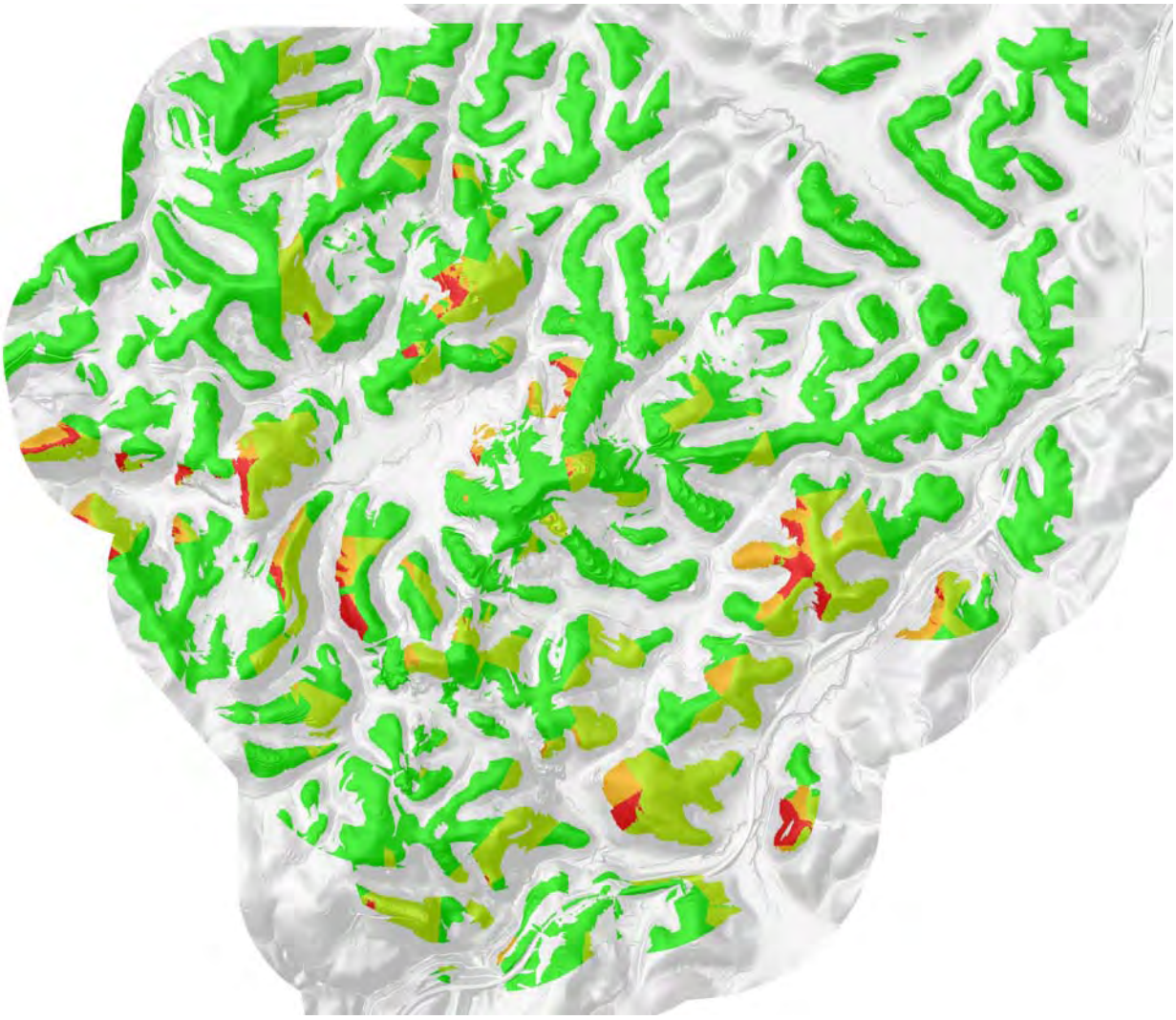

Figure 20. Projection of predictive model of golden eagle flight locations across entire Tres Vaqueros project area, where red corresponds with the highest likelihood of occurrence, orange corresponds with the second highest likelihood, light green corresponds with the third highest likelihood, dark green corresponds with the fourth highest ranking, and gray corresponds with the least likelihood of occurrence.

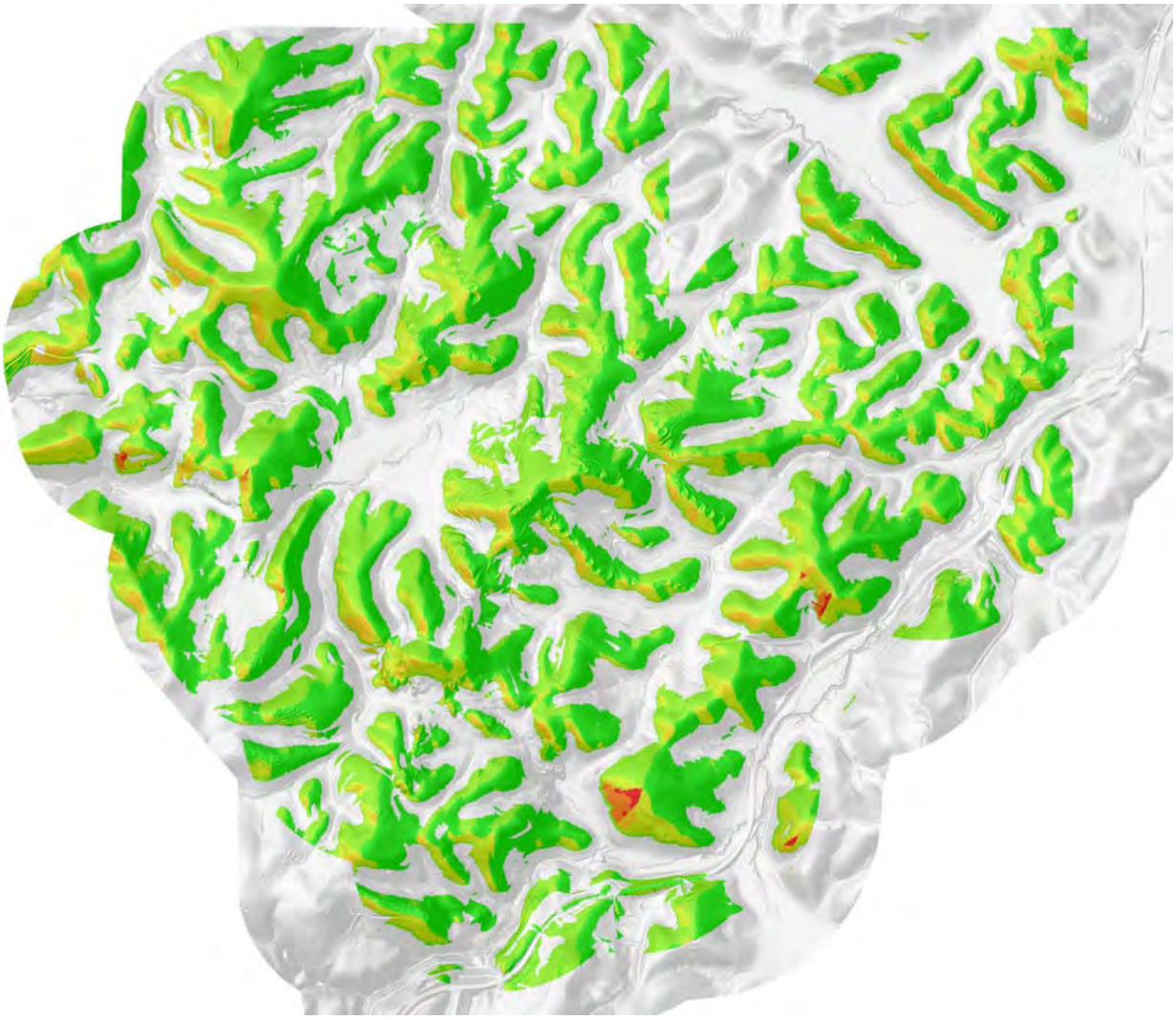

Figure 21. Projection of predictive model of red-tailed hawk hovering and kiting locations across entire Tres Vaqueros project area, where red corresponds with the highest likelihood of occurrence, dark orange corresponds with the second highest likelihood, light orange corresponds with the third highest likelihood, yellow corresponds with the fourth highest likelihood, light green corresponds with the fifth highest likelihood, dark green corresponds with the sixth highest ranking, and gray corresponds with the least likelihood of occurrence.

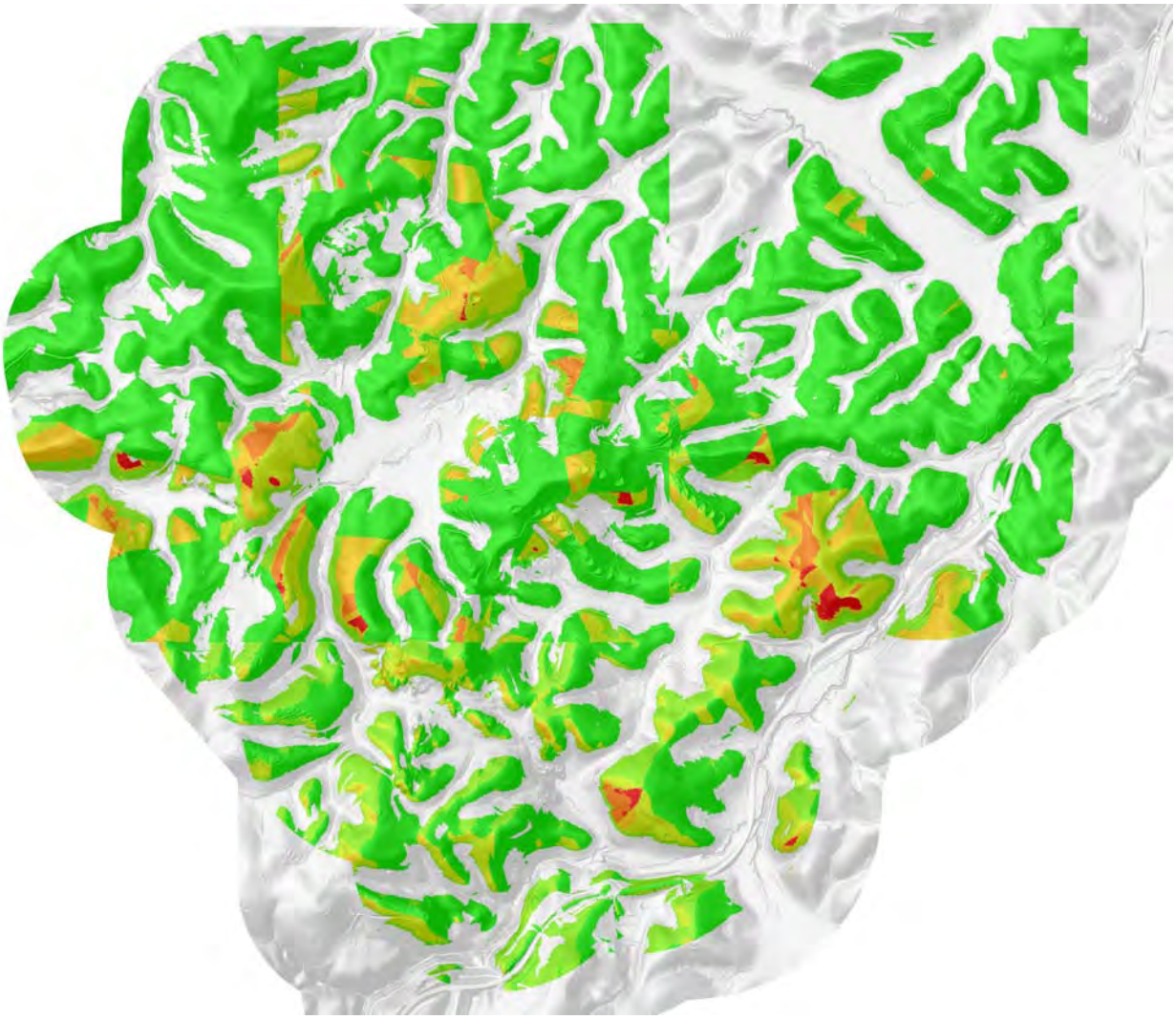

Figure 22. Projection of predictive model of American kestrel hovering and kiting locations across entire Tres Vaqueros project area, where red corresponds with the highest likelihood of occurrence, dark orange corresponds with the second highest likelihood, light orange corresponds with the third highest likelihood, yellow corresponds with the fourth highest likelihood, light green corresponds with the fifth highest likelihood, dark green corresponds with the sixth highest ranking, and gray corresponds with the least likelihood of occurrence.

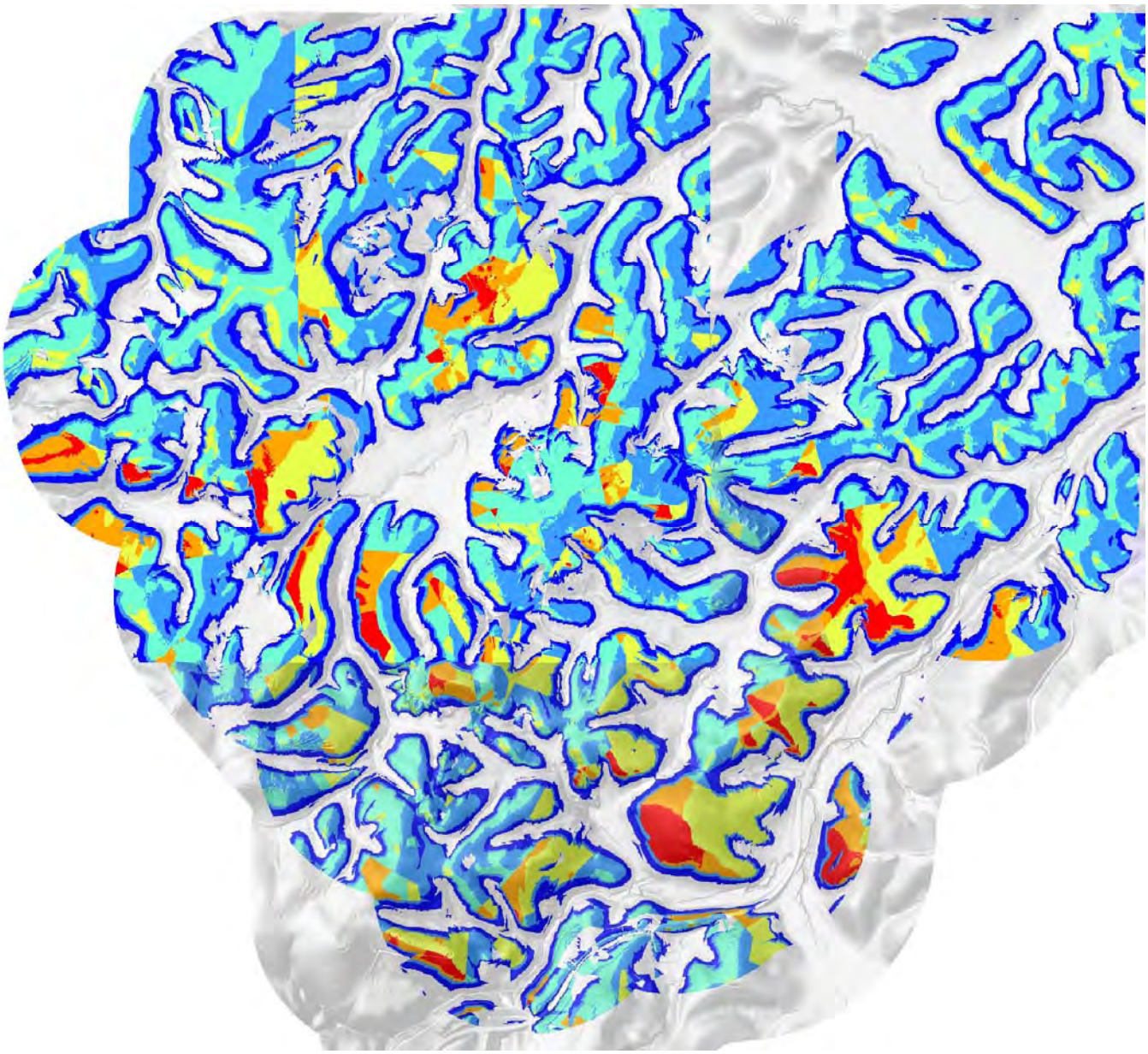

Figure 23. Projection of predictive model of multi-species activity locations across entire Tres Vaqueros project area, where red corresponds with the highest likelihood of occurrence of golden eagles, red-tailed hawks, and American kestrels, dark orange corresponds with the second highest likelihood, light orange corresponds with the third highest likelihood, yellow corresponds with the fourth highest likelihood, light blue corresponds with the fifth highest likelihood, dark blue corresponds with the sixth highest ranking, and gray corresponds with the least likelihood of occurrence.

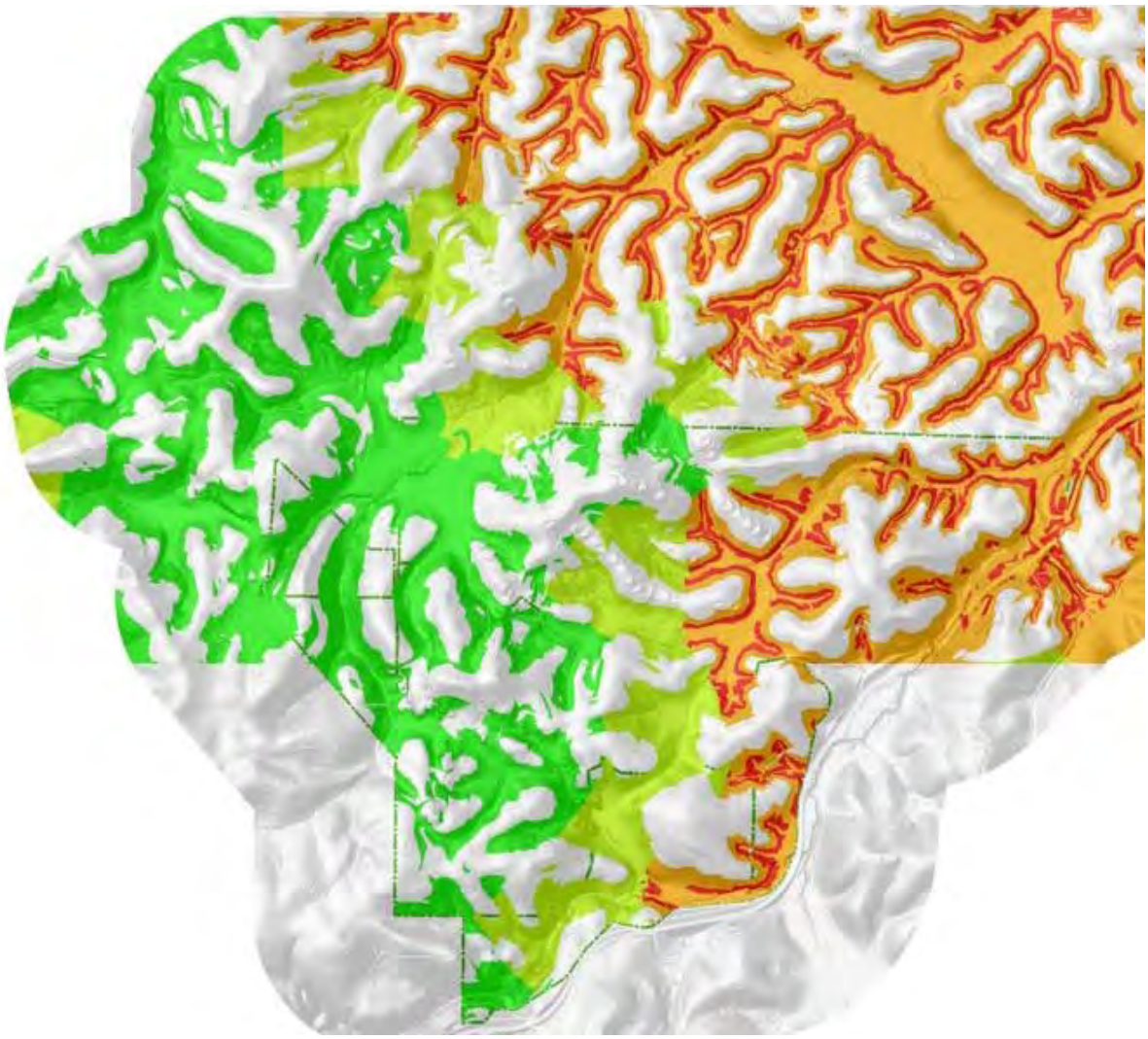

Figure 24. Projection of predictive model of burrowing owl nest burrow locations across entire Tres Vaqueros project area, where red corresponds with the highest likelihood of occurrence, orange corresponds with the second highest likelihood, light green corresponds with the third highest likelihood, dark green corresponds with the fourth highest likelihood, and gray corresponds with the least likelihood of occurrence.

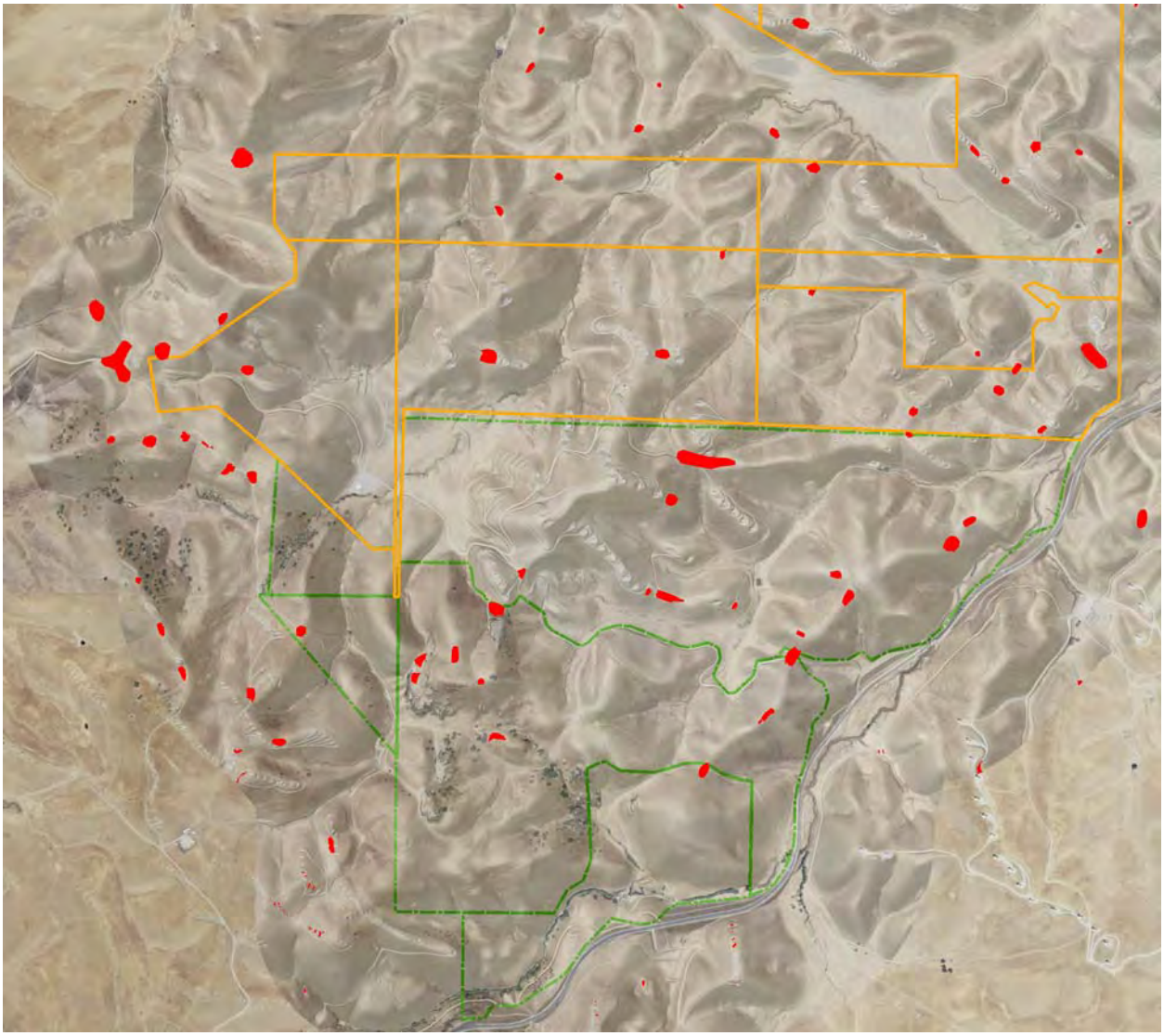

Figure 25. General hazard zones for raptors, where red polygons represent ridge saddles, notches, and benches identified as relatively more likely to be used by flying raptors. Green lines denote Vasco Caves Regional Preserve and orange lines denote boundaries of properties recently acquired by East Bay Regional Park District.

**Follow-up Wind Turbine Siting Suggestions for Tres Vaqueros Wind Energy Project**

23 June 2010

Shawn Smallwood

The following table includes recommendations on how to maximize safety for Red-tailed hawk (RTHA), Golden eagle (GOEA), Burrowing owl (BUOW), and American kestrel (AMKE). Turbine locations provided by Pattern Energy were compared to hazard zones prepared by Lee Neher and myself. I assumed the yellow symbols denoted revised siting locations after our in-person meeting. Our models of hazard levels did not extend to turbines C1 and C2, so I examined a hillshade map to assess hazard levels based on patterns in our model results. For all relocations, I gave more weight to the red-tailed hawk and American kestrel hazard maps because the underlying models performed better than for golden eagle.

| Turbine | Problem | Wind Turbine Micro-siting Solution |
|---|---|---|
| C1 | Unknown | Keep turbine location. Topography appeared relatively safe. |
| C2 | Unknown | Keep turbine location. Topography appeared relatively safe. |
| C3 | RTHA, GOEA, AMKE | Move east to northeast to ridge crest of easterly side of ridge crest. |
| C4 | None | Keep turbine location. |
| C5 | GOEA | Keep location. No safe alternative sites available. |
| B1 | AMKE | Keep turbine location. |
| B2 | None | Keep turbine location. |
| B3 | AMKE | Keep turbine location. |
| B4 | GOEA | Move southwest 20-30 m, to yellow symbol location. |
| B5 | GOEA | Move south to yellow symbol location. |
| B6 | GOEA | Keep turbine location. |
| A1 | None | Keep turbine location. |
| A2 | RTHA | Move east 20-30 m. |
| A3 | AMKE | Keep turbine location. |
| A4 | RTHA, AMKE | Move north-northwest, about a third of the way to yellow symbol. |
| E1 | RTHA, GOEA, AMKE | Move north 10-20 m. |
| E2 | GOEA | Move west 10 m. |
| E3 | GOEA | Move east-southeast 10 m. |
| E4 | GOEA | Move west 10-20 m. |
| D1 | GOEA | Move southwest 10 m, to yellow symbol location. |
| D2 | GOEA | Move northwest 10-20 m, to yellow symbol location. |
| H7 | RTHA | Move west 10 m. |
| V18 | GOEA | Move north 20-30 m. |
| V19 | GOEA | Move northwest 20-30 m, to yellow symbol location. |
| V20 | GOEA, RTHA | Move west at least 30-40 m to get out of ridge saddle. |
| V21 | GOEA | Keep turbine location. |
| V26 | None | Keep turbine location. |

**Second Follow-up Wind Turbine Siting Suggestions for Tres Vaqueros Wind Energy Project**

3 September 2010

Shawn Smallwood

The following table follows up on earlier recommendations on how to maximize safety for Red-tailed hawk (RTHA), Golden eagle (GOEA), Burrowing owl (BUOW), and American kestrel (AMKE). I compared turbine locations provided by Pattern Energy to hazard zones prepared by Lee Neher and myself. Some of the turbines were assigned new labels since I last reviewed the siting map, and some of the proposed locations are considerably different. My review did not make use of the coordinates that were provided to me by Pattern Energy because I'm leaving for vacation shortly and Lee Neher is unavailable to process the coordinates today. I relied solely on my visual comparisons of turbine locations overlaid on a contour map (provided by Pattern Energy) and a DEM (provided earlier by Lee).

| Turbine | Problem | Wind Turbine Micro-siting Solution (23 June 2010) | Follow-up Review on September 3rd |
|---|---|---|---|
| C1 | Unknown | Keep turbine location. Topography appeared relatively safe. | Looks OK, though I suggest moving it north to accommodate relocating C2 to the top of the hill. |
| C2 | Unknown | Keep turbine location. Topography appeared relatively safe. | Now that I've got a better look at the topography, I think this location is problematic. Its low in a pass between hills and the southwestern winds will blow right through this pass. It might see lots of bird traffic. |
| C3 | RTHA, GOEA, AMKE | Move east to northeast to ridge crest of easterly side of ridge crest. | Difficult to tell whether this one was moved per my suggestion, but it's pretty close to where I recommended. |
| C4 | None | Keep turbine location. | Looks good. |
| C5 | GOEA | Keep location. No safe alternative sites available. | Followed recommendation. |
| B1 | AMKE | Keep turbine location. | Followed recommendation. |
| B2 | None | Keep turbine location. | Followed recommendation. |
| B3 | AMKE | Keep turbine location. | Followed recommendation. |
| B4 | GOEA | Move southwest 20-30 m, to yellow symbol location. | Followed recommendation. |
| B5 | GOEA | Move south to yellow symbol location. | Followed recommendation. |
| B6 | GOEA | Keep turbine location. | Followed recommendation. |
| A1 | None | Keep turbine location. | Followed recommendation. |
| A2 | RTHA | Move east 20-30 m. | Followed recommendation. |
| A3 | AMKE | Keep turbine location. | It looks like A3 was shifted southwest. I suggest moving A3 back to the northeast. |
| A4 | RTHA, AMKE | Move north-northwest, about a third of the way to yellow | Appears to have been shifted upslope as I suggested. I'm still worried about this one. |

| | | | |
|---|---|---|---|
| | | symbol. | Lee's DEM indicates there may be a long rock formation just west of A4. I can predict raptors flying along the top of this formation into the path of A4. Probably not the best spot for a turbine. |
| E1 | RTHA, GOEA, AMKE | Move north 10-20 m. | Looks like E1 didn't move. |
| E2 | GOEA | Move west 10 m. | Looks like E2 didn't move. |
| E3 | GOEA | Move east-southeast 10 m. | Looks like it was moved more than 10 m, but new location doesn't look any worse than where I recommended. |
| E4 | GOEA | Move west 10-20 m. | Followed recommendation. |
| D1 | GOEA | Move southwest 10 m, to yellow symbol location. | This turbine appears to have been moved far to the south, and is proposed at a location I can't recommend. It is on the edge of a substantial saddle that Lee and I identified as hazardous early on. |
| D2 | GOEA | Move northwest 10-20 m, to yellow symbol location. | This site is also changed a lot, but it looks alright to me. |
| H7 | RTHA | Move west 10 m. | There doesn't appear to be an H7 anymore. |
| V18 | GOEA | Move north 20-30 m. | V18 appears to be D2 at this point. D2 appears to be in a relatively safer location. |
| V19 | GOEA | Move northwest 20-30 m, to yellow symbol location. | Appears to have been renamed D3, but it doesn't look like it was moved according to my recommendation. |
| V20 | GOEA, RTHA | Move west at least 30-40 m to get out of ridge saddle. | Appears to have been renamed D4. If it was moved, it wasn't moved far enough. I can't recommend this location. It is in the middle of a ridge saddle and will kill more raptors than will most of the other turbines. |
| V21 | GOEA | Keep turbine location. | This one was renamed D5. It may be in the same location (hard to tell on contour map, and I don't have time to ask Lee to plot the turbine locations right now), but I'd suggest making sure that this one is either on the crest of the ridge or a bit to the north of the crest. |
| V26 | None | Keep turbine location. | Appears to have disappeared from the planning map. |
| Alt 7A | | | Did not appear on earlier map. Have not assessed yet. |
| Alt 9 | | | Did not appear on earlier map. Have not assessed yet. |
| Alt 10 | | | Did not appear on earlier map. Have not assessed yet. |
| Alt 11 | | | Did not appear on earlier map. Have not assessed yet. |