Summit Wind Repower Project

Avian and Bat Protection Plan

April 2021

Altamont Winds LLC

Summit Wind Repower Project

Project No:	D3258600
Document Title:	Avian and Bat Protection Plan
Revision:	FINAL
Date:	April 2021
Client Name:	Altamont Winds LLC
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File Name:	SummitWind_ABPP_20210416_FINAL.docx

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Contents

Acronyms and Abbreviations

ABPP	Avian and Bat Protection Plan
ACCDA	Alameda County Community Development Agency
ADMM	adaptive management measure
Altamont Winds	Altamont Winds LLC
AMP	adaptive management program
APWRA	Altamont Pass Wind Resource Area
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
CARE	Californians for Renewable Energy
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
COD	commercial operation date
CUP	conditional use permit
DEM	digital elevation model
EACCS	East Alameda County Conservation Strategy
ECP	Eagle Conservation Plan
ESA	federal Endangered Species Act
ETP	Eagle Take Permit
FAA	Federal Aviation Administration
GE	General Electric
HM Lands	habitat management lands
ICF	ICF International
Jacobs	Jacobs Engineering Group, Inc.

kW	kilowatt
MBTA	Migratory Bird Treaty Act
MMRP	mitigation monitoring and reporting program
MW	megawatt
PEIR	Programmatic Environmental Impact Report
REA	Resource Equivalency Analysis
RPS	California Renewable Portfolio Standard
Summit Project	Summit Wind Repower Project
TAC	Technical Advisory Committee
USFWS	U.S. Fish and Wildlife Service
WEG	Wind Energy Guidelines
WRRS	Wildlife Reporting Response System
WTG	wind turbine generator

1. Introduction

1.1 Background

This Avian and Bat Protection Plan (ABPP) has been prepared by Jacobs Engineering Group, Inc. (Jacobs) on behalf of Altamont Winds LLC (Altamont Winds) in support of the Summit Wind Repower Project (Summit Project). This ABPP was prepared to assess potential avian and bat impacts resulting from the construction and operation of the repowered facility and reduce or avoid potential avian and bat fatalities using reasonable and effective measures. The facility of old-generation turbines that preceded the Summit Project was decommissioned in 2016 to 2018, which involved the removal of approximately 569 lattice tower wind turbine generators (WTGs) and related above ground infrastructure. The installed capacity of the original wind energy facility was 56.9 MWs as documented in PLN2011-00102. Concrete turbine foundations that remain at the old facility will be removed in 2020 to 2021, after receipt of applicable permits, and restored to native grassland.

In November 2014, the Alameda County planning board certified the *Altamont Pass Wind Resource Area Repowering Final Program Environmental Impact Report* (PEIR) for Alameda County's portion of the Altamont Pass Wind Resource Area (ACCDA 2014). The PEIR addresses an overall need to repower the entire Altamont Pass Wind Resource Area (APWRA) by replacing older-generation turbines with newer, generally larger turbines that serve to improve turbine efficiency and have the potential to substantially reduce avian mortality, especially for raptor species. The Summit Project was described generally as part of the PEIR and more specifically in the Summit Wind Repower Project *CEQA Implementation Checklist and Application Supporting Materials*, dated November 3, 2015. Conditional use permit (CUP) PLN2014-00056 was issued for the Summit Project on January 14, 2016 (Alameda County 2016) and project construction began in July 2019. Construction is anticipated to be completed by November2020 with an estimated commercial operation date (COD) of January 2021.

On August 2, 2018, Altamont Winds submitted an Eagle Conservation Plan (ECP) to the U.S. Fish and Wildlife Service (USFWS). The ECP was prepared to support eventual filling of an application for an Eagle Take Permit for the Summit Project. Altamont Winds followed the process outlined in the ECP Guidance (USFWS 2013) to plan the Summit Project. Consistent with the ECP Guidance, Altamont Winds initiated discussions with USFWS in 2016 regarding potential impacts to golden eagles and has maintained communication with USFWS throughout the development process. The conservation measures described in the ECP are harmonious with the measures presented in this ABPP, and collectively, avoid and minimize risks to golden eagles to the extent practicable such that any remaining take would be unavoidable.

The Summit Project is located in the APWRA, which is designated by the State of California and recognized by Alameda County as a Wind Resource Area because reliable wind currents are present that support economically viable wind energy projects. Overall, the process of repowering existing wind energy facilities has been identified as a method for reducing avian fatality associated with wind energy facilities in the APWRA (CEC and CDFG 2007), although contemporary data suggest this only holds reliably true for certain taxonomic groups. The general benefits of repowering for avian species are enhanced by several factors unique to the APWRA and the Summit Project, including:

- Using an extensive APWRA-wide base of avian studies and data that includes the Summit Project to avoid high-use areas during project design and construction (e.g., micrositing).
- The longevity of commercially operating wind facilities in the Altamont Pass has resulted in numerous studies on impacts to birds. This robust collection of studies and data provides a documented baseline for considering potential avian issues resulting from repowering. These studies are discussed in greater detail in Section 4.
- Integrating relevant and current monitoring information from other existing repowered projects in the APWRA, including the Buena Vista, Diablo Winds, Vasco Winds, and Golden Hills repowering projects.

1.2 Goals and Objectives

In addition to addressing the large-scale environmental impacts of air pollution and global warming through the development of renewable wind energy, Altamont Winds is committed to developing and operating wind energy in a way that minimizes direct impacts on wildlife. This ABPP defines the Summit Project's commitment to minimize impacts on local bird and bat populations in the APWRA. Impacts will be assessed and compared to the pre-repowered mortality rate estimates described in the PEIR (Section 6).

The elements of this plan are consistent with the structure of Alameda County's draft Avian Protection Program, which provides a framework and process for wind energy development to comply with applicable statutes (ICF 2013). This plan includes measures to avoid and minimize potential impacts and conservation measures to benefit avian and bat species. As stipulated by Mitigation Measure BIO-11a of the PEIR ("Prepare a project-specific avian protection plan"), this ABPP includes the following components:

- Information and methods used to site turbines to minimize risk.
- Documentation that appropriate turbine designs are being used.
- Documentation that avian-safe practices are being implemented on project infrastructure.
- Methods used to discourage prey for raptors.
- A detailed description of the post-construction avian and bat fatality monitoring methods to be used (consistent with the minimum requirements outlined in Mitigation Measure BIO-11g and BIO-14b).
- Methods used to compensate for the loss of raptors (consistent with the requirements of Mitigation Measure BIO-11h).

Consistent with Mitigation Measure BIO-11i (Implement an avian adaptive management program) of the PEIR, this ABPP also addresses adaptive management. Additionally, the purpose of this ABPP is to provide a mechanism where Altamont Winds can implement specific commitments to address wind and wildlife interactions that have been reviewed and approved by Alameda County in consultation with federal and state wildlife management agencies. This ABPP will be reviewed by the stakeholders for consistency and inclusion of appropriate mitigation measures. A final ABPP needs to be completed within 6 months of the COD for the Summit Project.

2. Proposed Project

2.1 Overview

The Summit Project is located north of Interstate 580 on the western side of California's Central Valley east of Livermore within Alameda County. The project boundary consists of approximately 3,302 acres and is part of the existing old-generation wind energy facility. Subsequent to CUP issuance, in coordination with Alameda County, Altamont Winds completed final micrositing, and based on its results and market conditions, a revised array of 26 General Electric (GE) 2.5 megawatt (MW) turbines was selected, increasing the aggregate nameplate capacity by 3.5 MW to a total of 57.5 MW. On September 5, 2018, Alameda County issued a grading permit based on the revised layout. None of the alternative turbine locations were required to be activated during project construction, therefore the final array involves only 23 new WTGs. Table 1 summarizes the characteristics of the Summit Project.

Table 1. Project Characteristics

Feature	Description
WTG model	GE 2.5 MW
Number of WTGs	23
Total Nameplate Capacity (MW)	57.5
Tower Hub Height (meters)	90
Rotor Diameter (meters)	116
Ground Clearance (meters)	32
Maximum Overall Height (meters)	148
Permanent Facility Footprint (acres)	24

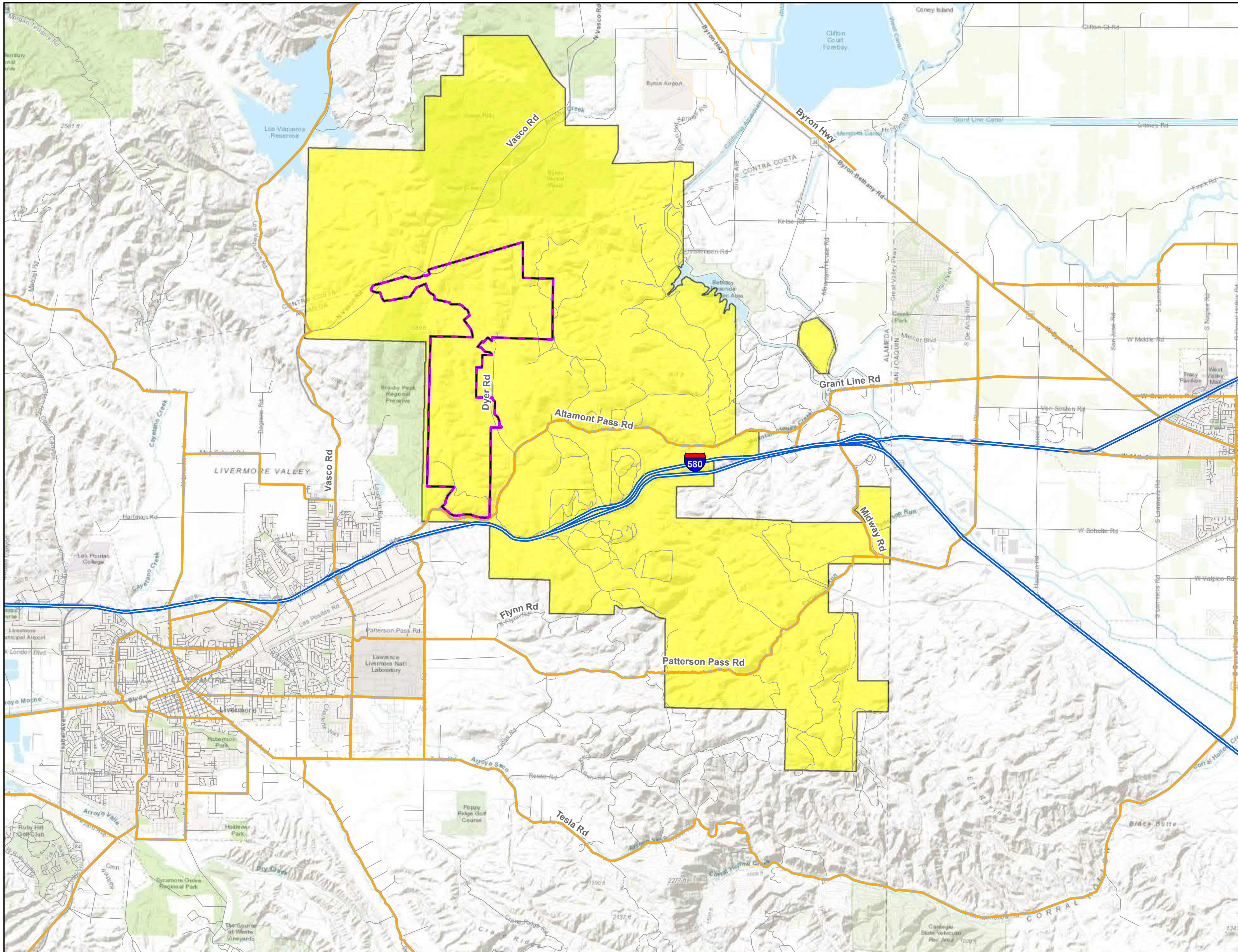
Figure 1 shows the regional setting of the Summit Project, and Figure 2 shows the layout of the new facilities.

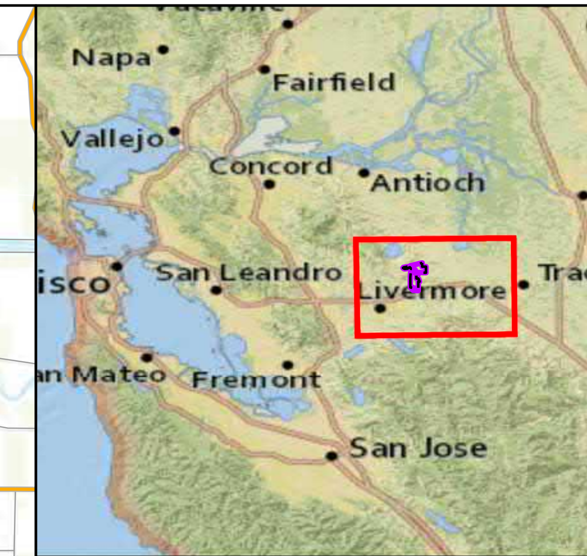
2.2 Micrositing

Altamont Winds' repowering included removal of 569 older turbines and replacement with 23 larger and more efficient turbines. The turbine array for the Summit Project was developed using predictive models to locate turbines in areas with the lowest (practical) potential for avian impacts to occur. The models originally developed by Smallwood and Neher (2010) and reemployed for the Summit Project integrate the body of literature derived from prior avian studies and more advanced data and analysis techniques to develop predictive models of bird flights and flight behavior that relate to collision hazards. The models include utilization data; Digital Elevation Model (DEM); slope attributes; techniques to identify saddles, notches, and benches; and associations between bird utilization and slope attributes. The models essentially result in a delineation of areas with predicted high activity where wind turbine siting should be avoided.

Upon review of the models provided by Smallwood, Altamont Winds moved turbines as far from risk areas as practicable. At each modification to the array, Smallwood reviewed and made recommendations on risk and location changes, and when possible, turbines were moved to reflect those recommendations. Limitations to the siting or movement of turbines may have included, but were not limited to, setbacks from public roads, setbacks from Livermore Area Recreation and Park District hiking trails, setbacks from residences, setbacks from power lines, setbacks from communication structures, minimum distances between turbines, constructability (geology, steepness, and remoteness, etc.), special-status species habitat considerations. Thirty-three (33) locations were originally proposed and reviewed, 27 were approved, of which 1 was removed for avian micrositing. Turbine size was increased, requiring only 23 constructed which is anticipated to result in reduced impacts to avian species. Three were removed as alternatives due to having highest avian risk and Native American concerns during the Section 106 consultation process. Appendix C discusses the Project's site-specific siting reports by Smallwood (2014; 2018) and Smallwood and Neher (2016).

Altamont Winds provided the permitted grading plans to Dr. Smallwood for review of the proposed grading in an effort to avoid additional avian risk due to the proposed grading. In several areas of the project Dr. Smallwood recommended minor grading changes to reduce avian activity caused by grading slope breaks.





LEGEND

- Project Area (3,302.4 acres)
- Altamont Pass Wind Resource Area

N

0 8,000
Feet

Figure 1
Project Location
Summit Wind Repower Project
Alameda County, California

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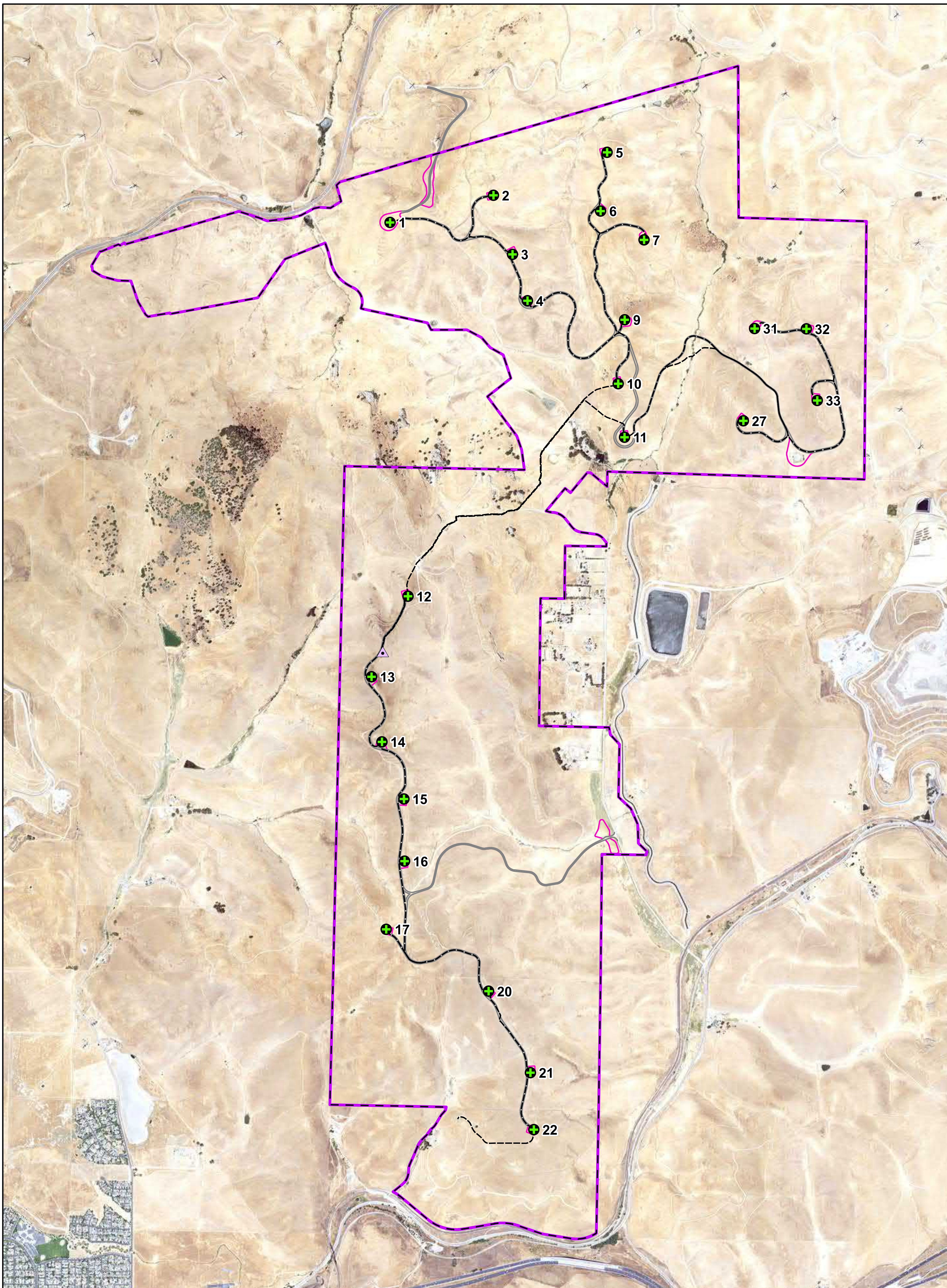

Legend

- Project Area (3,302.4 acres)
- Proposed Turbine
- Proposed Met Tower
- Underground Collection Line
- Edge of Road
- Edge of Pads and Laydown

N

0 2,000 4,000
Feet

Figure 2
Site Layout
Summit Wind Repower Project
Alameda County, California

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3. Regulatory Setting

3.1 Federal

3.1.1 Endangered Species Act

Section 9 of the federal Endangered Species Act (ESA) prohibits the “take” of species listed as endangered or threatened. “Take” is defined by regulation as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct.” “Harm” is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. “Harass” is defined as intentional or negligent actions that create the likelihood of injury to listed species by annoying them to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. “Incidental take” is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

Although “take” of a listed species is prohibited under ESA Section 9, incidental take authorization may be obtained pursuant to ESA Section 7 by federal entities following consultation with USFWS and issuance of a Biological Opinion, or Section 10 with adoption of a Habitat Conservation Plan by private entities.

3.1.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. It has been described as a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of an MBTA violation. The statute’s language is clear that actions resulting in a taking or possession (permanent or temporary) of a protected species, in the absence of an USFWS permit or regulatory authorization, are a violation of the MBTA, which states:

> Unless and except as permitted by regulations . . . it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill . . . possess, offer for sale, sell . . . purchase . . . ship, export, import . . . transport or cause to be transported . . . any migratory bird, any part, nest, or eggs of any such bird . . . [The Act] prohibits the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior.” The word “take” is defined by regulation as “to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect.

USFWS maintains a list of all species protected by the MBTA under 50 *Code of Federal Regulations* Section 10.13. This list includes over 1,000 species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds. The MBTA provides criminal penalties for persons who commit any of the acts prohibited by the statute in Section 703 on any of the species protected by the statute.

On January 10, 2017, the U.S. Department of the Interior, Office of the Solicitor, issued a memorandum (M-37041) which analyzed whether the MBTA prohibits the accidental or “incidental” taking or killing of migratory birds. Based on the analysis presented, M-37041 concluded that the “MBTA’s prohibitions on taking and killing migratory bird apply broadly to any activity, subject to the limits of proximate causation, and are not limited to certain factual contexts. Therefore, those prohibitions can and do apply to direct incidental take.” However, on February 6, 2017, M-37041 was suspended pending review and subsequently replaced by M-37050 on December 22, 2017. The new opinion (M-37050) concluded that "the MBTA's prohibition on pursuing, hunting, taking, capturing, killing, or attempting to do the same applies only to direct and affirmative purposeful actions that reduce migratory birds, their eggs, or their nests, by killing or capturing, to human control. " On August 11, 2020, a federal district court in New York ruled that incidental take of species protected under the MBTA is a crime under the Act, vacating M-37050. The district court did not vacate the USFWS guidance that implemented M-37050, nor did it restore M-37041.

The status of the MBTA remains in flux. On November 27, 2020, the USFWS published an EIS on regulations governing take of migratory birds. On January 7, 2021 the final regulation defining the scope of the MBTA published in the Federal Register with an effective date of February 8, 2021. However, on February 9, 2021 the Correction of Effective Date and Request for Public Comments was published in the Federal Register with a posted effective date of March 8, 2021. During this time the USFWS is seeking public comment and it is anticipated that changes will be made to the rule and/or it will be rescinded.

3.1.3 Bald and Golden Eagle Protection Act

Under the authority of the Bald and Golden Eagle Protection Act (BGEPA), bald and golden eagles are afforded additional legal protection. The BGEPA prohibits the take, sale, purchase, barter, offer of sale, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. The BGEPA also defines take to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," and includes criminal and civil penalties for violating the statute. The USFWS has further defined the term "disturb" as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior. The BGEPA authorizes USFWS to permit the take of eagles for certain purposes and under certain circumstances, including scientific or exhibition purposes, religious purposes of Indian tribes, and the protection of wildlife, agricultural, or other interests, so long as that take is compatible with the preservation of eagles.

In 2009, USFWS promulgated a final rule on two new permit regulations that, for the first time, specifically authorizes the non-purposeful (that is, incidental) take of eagles and eagle nests in a variety of situations under the BGEPA (74 Federal Register 46836–46879). The permits authorize limited, incidental take of bald and golden eagles, and authorize individuals, companies, government agencies (including tribal governments), and other organizations to disturb or otherwise take eagles in the course of conducting lawful activities, such as operating utilities and airports.

The USFWS amended the 2009 permit rule authorizing take of eagles in 2013. The new Duration Rule extended the maximum term for eagle take permits (ETPs) from 5 to 30 years, if the permit incorporated specific measures that may be necessary to ensure the preservation of eagles (USFWS 2013). Subsequently, the 30-year permit duration was invalidated by the U.S. District Court for the Northern District of California in 2015.[1]

In 2016, the USFWS once again amended the rules for permits authorizing take of eagles (81 Federal Register 91494–91554). The associated programmatic environmental impact statement and record of decision extended the ETP duration to 30 years with 5-year reviews. Under these new rules, USFWS also removed the distinction between programmatic and standard permits, modified the permitting standard to require only that permittees reduce eagle impacts to the maximum extent practicable (rather than meeting the previous unavoidable standard), and redefined Eagle Management Units.

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[1] Order Granting in Part and Denying in Part Motions for Summary Judgment of Plaintiffs, Federal Defendants, and Defendant-Intervenor, *Debra Shearwater et al. v. Dan Ashe et al.,* Case No. 14-CV-02830-LHK (N.D. Cal. Aug. 11, 2015).

Although eagles are protected by both the MBTA and the BGEPA, MBTA take authorization is not required because the Eagle Permit Rule exempts those who hold BGEPA permits from the requirement to obtain an MBTA permit.

3.1.4 Land-Based Wind Energy Guidelines

The USFWS main approach to reducing impacts to migratory birds from wind energy facilities is the use of the voluntary Wind Energy Guidelines (WEG) (USFWS 2012a). USFWS worked with the Department of the Interior Wind Turbine Guidelines Advisory Committee, a federal advisory committee consisting of representatives of the wind energy industry, conservation groups, and state wildlife agencies to develop the WEG. The WEG replace the interim voluntary guidance published by USFWS in 2003.

The final voluntary WEG provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote effective communication among wind energy developers and federal, state, and local conservation agencies and tribes. When used in concert with appropriate regulatory tools, the WEG form the best practical approach for conserving species of concern. The WEG discuss various risks to species of concern from wind energy projects, including collisions with wind turbines and associated infrastructure, loss and degradation of habitat from wind turbines and infrastructure, fragmentation of large habitat blocks into smaller segments that may not support sensitive species, displacement and behavioral changes, and indirect effects such as increased predator populations or introduction of invasive plants. The WEG assist developers in identifying species of concern that may potentially be affected by their proposed project, including migratory birds, bats, bald and golden eagles and other birds of prey, prairie grouse and sage-grouse, and listed, proposed, or candidate endangered and threatened species.

The WEG use a tiered approach for assessing potential adverse effects to species of concern and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail, quantifying the possible risks of proposed wind energy projects to species of concern and their habitats, and evaluating those risks to make siting, construction, and operation decisions. During the preconstruction tiers (Tiers 1, 2, and 3), developers work to identify, avoid, and minimize risks to species of concern. During post-construction tiers (Tiers 4 and 5), developers assess whether actions taken in earlier tiers to avoid and minimize impacts are successfully achieving the goals and, when necessary, take additional steps to compensate for impacts. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. Each tier offers a set of questions to help developers evaluate the potential risk associated with developing a project at a given location.

The tiered approach provides the opportunity for evaluation and decision-making at each stage, enabling a developer to abandon or proceed with project development, or to collect additional information, if required. This approach does not require that every tier, or every element within each tier, be implemented for every project. Instead, the tiered approach allows efficient use of developer and agency resources with increasing levels of effort. The WEG also provide best management practices for site development, construction, retrofitting, repowering, and decommissioning.

The WEG include a Communications Protocol that provides guidance to both developers and USFWS personnel regarding appropriate communication and documentation. Adherence to the WEG is voluntary and does not relieve any individual, company, or agency of the responsibility to comply with laws and regulations. However, if a violation occurs, USFWS will consider a developer’s documented efforts to communicate with USFWS and adhere to the WEG in its enforcement decision.

3.2 State

3.2.1 California Endangered Species Act

The California Endangered Species Act (CESA), administered by the California Department of Fish and Wildlife (CDFW), states that species listed as threatened or endangered in the State cannot be taken or harmed unless such "take" is authorized pursuant to a Section 2081 Incidental Take Permit, or through a 2080.1 Consistency Determination. "Take" currently is defined as to do or attempt to do the following: hunt, pursue, catch, capture, or kill a member of a listed species. Unlike the federal ESA, habitat modification or degradation is not included in the definition of "take" under CESA.

3.2.2 Various Fish and Game Codes

Fish and Game Code Section 3511, 4700, 5050, and 5515. Describe species that are "fully protected." Fully protected birds may not be taken or possessed, except under specific permit requirements. Sections 3511, 4700, 5050, and 5515 list bird, mammal, amphibian, and reptile species that are fully protected in California.

Fish and Game Code Section 3503. States that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.

Fish and Game Code Section 3513. Makes it unlawful to take, possess, or destroy any birds of prey or to take, possess, or destroy the nest or eggs of any such bird.

Fish and Game Code Section 4150. States that a mammal occurring naturally in California that is not a game mammal, fully protected mammal, or fur-bearing mammal is a nongame mammal. A nongame mammal may not be taken or possessed except as provided in this code or in accordance with regulations adopted by the commission.

3.2.3 California Environmental Quality Act

The California Environmental Quality Act (CEQA) declares that the state shall prevent the elimination of fish or wildlife species due to man's activities and ensure that wildlife populations do not drop below self-perpetuating levels (§ 21001(c)). Furthermore, mandatory findings of significant impact include substantial reduction in habitat of wildlife species, or if impacts cause a species population to drop below self-sustaining levels (§15065[a][1]).

Alameda County adopted findings required by CEQA that fatality impacts as a result of the Summit Project would be considered unavoidable, potentially substantial and significant among certain specified avian species. As such, the PEIR identified mitigation measures that would reduce or avoid the greatest severity of these effects than those acknowledged to result from the wind turbines that were previously permitted in the APWRA. Recent studies on the nesting population of golden eagles in the region indicate consistent use, occupation, and productivity of the breeding population of golden eagles in the Diablo Range (Wiens et al. 2018). Recent studies have suggested that the current level of wind-induced fatalities is sustainable; so, it stands to reason that the estimated mortality rate at the Summit Project would likely not cause a decline in the local golden eagle population (Wiens et al. 2015).[2]

[2] Wiens estimates that there are 280 nesting pairs of golden eagles in the Diablo Range, and previous studies (cited by Wiens et al. 2015) indicate that about 165 pairs of nesting eagles could sustain 50 turbine blade-strike fatalities annually. Hunt et al. 2017 concludes that 216-255 breeding pairs in the Diablo Range would be required to support 55-65 deaths due to turbines. The rate of annual fatalities from 1998-2002 is estimated to be 28-68 golden eagles (Smallwood and Thelander 2008, ICF International 2014) and 55-65 from 1998-2007 (Hunt et al. 2017). This number is believed to have fallen as repowering has taken place. Hunt et al. 2017 demonstrate the stability of the local golden eagle population in a period prior to the majority of repowering which is believed to be buffered through the documented presence of non-breeding 'floaters', and Katzner at al. 2016 adds that the stability of local population is augmented by immigration of golden eagles across the Western U.S. but provides no contradiction to perceived stability of the APWRA population of golden eagles. Hunt et al. 2017 further provided that follow-up surveys performed in 2005 and 2013 indicate that occupancy of the breeding sample subset was nearly identical to that of 2000, further supporting the stability of the APWRA golden eagle population.

Alameda County reviewed the Summit Project at a project level and pursuant to the PEIR issued CUP PLN2014-00056 to enable the construction of the project. The review included the requirement that a project-specific avian protection plan would be prepared, and which would "specify measures and protocols consistent with the program-level mitigation measures that address avian mortality" (Section 1.2 discusses the required components of an ABPP). All mitigation measures pertaining to birds and bats in the PEIR are also included in Appendix A of this ABPP.

3.3 State Renewable Energy Directives and Goals

The California Renewable Portfolio Standard (RPS) legislation, enacted in 2002 (Senate Bill 1078) and accelerated in 2005, required retail sellers of electricity to obtain 20 percent of their supply of electricity from renewable energy sources, such as wind, by 2010. The governor of California set a statewide goal of achieving a 33 percent renewable energy share by 2020 and expanded that target to 50 percent by 2030 in 2015. Power generated by the Summit Project will be delivered to the California energy market. By using the wind sites best suited to generate power, such as the APWRA, the Summit Project will meet the California RPS requirements more cost effectively than sites with less wind output. Additionally, the Summit Project will contribute to the overall reduction of greenhouse gas emissions that would otherwise be released into the atmosphere from sources of nonrenewable power.

3.4 Local and Other

3.4.1 2007 Settlement Agreement

In January 2007, Audubon, Californians for Renewable Energy (CARE), Alameda County and several wind power companies entered into a settlement agreement (2007 Settlement Agreement). On January 11, 2007, Alameda County modified the CUPs for the wind power companies to be consistent with the 2007 Settlement Agreement. The 2007 Settlement Agreement requires the wind power companies to reduce raptor mortality by 50 percent and to implement adaptive management measures (ADMMs) if a 50 percent reduction in mortality is not achieved. The 2007 Settlement Agreement also contemplates the development of a Natural Communities Conservation Plan/Habitat Conservation Plan or similar agreement (e.g., this ABPP) to address the long-term operation of wind turbines at the APWRA. As set forth in the PEIR, proponents are expected to develop project-specific avian protection plans incorporating mitigation, monitoring, and adaptive management strategies.

3.4.2 East Alameda County Conservation Strategy

Alameda County has developed a conservation strategy with the purpose of preserving endangered species by developing strategies that address long-term habitat protection. The East Alameda County Conservation Strategy (EACCS) lays out a voluntary system of mitigation that supports conservation and/or recovery of sensitive species. The strategy also aims to assist with and streamline the state environmental permitting process by providing guidance on avoidance, minimization, and mitigation for project compliance with CEQA and other applicable laws. The APWRA lies within the area covered by the EACCS, and the PEIR and EACCS are closely aligned with one another. Where applicable, the goals and objectives in the EACCS were used to develop mitigation measures in the PEIR to minimize potential impacts to biological resources resulting from repowering projects in the APWRA.

On November 17, 2017, USFWS granted a Section 7 ESA Biological Opinion (Ref #08ESMF00-2017-F-1854) to the Summit Project for potential effects on the federally endangered longhorn fairy shrimp, the threatened vernal pool fairy shrimp, the threatened California red-legged frog, the threatened California tiger salamander, the endangered San Joaquin kit fox, the threatened Alameda whipsnake, and the endangered Callippe silverspot butterfly. USFWS determined that the Summit Project was appropriate to append to the *Programmatic Biological Opinion for the Corps Permitted Projects Utilizing the East Alameda County Conservation Strategy that May Affect Federally Listed Species in East Alameda County, California* (USFWS 2012b).

4. Wind Development in the Altamont Pass

4.1 History

Since the early 1980s, wind energy facilities have been operating in the Altamont Pass. The APWRA is recognized nationally and is designated by the State of California and Alameda County as a Wind Resource Area because it maintains winds at a level that supports economically viable wind energy projects. According to the California Energy Commission (CEC) (2020), approximately 95 percent of all wind generating capacity and output is located in the Altamont Pass, Tehachapi, and San Gorgonio, making the ongoing production of wind energy in the Altamont Pass a critical part of California's diverse energy portfolio.

The Altamont Pass is located in the Diablo Range of the California Coast Range. Meteorological conditions are particularly favorable for creating sustained high winds, making commercial wind energy feasible. Wind development in the Altamont Pass began in the early 1980s, prompted by good wind energy resources and favorable federal and state legislation in the wake of the high energy prices of the 1970s. By 1986, California had installed more than 1.2 gigawatts of wind power, representing nearly 90 percent of global installations at that time (Department of Energy 2008).

The actual number of turbines built in the Altamont Pass is in the range of 4,200 to 5,400, depending on the source document and time period. Early turbine models consisted of a turbine mounted on a lattice tower. A good example of this model is the Kenetech 56-100 turbines equipped on 18-meter lattice towers, with rotor diameters of 18 meters, down-wind blades spinning at approximately 60 revolutions per minute, with tips within 9 meters of the ground (WEST 2002). These smaller turbines were densely placed in clusters, leaving little to no space for birds to maneuver between them.

Over a period of time, a high incidence of bird mortality was observed in the APWRA, primarily from collisions with operating old-generation turbines. As noted by Hoover (2002), raptors were the type of bird most commonly killed within the APWRA, including an estimated 36 to 50 golden eagles and hundreds of other raptors are estimated to have been killed annually between monitoring years 2005 to 2013 (ICF 2016). During the period cited, old-generation turbines dominated the APWRA. In response to this trend, a myriad of avian mortality studies began to determine the causal relationships between wind turbines and bird mortality. Most data indicate that raptor mortality is more a consequence of turbine placement, rather than turbine type, particularly in relation to the topography and turbine spacing (Hoover 2002). Repowering has been occurring in the APWRA in an attempt to minimize the impact to avian species.

4.2 Current Repowering Projects

Smallwood and Thelander (2004) found that repowering may be the most effective approach to reducing turbine-related avian mortality in the APWRA because it appears that fewer, taller, and larger output turbines offer lower risk than many, smaller, lower-output turbines. Additionally, results of studies of repowered sites (Diablo Winds, Buena Vista, Vasco Winds) in the APWRA indicate that repowering with newer-generation turbines has resulted in a reduction in the estimated total number of avian fatalities and the overall mortality rate per MW of capacity for all species groups and for all individual species (ACCDA 2014; Ventus Environmental Solutions 2016).

The results included in the draft HT Harvey and Associates (2020) Years 1-3 fatality monitoring report for Golden Hills are consistent with these findings for American kestrel, western burrowing owl, and all raptors. For golden eagle, HT Harvey and Associates (2020) study determined an above-average adjusted fatality rate compared to other pre- and post-repower APWRA studies, with a 3-year of 0.16 fatalities/MW/year that is twice as high as the APWRA-wide pre-repower rate of 0.08 fatalities/MW/year (ACCDA, 2016). HT Harvey and Associates (2020) states further that…"…although the basis for our average adjusted rates may be most similar to that of the other adjusted estimates and therefore represent the fairest across-study comparison, we reemphasize that we do not consider the adjusted estimates accurate indicators of the golden eagle fatality rate during our study. Regardless, focusing on the alternative naïve-with-offplot estimates, which we consider the most accurate, does not change the overall conclusion of an above-average fatality rate for golden eagles during this study (an estimated average of 0.12 fatalities/MW/year remains higher than all previous estimates and 50% higher than the pre-repower rate represented in the final programmatic EIR). For red-tailed hawk, HT Harvey and Associates (2020) determined high interannual variability and a 3-year average fatality rate (0.56 fatalities/MW/year) that exceeded the averages from prior APWRA studies. However, although the Year 1 fatality estimate was atypically high, the Year 2 and 3 estimates were similar to averages from the Vasco Winds post-repower and APWRA-wide pre-power studies.

The draft Year 1 results for Golden Hills North were less concerning for the focal raptor species, compared to both the Golden Hills site and other pre- and post-repowering studies (Great Basin Bird Observatory & HT Harvey and Associates 2020). For both golden eagles and red-tailed hawks, the Year 1 Golden Hills North rates were half the 3-year Golden Hills averages and 12 and 28% lower, respectively, then the APWRA-wide pre-repower averages. For red-tailed hawks, there is inter-annual variation, and the fatality patterns indicate a territory was likely wiped out in year one. Other pairs may be attracted to that vacant territory and similar impacts could be on going. For American kestrels, the Year 1 Golden Hills North rate essentially matched the 3-year Golden Hills average and was approximately 80% lower than the APWRA-wide pre-repower average. For burrowing owls, the Year 1 Golden Hills North rate was second lowest among the compared projects and many times lower than the APWRA-wide pre-repower average (Great Basin Bird Observatory & HT Harvey and Associates 2020).

The following sections summarize the current repowering efforts in the Altamont Pass.

4.2.1 Diablo Winds

At the Diablo Winds site, 169 FloWind, vertical-axis turbines were replaced with 31 660-kilowatt (kW) Vestas V47 turbines in 2005 (WEST 2008). Although the Vestas turbines were larger than the FloWind turbines and structurally very different (vertical-axis turbines versus horizontal turbines on tubular towers), they are smaller than the standard modern turbines rated at 1 MW or more. The Diablo Winds repowering project was evaluated for avian mortality by WEST (2008), Smallwood and Karas (2009), and ICF International (ICF) (2016).

4.2.2 Buena Vista

The Buena Vista site was repowered in 2005 and became operational in December 2006. A total of 179 older-generation 150- and 160-kW turbines were replaced with 38 new Mitsubishi 1-MW turbines. Post-construction monitoring at Buena Vista used a census of the turbines, a 2-week search interval, and monitoring of carcass removal and searcher efficiency rates. The Buena Vista repowering project was evaluated for avian mortality by Insignia Environmental (2012). It is worth noting that developing estimates from the monitoring program for Buena Vista proves to be difficult due to the lack of (and quality of) data available (searcher efficiency and scavenging estimates) for adjusting raw fatality numbers.

4.2.3 Vasco Winds

The Vasco Winds site was repowered in 2011. In 1985, the area originally consisted of 800 KCS56 100-kW turbines and produced 80 MW of electric power. In 1992, 20 KVS33 400-kW turbines were added. Over time, the number of turbines in the area declined due to attrition, mitigation efforts, and removal projects (e.g., construction of the current Vasco Road through the original project area). In 2011, the 438 remaining wind turbines were removed and replaced by 34 Siemens 2.3 MW wind turbines. The 78.2 MW repowered project commenced operations in February 2012. The Vasco Winds repowering project was evaluated for avian and bat mortality and use by Ventus Environmental Solutions Inc (2016) from 2012 to 2015.

4.2.4 Golden Hills

The Golden Hills site was repowered in 2015. The number of active turbine sites for this project had diminished as well over time due to attrition and mitigation. The project removed 775 existing wind turbine locations in order to install 48 1.79 MW GE turbines. The 85.92 MW project commenced operations in December 2015 and completed the first three years of post-construction bird and fatality monitoring in September 2019 by HT Harvey and Associates (2020). In contrast to the other repowering projects, Golden Hills' monitoring program is relying on the use of scent-detection dogs versus human searchers.

4.2.5 Golden Hills North

The Golden Hills North site was repowered in 2017. The number of active turbine sites for this project had diminished as well over time due to attrition and mitigation. The project removed approximately 324 existing wind turbine locations in order to install 20 2.3 MW GE turbines. The 46 MW project commenced operations in January 2018 and completed the first of three years of post-construction bird and fatality monitoring in October 2019 by Great Basin Bird Observatory and HT Harvey and Associates (2020). Similar to Golden Hills, the monitoring program is relying on the use of scent-detection dogs.

5. Site Characterization and Surveys

5.1 Overview of Project Area

The Summit Project is located less than 5 miles northeast of Livermore and approximately 8 miles west of Tracy, California, in the Altamont Hills region (Figure 1). The region has a typical Mediterranean climate with hot dry summers and cool wet winters generating an average annual rainfall of 12 to 15 inches per year. Ecologically, the repowered facility is within the Coast Range geomorphic province of California. The province is characterized by a series of northwest-trending ridges and valleys. The project area is characterized by mostly treeless rolling hills interspersed with low-lying narrow valleys south of the Diablo Range, with elevations ranging from 442 to 1,327 feet above sea level.

The project area is dominated by grazed annual brome grassland interspersed with seasonal drainages, intermittent creek (Brushy Creek), occasional trees, and seasonal and perennial ponds (stock ponds). Numerous large sandstone rock outcroppings occur near the central part of the project area and support vernal pools. These rock outcrops are less affected by cattle grazing due to the difficulty for cattle to forage among the rocks. As a result, several species occur here that are not found elsewhere in the grassland including but not limited to California sagebrush and California buckeye (Sycamore Environmental Consultants, Inc. 2017). Thickets of red willow grow along Brushy Creek. Just beyond the site is a fairly large patch of California buckeye woodland on an east facing slope overlooking Brushy Creek. Chaparral habitats that are indicative of higher elevations of the Diablo Range are generally lacking.

Birds commonly found foraging in grasslands in this region include loggerhead shrike (*Lanius ludovicianus*), golden eagle (*Aquila chrysaetos*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus leucurus*), and California horned lark (*Eremophila alpestris actia*). Ground-nesting birds in these vegetation types include western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), and the western burrowing owl (*Athene cunicularia*), a species that nests and roosts in small mammal burrows and other burrow-type settings associated with human disturbance. The trees and shrubs provide nesting habitat for birds including golden eagle, but are not located near any of the final turbine sites.

Common mammals include black-tailed jackrabbit (*Lepus californicus*), cottontail rabbit (*Lepus sylvaticus*), California ground squirrel (*Spermophilus beecheyi*), and Botta's pocket gopher (*Thomomys bottae*), and coyote (*Canis latrans*). Rock outcrops in the vicinity can provide nesting habitat for raptors including golden eagle and prairie falcon (*Falco mexicanus*), and other birds including rock wren (*Salpinctes obsoletus*). Additionally, these rock outcrops also provide cover and nesting or roosting habitat for small mammals including cottontail rabbit, California ground squirrel and bats, as well as reptiles including western fence lizard (*Sceloporus occidentalis*), Alameda whipsnake (*Masticophis lateralis euryxanthus*) and Pacific rattlesnake (*Crotalus oreganus*). Mammals and reptiles attracted to rock outcrops provide foraging opportunities for raptors.

On October 30, 2020 The Technical Advisory Committee (TAC) indicated that an undocumented golden eagle roost occurs near the Project.

5.2 Bird and Bat Use

5.2.1 Avian Studies in the Altamont Pass

Numerous studies addressing avian mortality have been conducted within the APWRA, including areas that encompass the Summit Project. Early research focused on identifying the extent of avian mortality. As studies progressed, research began addressing causal relationships for avian mortality. The National Renewable Energy Laboratory initiated research, and other agencies have since funded multiple studies, to address the causes of mortality of various bird species from wind turbines (Smallwood and Thelander 2005). Since 1998, these studies have quantified avian mortality, use and behavior within the APWRA (Smallwood and Thelander 2004b, 2004c).

Within the APWRA, multiple wind energy projects differ in their location and in the types and sizes of turbines in operation. These different groups theoretically present different levels of risk to birds based on the variability in bird use patterns and variability in the collision risk between different types and sizes of turbines. Despite some similarities in search methodology (e.g. search intervals), the studies used different sampling schemes, survey methods (e.g. humans vs. dogs), and analytical techniques that result in variations in interpretations of the number of avian and bat deaths attributable to wind turbines. Variability of mortality study parameters (for example, search interval, searcher efficiency, carcass removal rate, estimates of mortality) is not uncommon, and greater detail on these variations is presented by ICF (2010).

Some of the key studies related to avian mortality are described in greater detail below, with respective study parameters further detailed in Appendix B.

Alameda County Avian Monitoring Team

The Alameda County Avian Monitoring Team was led by WEST in 2005; the Predatory Bird Research Group at U.C. Santa Cruz from 2006 to 2008; and by ICF (formerly ICF Jones & Stokes) from 2008 - 2015. The Alameda County Avian Monitoring Team conducted fatality searches beginning in December 2005, but the number of monitored turbines has decreased dramatically over time. The APWRA was subdivided into northern and southern halves and stratified by blocks. Blocks of turbines containing small turbines (by far the most common turbine size in the APWRA) were then selected at random, while all very small and medium-sized turbines were monitored. Turbines were searched approximately every 30 to 40 days, with the search interval steadily decreasing over time as the efficiency of the program increased. The searcher efficiency adjustment factors were derived from Smallwood (2007), and the estimated carcass removal adjustment factors were taken from a variety of sources. The value for large birds was derived by following fresh carcasses of large birds found by the search team through time. The value for small birds was derived similarly from a study of small bird carcasses found during a study of the effects of using a 2-day search interval. The resulting adjustment factors were greater than those reported from other studies, which suggest higher detection probabilities and produced lower estimates of total mortality. Consequently, some of the fatality estimates were lower in the ICF (formerly ICF Jones & Stokes) report than in the previous work by Smallwood and Thelander (2004a).

Several analyses were conducted in an attempt to make comparisons between estimated mortality from the baseline study (using the data from Smallwood and Thelander [2004a]) and estimated mortality from the ICF fatality study (ICF 2016). Attempts to make the datasets comparable involved using different subsets of turbines and searches from the baseline and ICF studies to standardize variables such as search interval and the number of searches conducted at a particular turbine, and other factors that are known to have a potentially substantial effect on resulting estimates of mortality. Overall estimates of annual mortality varied widely among years, depending on the datasets used and the analysis method. Numerous assumptions were made in order to generate the following estimates, and for many reasons the actual fatality rate could be very different than the estimates provided in ICF's report (2016). Adjusted mortality estimates ranged from 278 to 1,101 raptor fatalities/year and from 1,838 to 2,982 bird fatalities per year.

The major conclusion was that annual mortality rates for most species and species groups (raptors, nonraptors, large raptors, small raptors) varied significantly across years, confounding attempts to assess the effectiveness of management measures. Management measures implemented during the ICF study period included shutting down turbines for various lengths of time during the winter months (seasonal shutdown) and the removal of turbines rated as hazardous by the Scientific Review Committee (hazardous turbine removal).

Smallwood and Karas (2009)

Smallwood and Karas presented a parallel analysis of the data presented in ICF (2009), but examined only 2 years rather than 3 years because the third year of data was not yet available when they conducted their analysis. Adjustment factors used in Smallwood and Karas (2009) were derived from Smallwood (2007). Estimates of average annual mortality rates were substantially higher than those reported by ICF (2009) primarily due to the use of different adjustment factors and calculation methods; inclusion of Wildlife Reporting Response System (WRRS) records (fatality records recorded by power company personnel and not found as part of the standardized sampling scheme); the inclusion of only 2 years of data, of which one was a year of record high mortality (ICF 2009); and some differences in the specific turbines, search information, and fatality records that were included. However, conclusions by Smallwood and Karas (2009) were the same as those found by ICF (2009), regarding: changes in fatality rates between the pre-ICF and ICF fatality study periods; the lack of evidence for the effectiveness of management measures to reduce turbine-related avian mortality; and, notable differences between fatality rates associated with older and newer-generation turbines, including the lower calculated mortality rates at the repowered Diablo Winds site.

Smallwood (2010)

Smallwood also prepared a report on avian mortality rates for the proposed Tres Vaqueros Wind Project (Smallwood 2010). The 2010 report extrapolated data from existing fatality searches from 2005 to 2009 (from data associated with APWRA-wide monitoring) and from the two operating wind repower projects, Diablo Winds and Buena Vista. Using these data from the area of the proposed Tres Vaqueros Project, other regional monitoring data, and from operating projects, Smallwood developed four separate sets of baseline fatality rate estimates and selected one of those based on a series of assumptions about representative fatality rates from previously operating turbines models and sizes. Smallwood made assumptions and incorporated data from operating projects and from APWRA-wide monitoring to reduce the potential for establishing an inappropriately low baseline. Smallwood notes that "using the fatality monitoring data from Tres Vaqueros alone could prove misleading as the foundation for baseline fatality rates because the baseline conditions were changing rapidly."

Smallwood and Neher (2011)

Smallwood and Neher (2011) analyzed the optimal turbine layout for the Vasco Winds Project. This study evaluated a DEM and raptor use and behavior data to develop geographical and topographical map-based predictive models that show where on the project site raptors more often fly and perform other specific behaviors such that locating turbines in these areas would create greater risks to raptors. To reduce avian mortality, Vasco Winds LLC applied and supplemented certain measures for site-specific conditions, as documented in Smallwood and Neher (2010). The report documents site-specific modeling of golden eagle flights, red-tailed hawk and American kestrel hovering and kiting, and burrowing owl nest burrow locations. These models were used to site wind turbines in a way that would minimize encounter frequencies between raptors and operating turbines. Vasco Winds implemented the Smallwood and Neher recommendations in developing the project layout, and the report documents that the project's final turbine layouts are consistent with the report's recommendations and with how the report authors intended the predictive models of raptor use behavior to be used.

Smallwood (2013)

In 2013, Smallwood published a report attempting to unify national fatality estimates and makes the following estimate for 2012: 888,000 bat and 573,000 bird fatalities/year (including 83,000 raptor fatalities) at 51,630 megawatt (MW) of installed wind-energy capacity in the United States. Adjusted fatality rates correlated inversely with wind-turbine size for all raptors as a group across the United States, and for all birds as a group within the Altamont Pass Wind Resource Area, California, suggesting that most fatalities decrease with repowering projects. This report calls for the need to improve these monitoring methods and incorporation of concurrent detection trials.

Wiens, Kolar, Fuller, W. Hunt, and T. Hunt (2015)

In 2014, a report was published using multistate occupancy sampling design to estimate occupancy, breeding success, and abundance of territorial pairs of golden eagles in the Diablo Range, California. Methods include the use of spatial pattern of detections and non-detections over repeated visits to survey sites to estimate probabilities of occupancy and successful reproduction. It was estimated that the probability of detecting territorial pairs of golden eagles and their young was less than 1 and varied with time of the breeding season, as did the probability of correctly classifying a pair's breeding status. Analysis indicated that imperfect detection and breeding classification led to a sizeable difference between the uncorrected, naïve estimate of the proportion of occupied sites where successful reproduction was observed (0.20) and the model-based estimate (0.30). The analysis further indicated a relatively high overall probability of landscape occupancy by pairs of golden eagles (0.67, standard error = 0.06), but that areas with the greatest occupancy and reproductive potential were patchily distributed.
The study results emphasize the importance of accounting for imperfect detection and spatial heterogeneity in studies of site occupancy, breeding success, and abundance of golden eagles.

W. Hunt, Wiens, Law, Fuller, T. Hunt, Driscoll, and Jackman (2017)

Population-level effects of anthropogenic causes of raptor mortality are rarely quantified due to the complicated dataset required. This study focused on the demography of a resident, tree-nesting population of golden eagles in the vicinity of the APWRA. During 1994-2000, we tracked the fates of >250 radio-marked individuals of four life-stages and conducted five annual surveys of territory occupancy and reproduction. It was concluded that collisions with wind turbines accounted for 41% of 88 uncensored fatalities, most of which were subadults and nonbreeding adults. Occupancy surveys 5 and 13 years later (2005 and 2013) showed that the nesting population remained intact. It was estimated that the entire annual reproductive output of 216-255 breeding pairs in the region would have been necessary to support published estimates of 55-65 turbine blade-strike fatalities per year.

Katzner, Nelson, Braham, Doyle, Fernandez, Duerr, Bloom, Fitzpatrick, Miller, Culver, Braswell, and DeWoody (2017)

Katzner et al. used genetic and stable isotope data collected from golden eagle carcasses within the APWRA demographic models to test hypotheses about the geographic extent and demographic consequences of fatalities caused by renewable energy facilities.
The analysis concluded that ≥25 percent of these APWRA killed eagles were recent immigrants to the population, most from long distances away (>100 km), inferring the stability of the golden eagle population was maintained by continental-scale immigration. The analysis further provides that mortality is heavily skewed toward younger birds.

Kolar and Wiens (2017)

Kolar and Wiens reviewed data collected between 2014 and 2016 in the Diablo Range, surrounding the APWRA. Surveys documented up to 15 territorial pairs within 3.2 kilometers (km) of wind turbines at the APWRA annually. It was found that there was evidence of nesting activity by adult pairs at least once during our study at six of these territories. It was also determined that 23–36 percent of territories identified within 3.2 km of the APWRA had a subadult pair member, but that no pairs with a subadult member attempted to nest.

Wiens, Kolar, Fuller, Bell, W. Hunt, and T. Hunt (2018)

Wiens et al. presents results of an investigation on occupancy and breeding success of golden eagles in the Diablo Range, California. The study used a broad-scale sampling design during a period of exceptional drought (2014–2016). Detection included 199 pairs of eagles, 100 of which were detected in focal sample sites. With the use of dynamic multistate modeling to identify relationships between site occupancy and reproduction, the study observed little variability among years in site occupancy (3-yr mean¼ 0.74), but the estimated annual probability of successful reproduction was relatively low during the study period and declined from 0.39 (6 0.08 SE) to 0.18 (6 0.07 SE). Probabilities of site occupancy and reproduction were substantially greater at sample sites that were occupied by successful breeders in the previous year, indicating the presence of sites that were consistently used by successfully reproducing eagles. They found strong evidence for nonrandom spatial distribution in both occupancy and reproduction; sites with the greatest potential for occupancy were characterized by rugged terrain conditions with intermediate amounts of grassland interspersed with patches of oak woodland and coniferous forest, whereas successful reproduction was most strongly associated with the amount of precipitation that a site received during the nesting period. The findings highlight the contribution of consistently occupied and productive breeding sites to overall productivity of the local breeding population and show that both occupancy and reproduction at these sites were maintained even during a period of exceptional drought.

Wiens, Kolar, and Bell (2020)

Wiens et al. estimated site-occupancy, abundance, and reproduction of golden eagles in the HCP/NCCP inventory area in 2019. Ninety-nine (99) surveys were completed and a total of 50 detections of territorial pairs of eagles were recorded at 20 (67 percent) of 30 sites (13.9-square-kilometer [km2] plots). Detection probability of territorial pairs was highest in January and February (≥0.75) and lowest in mid-June to late July (<0.50). After correcting for imperfect detection, the expected probability of site-occupancy was 0.69 (standard error [SE] = 0.09), and mean expected abundance was 0.76 pairs per site (SE = 0.16), or 27.4 pairs per 500 km2. They found evidence of successful nesting (≥1 young fledged) for 3 (14 percent) of 22 pairs of eagles monitored in 2019Bat Studies in the Altamont Pass

The Altamont Pass supports habitats suitable for roosting, foraging, and migration for special-status and common bats. Common bats include canyon bat (*Parastrellus hesperus*), Mexican free-tailed bat (*Tadarida brasiliensis mexicanus*), and California myotis (*Myotis californicus*). Special-status bat species include little brown bat (*Myotis lucifugus*), western mastiff bat (*Eumops perotis*), silver-haired bat (*Lasionycteris noctivagans*), western red bat (*Lasiurus blossevillii*), hoary bat (*Lasiurus cinereus*), pallid bat (*Antrozous pallidus*), and Townsend's big-eared bat (*Corynorhinus townsendii*).

According to CDFW (2020), there are no known roosts or nursery sites within the area of Summit Project; however suitable habitat is present at the site. Rock outcrops, riparian vegetation, and individual and clusters of non-native eucalyptus; native oak and California buckeye at rock outcrops and at other locations exist within and adjacent to the site. During a baseline bat roost assessment conducted for the Project in August 2017, suitable roosting sites were identified however no physical sign (guano and urine staining) or individual bats during an emergence survey were detected.

Based on data obtained from acoustic monitoring at nearby wind facilities (Pandion Systems 2010; Szewczak 2013; HT. Harvey and Associates 2020; Great Basin Bird Observatory & HT. Harvey and Associates 2020), the following bats are known to occur in in the Altamont Pass: Mexican free-tailed bat, canyon bat, big brown bat (*Eptesicus fuscus*), western red bat, hoary bat, western mastiff bats, California myotis, Yuma myotis (*M. yumanensis*), silver-haired bat, and long-legged myotis (*M. volans*). The Townsend's big-eared bat has not been recorded as of yet. The hoary bat and Mexican free-tailed bat accounted for the highest fatality rate of bats recorded for a recent study at the Golden Hills repowering site, whereas western red bats, big brown bats, and silver-haired bats occurred at much lower rates (HT Harvey and Associates 2020).

Smallwood and Bell (2020)

Smallwood and Bell tested the effects of curtailment on bird and bat species using the before-after, control-impact (BACI) method. The results of this study appear to refute the roost attraction hypothesis, but could support a number of other hypotheses related to heat, acoustic, visual attractants, insect attraction, or the echolocation failure or electromagnetic disorientation hypotheses. This study did not attempt to text any of these hypotheses.

This study supports the theory that curtailment during migration reduces bat fatalities. Notably, this appears not to effect bird species.

Smallwood (2020)

Smallwood uses wind turbine bat collision fatality data collected in 2012 to estimate current national bat fatalities in 2014 at 1.1 million and 1.72 million in 2019 across the U.S. In 2014, Smallwood found no significant relationship between bat fatality rates and wind turbine size. Bat fatality rates increased with increasing tower height, but this increase mirrored the increase in fatality rates with shortened fatality search intervals that accompanied the increase in tower heights. Regional weighting of mean project-level bat fatalities increased the national-level estimate 17 percent to 1.3 million (95% CI: 0.15–3.0). Smallwood then restricted the estimate's basis to project-level fatality rates that were estimated from fatality search intervals shorter than10 days, and the estimate increased by another 71% to 2.22 million (95% CI: 1.77–2.72) bat fatalities in the USA's lower 48 states in 2014. Project-level fatality estimates based on search intervals shorter10 days were, on average, eight times higher than estimates based on longer search intervals. Shorter search intervals detected more small-bodied species, which contributed to a larger all-bat fatality estimate.

6. Risk Assessment

6.1 Avian Species

Bird density, age, residency status and season, flight style, interaction with other birds, and presence of foraging opportunities all may influence the likelihood of collisions with a WTG. The majority of birds detected in the APWRA during fatality studies have been nonraptors (ICF 2016), which is consistent with other studies (Arnett et al. 2007). This ABPP relies on the fatalities expected to occur as documented in recent years by neighboring repowering projects (see Table 2): Vasco Winds (Ventus Environmental Solutions, 2016), Golden Hills (HT Harvey & Associates, 2020), and Golden Hills North (Great Basin Observatory & HT Harvey and Associates, 2020) – seven years of monitoring in total. The adjusted fatality rates from nonrepowered turbines (APWRA-wide), and repowered turbines to date were multiplied by the nameplate capacity of the pre-repowered Summit Project (N=56.9 MW) and repowered Summit Project (N=57.5 MW) to estimate total number of fatalities resulting from the nonrepowered turbines and repowered turbines. The resulting number of fatalities are provided in Table 2.

Table 2. Annual Adjusted Avian Fatality Rates for Nonrepowered and Repowered APWRA Turbines

Species/Group	Adjusted Fatality Rates[a]		Estimated Summit Wind Fatalities[b]	
	NonRepowered[c]	Vasco Winds / Golden Hills / Golden Hills North[d] (95% CI)	Non Repowered 56.9 MW	Repowered 57.5 MW using Vasco Winds / Golden Hills / Golden Hills North Rate and [Average]
American Kestrel	0.59	0.28 (0.07-0.50) / 0.10 (0.04-0.26) / 0.11 (0.09-0.17) [0.16]	31.57	16.10 / 5.75 / 6.33 [9.39]
Burrowing Owl	0.78	0.06 (0.00-0.17) / 0.19 (0.15-0.32)/ 0.03 (0.02-0.07) [0.09]	44.38	3.45 / 10.93 / 1.73 [5.37]
Golden Eagle	0.08	0.04 (0.02-0.07) / 0.16 (NA) / 0.08 (NA) [0.10]	4.55	2.88 / 9.20 / 4.60 [5.56]
Red-tailed Hawk	0.44	0.21 (0.04-0.38) / 0.57 (NA) / 0.29 (0.20-0.52) [0.36]	25.03	12.08 / 32.78 / 16.68 [20.51]
All Raptors	2.43	0.64 (0.20-1.09) / 1.15 (NA) / 0.64 (0.49-0.98) [0.81}	138.27	36.80 / 66.13 / 36.80 [46.58]
All Native Non-raptors	4.50	2.09 (NA) / 7.83 (NA) / 6.19 (4.97-8.58) [5.37]	256.05	120.18 / 450.23 / 355.93 [308.76]

[a] Annual fatalities per MW of nameplate capacity.
[b] Estimated total number of Project-wide fatalities. Calculated by multiplying adjusted fatality rate by MW.
[c] Table 3.4-10 Annual Adjusted Fatality Rates for Nonrepowered and Repowered APWRA Turbines (PEIR 2014).
[d] Vasco Winds 3 year average (Ventus Environmental Solutions, 2016), Table 3.4-10 PEIR 2014 / Golden Hills Year 3 (HT Harvey & Associates Draft, 2020) / Golden Hills North Year 1 (Great Basin Observatory & HT Harvey and Associates Draft, 2020) with the average across the three projects provided in brackets [ ]. Naïve-with-offplots estimate used for Golden Eagle estimates for Golden Hills. Since estimates varied across the three year study, the Fatalities per MW were averaged for species without three-year averages provided in the report.

6.2 Bat Species

Bat fatalities can occur throughout the year, but are typically concentrated during late summer and fall months, after young-of-the-year pups take flight (Arnett et al. 2008). Within the APWRA, Mexican free-tailed bats and hoary bats have made up the majority of documented fatalities (ACCDA 2014), which was also the case for Golden Hills (58% and 37%, respectively) (HT Harvey and Associates 2020) and Golden Hills North (79% and 16%, respectively) (Great Basin Bird Observatory & HT Harvey and Associates 2020). Western red bat, another migratory species and a California species of special concern, sustained the third highest number of documented fatalities (3%) at Golden Hills (3%) and Golden Hills North (2%).

According to WEST (2012), bat fatality rates in California vary from 0.24 to 3.92 bat/MW/year. At the Golden Hills site (Years 1-3), the estimated annual fatality rate for all bats species ranged from 1.40 bats/MW/year to 7.12 bats/MW/year based depending on four alternative estimation approaches (HT Harvey and Associates 2020). At the Golden Hills North site (Year 1), the estimated annual fatality rate for all bats species ranged from 8.03 bats/MW/year to 18.43 bats/MW/year (Great Basin Bird Observatory & HT Harvey and Associates 2020), According to HT Harvey and Associates (2020), although most previous studies suggested that bat fatalities were rare in the APWRA (e.g., ICF, 2016). Golden Hills was the first time scent-detection dogs have been used for an extended period to conduct fatality searches along with a shorter 7-day search interval. This combination resulted in detecting a far greater number of bat fatalities than ever before in the APWRA; however, similar estimates of per MW fatality rates in this study and the post-repowering Vasco Winds study suggest that repowering with larger, taller turbines also may have contributed to a higher fatality rate for bats (HT Harvey and Associates 2020).

Table 4 below derived from Table 3.4-6 from the PEIR provides raw bat fatalities within the APWRA with updates for Vasco Winds (Years 1-3) and Golden Hills (Year 1). Table 5 from the PEIR (see PEIR, Table 3.4-15) provides the estimated total bat fatalities for the Summit Project using various fatality rates with updates for Vasco Winds (Ventus Environmental Solutions 2016), Golden Hills (HT Harvey and Associates 2020), and Golden Hills North (Great Basin Bird Observatory & HT Harvey and Associates 2020).

Table 4. Raw Bat Fatalities by Species Detected in Standardized Searches at Various APWRA Monitoring Projects

Species	2005	2006	2007	2008	2009	2010		2012	2013	2014		2017	2018	2019	Total
APWRA Monitoring															
Hoary bat	0	2	1	0	2	0									5
Mexican free-tailed bat	0	1	1	1	1	0									4
Western red bat	0	1	1	1	0	0									3
Little brown bat	0	0	0	0	1	1									2
Unidentified bat	0	2	1	1	1	2									7
Total Bats	0	6	4	3	5	3									21
Buena Vista Site															
Hoary bat				1	5	3									9
Mexican free-tailed bat				0	1	2									3
California myotis				0	0	1									1
Total Bats				1	6	6									13
Vasco Winds Site (Years 1-3)															
Hoary bat								11	11	2					24
Mexican free-tailed bat								8	5	16					29
Western red bat								1	1	0					2
California myotis								0	1	0					1
Total Bats								20	18	31					56
Golden Hills Site (Years 1-3)															
Hoary bat												84	46	50	180
Mexican free-tailed bat												133	71	70	274
Western red bat												7	4	4	15
Big brown bat												2	0	0	2
Silver-haired bat												1	0	1	2
California myotis												0	1	1	2

Species	2005	2006	2007	2008	2009	2010		2012	2013	2014		2017	2018	2019	Total
Western mastiff bat												0	0	1	1
Unidentified bat												2	2	6	10
Total Bats												229	124	133	486
Golden Hills North Site (Years 1)															
Hoary bat														48	48
Mexican free-tailed bat														234	234
Western red bat														7	7
Big brown bat														1	1
Silver-haired bat														1	1
Unknown bat														14	14
Total Bats															305

Sources: ACCDA, 2014 (PEIR Table 3.4-6); Ventus Environmental Solutions, 2016; HT Harvey and Associates, 2018; Great Basin Bird Observatory & HT Harvey and Associates 2020

Table 5. Estimated Annual Fatalities of All Bats for the Summit Repower Project as Compared to other Studies

Study Area	Nameplate Capacity (MW)	Pre-repowering Fatalities[b]	Predicted Fatalities[c]
Existing program area	329	87	-
Program Alternative 1	417	110	1,339-4,708
Program Alternative 2	450	118	1,445-5,081
Golden Hills	85.92	23	276-970
Golden Hills North	46	12	148-519
Patterson Pass	19.8	5	64-224
Summit Wind Repower Project[a]	56.9/57.5	15	185-649

Sources: PEIR Table 3.4-15 (ACCDA 2014); Ventus Environmental Solutions 2016; HT Harvey and Associates 2020; Golden Hills North (Great Basin Bird Observatory & HT Harvey and Associates 2020)

[a] The capacity of the former Summit Wind site was 56.9 MW. The capacity of the repowered project is 57.5 MW.

[b] Estimate of total baseline fatalities are based on the Smallwood and Karas (2009) fatality rate of 0.263 fatality/MW/year derived from 2005–2007 monitoring at the APWRA.

[c] Estimate of total predicted fatalities are based on fatality rates from the Vasco Winds Years 1-3 (3.21 fatalities/MW/year), and from Golden Hills Year 1-3 (7.12 fatalities/MW/year), and from Golden Hill North Year 1 (11.29 fatalities/MW/year).

7. Avoidance, Minimization and Mitigation Measures

Repowering will not eliminate all impacts to birds and bats, and this section of this ABPP describes preconstruction, construction, and post-construction (operational) measures to avoid or minimize, and to mitigate, the effects of construction and operation of wind turbines for the Summit Project. The measures were certified in the PEIR, referenced in the Summit Wind Repower Project CUP PLN2014-00056, and are consistent with the draft Avian Protection Program (ICF 2013).

When impacts are identified in an EIR, CEQA requires a mitigation reporting or monitoring program to be prepared and implemented for the project. The PEIR and the Summit Wind Repower Project Mitigation Monitoring and Reporting Program (MMRP) outline various mitigation measures for biological resources including those to avoid or minimize potential adverse impacts to avian and bat species. The full text of the mitigation measures referred to in this section is provided in Appendix A.

7.1 Preconstruction

Mitigation measures from the MMRP related to siting and design of wind turbines to reduce impacts to avian species are summarized below, followed by additional detail on how Altamont Winds will comply with the measures.

7.1.1 Avian-Sensitive Turbine Siting and Design

Mitigation Measure BIO-11b: Site turbines to minimize potential mortality of birds; Mitigation Measure BIO-11c: Use turbine designs that reduce avian impacts

Altamont Winds' repowering included removal of older turbines and replacement with larger and more efficient turbines. The turbine array for the Summit Project was developed using predictive models to locate turbines in areas with the lowest (practical) potential for avian impacts to occur. The models originally developed by Smallwood and Neher (2010) and reemployed for the Summit Project integrate the body of literature derived from prior avian studies and more advanced data and analysis techniques to develop predictive models of bird flights and flight behavior that relate to collision hazards. The models include utilization data; DEM; slope attributes; techniques to identify saddles, notches, and benches; and associations between bird utilization and slope attributes. The models essentially result in a delineation of areas with predicted high activity where wind turbine siting should be avoided.

Upon review of the models provided by Smallwood, Altamont Winds moved turbines as far from risk areas as practicable. At each modification to the array, Smallwood reviewed and made recommendations on risk and location changes, and when possible, turbines were moved to reflect those recommendations. Limitations to the siting or movement of turbines may have included, but were not limited to, setbacks from public roads, setbacks from residences, setbacks from power lines, setbacks from communication structures, minimum distances between turbines, constructability (geology, steepness, and remoteness, etc.), special-status species habitat considerations. Appendix C discusses the Project's site-specific siting reports by Smallwood (2014; 2018) and Smallwood and Neher (2016).

Mitigation Measure BIO-11d: Incorporate avian-safe practices into design of turbine-related infrastructure

A turbine design was selected that reduces the collision risk for birds. Turbine tubular tower design limits or eliminates perching and nesting opportunities, which has been shown to reduce avian fatalities. Lighting on turbines will be the minimum required by Federal Aviation Administration (FAA) regulations.

To reduce the risk of electrocution and collision, mitigation measures were applied when designing and siting ancillary components including meteorological stations, power lines, and lighting. The meteorological tower was constructed with no guy wires. Meteorological towers will be lit only as required by the FAA. Power collection lines were installed below ground. Guidelines from the Avian Power Line Interaction Committee will be followed to prevent electrocutions. Lighting will be focused downward where possible to minimize skyward illumination.

Mitigation Measure BIO-11e: Retrofit existing infrastructure to minimize risk to raptors

Altamont Winds will ensure that any infrastructure or ancillary components present at the Summit Project site are avian-safe to the extent possible through retrofitting or other actions. This action was completed primarily through removal of all overhead power collection lines and installation of new components below ground.

Mitigation Measure BIO-11f: Discourage prey for raptors

To discourage small mammals from nesting or burrowing near turbines, boulders and rock piles will be placed 500 meters (1,640 feet) or more away from turbines, and gravel will be placed around the foundation of each turbine. Altamont Winds will not utilize rodenticide on the project site to avoid the risk of raptors scavenging in the area and the risk of secondary poisoning of non-target species.

7.1.2 Wildlife Response and Reporting System

Altamont Winds will implement a WRRS. The WRRS will include worker training and education including PowerPoint presentations to field maintenance and operations staff at regularly scheduled intervals. Altamont Winds is aware that permits are required for removing carcasses and carrion, and this requirement will be included in the worker safety training program. Altamont Winds will obtain a USFWS Special Purpose Utility permit as necessary and will participate in regular communication with the appropriate agency staff. Wildlife and safety training will also be given to monitoring contractors and others who access the site. The training presentations given to field staff will focus on a consistent message of reporting field observations to the site manager/qualified biologist. At a minimum, reports will be made upon discovery of a required condition.

7.2 Construction

The MMRP provides additional mitigation measures to be implemented at the project site during construction to minimize impacts to birds and their habitats. These mitigation measures are outlined below and provided in full in Appendix A. Unless otherwise noted, the nesting season is typically February 1 to August 31, and the non-breeding season is typically September 1 to January 31.

Mitigation Measure BIO-8a: Implement measures to avoid and minimize potential impacts on special-status and non-special-status nesting birds

Where suitable habitat is present, the following measures will be implemented for raptors (within 1 mile of suitable habitat), golden eagles (within 2 miles of suitable habitat), and tree/shrub- and ground-nesting birds (within 50 feet of suitable habitat):

- Suitable nesting habitat (shrubs and trees) will be removed during the non-breeding season (typically September 1 to January 31).
- Construction activities near suitable or occupied nesting habitat will be avoided to the extent feasible during the nesting season.
- Preconstruction nest surveys by a qualified biologist will take place if construction activities are scheduled during the nesting season.

- If an active nest is identified near a proposed work area when construction is scheduled to occur, coordination with USFWS and/or CDFW will occur to establish an appropriate no-activity buffer around the nest.

Mitigation Measure BIO-8b: Implement measures to avoid and minimize potential impacts on western burrowing owl

Where suitable habitat for western burrowing owl is in or within 500 feet of proposed work areas, the following measures will be implemented:

- During the nesting season, construction activities near active burrows will be avoided to the extent feasible.
- Preconstruction surveys for burrowing owl will occur no less than 14 days prior to, and within 24 hours of initiating ground-disturbing activities.
- If an active burrow is identified during the breeding season near a proposed work area, an appropriate no-activity buffer will be established with coordination from CDFW. An appropriate no-activity buffer will also be established for burrows occupied outside of the breeding season. If a no-activity buffer cannot be established, additional measures will be put in place as specified by a qualified biologist and CDFW.
- An approved burrowing owl exclusion plan may be used to exclude owl from burrows in the active project area during the non-breeding season.
- Ongoing surveillance of the project site will occur during project activities.

7.3 Operations

In addition to the mitigation measures indicated in the MMRP, the TAC has recommended turbine curtailment for occupied golden eagle nests. Curtailment will be employed from sunrise to sunset on turbines within 1 mile of a nest with an incubating adult through the post-fledging phase, defined as the period approximately 1 month after fledging when young are still heavily dependent on the nest site. If a nest fails, curtailment will be suspended. Modifications to curtailment may be employed in coordination with the USFWS.

7.4 Post-Construction Fatality Monitoring

Altamont Winds will implement a post-construction avian and bat monitoring program in accordance with the PEIR (**Mitigation Measure BIO-11g, Implement post-construction avian fatality monitoring for all repowering projects; Mitigation Measure BIO-14b, Implement post-construction bat fatality monitoring program for all repowering projects**) and the MMRP. Consistent with recent repowering studies, the following provides more detail on the monitoring program methodology.

Fatality monitoring will be conducted at the Summit Project for a minimum of 3 years beginning as close to the COD for the project as possible, following monitoring program approval by the TAC. If results of the initial 3-year monitoring period indicate that baseline fatality rates are exceeded, monitoring will be extended until the average annual fatality rate has dropped below baseline fatality rates for 2 years, and to assess the effectiveness of ADMM (Section 8). An additional 2 years of monitoring will commence on the 10th anniversary of the COD. The monitoring program will be managed by an approved consultant ("Monitor") and monitoring activities will be conducted by qualified biologists. Alameda County and the TAC will review the post-construction monitoring program for final approval, but in general, will be comprised of the following procedures.

The post-construction monitoring program will use red-tailed hawks, golden eagles, American kestrels, and burrowing owls ("Focal Raptor Species" benchmarks), all four focal species, all raptors, all non-raptors, and all birds combined as well as bats for evaluating the effectiveness of the overall project repowering in reducing turbine-related mortality and informing and updating future siting analyses, although the fatality rates for other species will be presented. The monitoring program will entail the following methodology, subject to the review and approval by Alameda County and the TAC.

7.4.1 Bird and Bat Carcass Surveys

Bird and bat carcass surveys will extend to a radius of 122 meters (Hull and Muir, 2010), with 15-meter concentric transects within each plot, for each turbine. Twenty-three (23) turbines randomly selected will be monitored year-round on either a 7- or 28-calendar-day cycle. The survey plan for the 23 new turbines is as follows:

- Randomly assign turbines to each search interval on an annual basis, with 8 turbines searched in years 1 and 2, and 7 turbines searched in year 3 on a 7-calendar-day cycle with the use of scent detection canines as required by the TAC. Fifteen (15) turbines searched in years 1 and 2, and 16 turbines in year 3 on a 28-calendar-day cycle using human searchers. All 23 turbines will be subject to a 7-day interval once during the study. At the recommendation of the TAC, Turbine 7 will be excluded from searches with scent detection canines due to the sensitive eagle use area nearby, but will be searched with human searches in the year that it is assigned to a 7-day search interval.
- Each fatality will include body parts, bones, or feathers. If only feathers area discovered, a minimum of 5 tail feathers or 2 primaries from the same wing must be found within 5 meters of each other, or a minimum of 10 body feathers must be found to qualify as a fatality.
- Each fatality find will be assigned a unique number, photographed, and described on an incident report form, then bagged for freezing (all State or Federally Threatened or Endangered species will be left in the field and its location reported to the project's Wildlife Program Coordinator for collection). The date and time the carcass was found, species, age, sex, GPS location, surrounding vegetation, distance and bearing to the nearest turbine, estimated time of death, notes on possible cause of death, and other data will be recorded. The condition of each carcass will be classified as intact, dismembered, or a feather spot (>10 feathers).
- Fatalities for which cause of death cannot be determined will be treated as wind turbine-caused fatalities, even though they could have been caused by other factors such as predation, electrocution or vehicle collisions. Partial remains will be checked against previous fatality finds to minimize risk of double counting the same fatality. Collected carcasses will be stored at a facility freezer in accordance with Federal collection and salvage permits. Incidental finds within wind turbine search areas will be processed in the same manner as routine fatality finds and left in place to possibly be detected during routine searches.
- Consistent with other studies in the APWRA, carcasses found incidental to routine fatality searches within monitored areas will be recorded like all fatalities and field marked but left in place for potential detection during a standard survey. This carcass data will only be included in calculating adjusted fatality rates if it is found during a standard survey. All carcasses that require immediate collection (special-status species) will be excepted from this process.
- Fatalities will be excluded from fatality rate estimation if they are found beyond 122 meters, determined to have died due to non-turbine related reasons, or, in the case for year one, estimated to have died prior to turbine operation.

7.4.2 Integrated Searcher Efficiency and Carcass Persistence Trials

Integrated searcher efficiency and carcass persistence trials (i.e., the TAC-approved "Big D" approach) will involve the following parameters. At the recommendation of the TAC, 10 small birds, 10 M/L birds, and 10 bats per season (2 seasons) and search interval type (7-day, 28-day). Bird carcasses will be placed at random times and locations within the search areas of wind turbines searched every 7 days and of wind turbines searched every 28 days. Bat trial carcasses will only be deployed at turbines searched every 7 days and this data will be extrapolated across the remaining turbines. As found by neighboring projects (Ventus 2016; HT Harvey and Associates 2020;

Great Basin Bird Observatory and HT Harvey and Associates 2020), the probability of bats being detected was greatest at the turbines searched every 7 days.

Placed carcasses will be inconspicuously marked as trial specimens (i.e., clipping flight feathers). Placed carcasses will be tossed over the shoulder to vary their dispositions on the ground, and they will be mapped using a GPS to help prevent counting the carcass as a collision casualty. Although every effort will be made to acquire carcasses for trials, in the absence of other practicable options, Altamont Winds will coordinate with the County and TAC as appropriate if carcass availability is preventing the facility from completing trials. Any bats used in the integrated trial study will have the prior approval of CDFW. Carcasses will be recorded as detected during routine searches and left in place.

7.4.3 Analytical Methods and Reporting

Consistent with other projects approved by the TAC, Altamont Winds will prepare annual monitoring reports and submit them to Alameda County within 3 months of completing each year of post-construction monitoring and also prepare and submit a final 3-year monitoring report within 6 months of completing 3 years of post-construction monitoring and a final 2-year monitoring report within 6 months of completing 2 years of post-construction monitoring. At a minimum, GenEst software will be used for the analysis. All monitoring reports will report adjusted and unadjusted annual fatalities for the Focal Raptor Species, individual focal species, all raptors, all non-raptors, all birds combine, and all bat species, on a per-turbine, per MW, and per MW produced basis. Monitoring reports also will summarize the results for the preceding 1 or 2 years, as applicable.

During the post-construction monitoring periods, monthly digital summary data from the monitoring program, as well as incidental reports of dead birds and bats discovered on the Summit Project, will be reported to Alameda County (along with the Federal and State agencies). Raw data will be provided in electronic format to Alameda County once per year, and - at a minimum - all data required to replicate the analyses conducted in the annual report will be included in the data set. If paper data sheets are generated from field monitoring, those data sheets will be provided to the County upon request.

7.4.4 Avian Use Surveys

During the TAC approval process for this ABPP, the TAC indicated the presence of an important eagle use area, specifically a tree referred to as a ‘communal roost’, adjacent to the Summit Project. In coordination with the TAC, Altamont Winds has opted to perform golden eagle monitoring at the important eagle use area in lieu of the avian use surveys indicated in Mitigation Measure BIO-11g (Operators are required to provide for avian use surveys to be conducted within the project area boundaries for a minimum of 30 minutes duration. Surveyors will be qualified and trained subject to approval by the County.),

To reduce or eliminate disturbance, monitoring will consist of installation of and data retrieval from one or multiple remote cameras, as applicable, to characterize golden eagle use of the specific tree. Photos will be taken on a regular schedule (30 minutes) for at least one calendar year to record use. The cameras’ motion sensing function will be used to attempt to capture entry and exit time of each individual to further narrow actual duration and nature of use. This information will be analyzed to identify the dynamics of golden eagle use of the tree, including duration and nature of use, including time of day and seasonality, as applicable.

7.5 Mitigation

PEIR Mitigation Measure BIO-11h: Compensate for the loss of raptors and other avian species, including golden eagles, by contributing to conservation efforts

The PEIR outlines conservation efforts for the area that includes the Summit Project (ACCDA 2014). The strategy identifies a set of mitigation standards including avoidance and minimization measures and a compensation program to offset impacts expected from projects in the study area. These measures fall under **Mitigation Measure BIO-11h** requiring conservations efforts for avian species. The PEIR states that "Project proponents will use the avian conservation strategy to craft an appropriate strategy using a balanced mix of the options…, as well as considering new options suggested by the growing body of knowledge during the course of the project lifespan, as supported by a Resource Equivalency Analysis (REA) or similar type of compensation assessment acceptable to the County that demonstrates the efficacy of proposed mitigation for impacts on raptors."

In consideration of the options provided for by the PEIR, the following conservation measures will be implemented for the project for the benefit of raptors and other avian species.

7.6 Compensatory Mitigation

In addition to the acquisition of conservation lands (see below), funds will be paid out by the Summit Project for ongoing fatalities of bird and bat species. The value paid out by the Summit Project, consistent with the compensation assessment provided by the 2010 Settlement Agreement[3], will be approximately $12,600/MW of installed capacity, adjusted for inflation. The mitigation fee amount will be based on the Settlement Agreement's original 2010 contribution amount of $10,500 per installed MW, adjusted for inflation from December 2010 through the date of the first contribution in 2021 (representing 10+ years of inflation adjustment).The mitigation fee will be paid in three 10-year installments with the first payment due no later than nine months of the COD of the project. Important raptor habitat for hunting and nesting may be managed and maintained in perpetuity. Continued support of research focused on impacted species may be provided to better understand local populations that are directly impacted by wind energy projects. Mitigation funds could be paid out to the East Bay Regional Park District. Examples of funded research that may be possible are:

- Diablo Range eagle and raptor nesting surveys
- Eagle and raptor capture, telemetry and GIS tracking to build upon siting models and general knowledge of local population behaviors and uses of the landscape.
- Nesting burrowing owl surveys and nocturnal observations of owls to build upon siting models and general knowledge of local population behaviors and uses of the landscape.

Mitigation funds may also be used to retrofit high-risk power poles (poles known or suspected to electrocute and kill eagles). USFWS has developed a REA as a tool to estimate the compensatory mitigation (number of retrofits) required for the take of eagles.

7.7 Conservation Lands

Separately from this ABPP, to meet the requirements of **Mitigation Measure BIO-9** and other non-avian mitigations of the PEIR, as well as the Summit Project's USFWS Biological Opinion (Ref #08ESMF00-2017-F-1854) and CDFW Incidental Take Permit (Ref #2081-2016-053-03), Altamont Winds will provide for the perpetual protection and management of approximately 250 acres of habitat management lands (HM Lands) for the listed species San Joaquin kit fox, California red-legged frog, California tiger salamander, and Alameda whipsnake. Altamont Winds will provide the compensatory HM Lands consistent with the conservation priorities and mitigation ratios described in the EACCS and as close to the Summit Project as possible within the APWRA.

The HM Lands will also benefit the local avian and bat species potentially impacted by the Summit Project. At a minimum, the HM Lands will provide high quality grassland foraging habitat for various raptor and non-raptor species and nesting habitat for western burrowing owl and other ground-nesting species. The HM lands will also include one or more onsite ponds and therefore provide foraging and nesting opportunities for various waterbirds.

[3] 2010 Settlement Agreement dated December 3, 2010 to Repower Turbines at the Altamont Pass Wind Resource Area, by and between "Audubon", Californians for Renewable Energy, "NextEra Wind", and the People of the State of California, ex rel Attorney General.

Depending on the final needs of the project and layout of the HM Lands easement, any onsite trees and/or rock outcrops would also benefit avian species by providing nesting habitat. Many of the benefits afforded to avian species by the HM Lands would also benefit the area's bat species. Trees and rock outcroppings would provide roosting opportunities to bats and open grassland and ponds would provide foraging habitat. The HM lands will have the wind rights retired as an additional benefit to avian and bat species.

8. Adaptive Management

Research is ongoing within and beyond the APWRA to study and correlate the interaction of birds and bats with wind energy generation and the fatalities that can result. The amount of information continues to increase and methods to mitigate negative impacts are constantly evolving and improving. Accordingly, incorporating an adaptive management strategy to adjust operation and avian and bat management to the results of onsite monitoring, results of neighboring monitoring studies, new technology, and new behavioral information is necessary in attempting to minimize impacts to the greatest extent feasible.

8.1 Avian Species

Mitigation Measure BIO-11i: Implement an avian adaptive management program

> Requires an adaptive management program (AMP) to be implemented if baseline fatality estimates are exceeded during operation of wind energy facility in the APWRA. The goal of the AMP is to ensure the best available science and emerging technologies are used to assess and manage impacts to avian species. Site-specific data and current research will be used to form effective impact-reduction strategies. The adaptive measures of the program will aim to minimize impacts to the greatest extent possible while maximizing energy production.

Preconstruction APWRA-wide baseline fatality rate estimates as cited in the PEIR are provided in Table 2 above (see Section 6.1). If post-construction monitoring results indicate a fatality rate that exceeds the pre-repowering baseline fatality estimates for any focal species or species group, then the ADMMs (Section 8.1.1) provided by the PEIR will be implemented, in consultation with the TAC. The best information available will be used to determine which measures to implement from the list pre-determined by Alameda County. The TAC will review the avian impacts and advise Altamont Winds and the County on which measures that they recommend for implementation. The program requires approval by Alameda County and will be implemented within 2 months of its approval.

The AMP will be used to adjust mitigation measures and, potentially, operations based on the results of monitoring, research data, and new technology to ensure that the best available science is used to minimize impacts to avian species, and reduce fatalities to below baseline numbers. The program will entail implementing an adaptive measure or measures and monitoring the outcome and results of the measures for success or failure. Additional measures will be added as necessary and followed by monitoring until the approved success criteria are achieved.

8.1.1 Adaptive Management Measures

As detailed in the PEIR and MMRP, the following ADMMs will be considered in the order shown below, but all, none, or some combination of these measures with or without additional measures not defined below may be recommended for implementation by the TAC.

ADMM-1: Visual Modifications (*PEIR Threshold 1*)

> Visual modifications may include painting a pattern on a portion of turbine blades or painting one blade black to reduce motion smear (the blurring of turbine blades due to rapid rotation that makes the blades less visible to birds).

ADMM-2: Anti-Perching Measures (*PEIR Threshold 2*)

> Anti-perching devices may be considered for installation on select artificial structures (excluding utility poles) within 1 mile of the project area.

ADMM-3: Prey Reduction (*PEIR Threshold 2*)

Altamont Winds may implement a prey reduction program around the most hazardous turbines. Examples of prey reduction measures may include changes in grazing practices to make the area less desirable for prey species, active reduction through direct removal of prey species, or other measures provided they are consistent with management goals for threatened and endangered species. In response to TAC comments provided in November 2020, the Project acknowledges that removal of California ground squirrel, a keystone species in the region, will be carefully considered prior to employment due to this species' importance in the region. If removals will include shooting, lead ammunition will be prohibited. Following removals, all carcasses will be removed and disposed of so as to prevent scavenging.

ADMM-4: Experimental Technologies (*PEIR Threshold 3*)

Altamont Winds may deploy experimental technologies to test their efficacy in reducing turbine-related fatalities. Examples may include, but are not limited to, visual deterrents, noise deterrents, and active radar systems.

ADMM-5: Turbine Curtailment (*PEIR Threshold 3*)

Turbines that have been shown to have significantly higher numbers of avian fatalities may have operations curtailed.

ADMM-6: Cut-in Speed Study (*PEIR Threshold 3*)

Cut-in speeds may be altered and monitored to determine if increases would significantly reduce avian fatalities.

ADMM-7: Real-Time Turbine Curtailment (*PEIR Threshold 3*)

Turbine curtailment may occur based on observations from an onsite biologist, radar, video, or other monitoring technology that detects the presence of raptors or other avian species within the operational project area.

8.2 Bat Species

Mitigation Measure BIO-14d: Develop and implement a bat adaptive management plan

In concert with Mitigation Measure BIO-14b, all project proponents will develop adaptive management plans to ensure appropriate, feasible, and current incorporation of emerging information. The goals of the adaptive management plans are to ensure that the best available science and emerging technologies are used to assess impacts on bats, and that impacts are minimized to the greatest extent possible while maximizing energy production.

As required by the PEIR, an initial adaptive management threshold will be established using the low fatality estimates from Vasco Winds, or 1.679 fatalities/MW/year, to ensure that the most conservative trigger for implementation of ADMM is adopted. If post-construction fatality monitoring results in a point estimate for the bat fatality rate that exceeds the 1.679 fatalities/MW/year threshold by a statistically significant amount, then ADMM-7 and ADMM-8 (described below) for bats will be implemented.

ADMM-7: Seasonal Turbine Cut-in Speed Increase

Cut-in speed increases offer the most promising and immediately available approach to reducing bat fatalities at fourth-generation wind turbines.

ADMM-8: Emerging Technology as Mitigation

Altamont Winds may request, with consultation and approval from agencies, replacement or augmentation of cut-in speed increases with developing technology or another mitigation approach that has been proven to achieve similar bat fatality reductions.

9. References

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Appendix A. Summit Wind Repower Project Mitigation Monitoring and Reporting Program

November 6, 2015

ALTAMONT WINDS LLC

EXHIBIT B

Summit Wind Repower Project

Mitigation Monitoring and Reporting Program

PROJECT NUMBER:
133377

PROJECT CONTACT:
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POWER
ENGINEERS

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NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
Aesthetics					
AES-1	Limit construction to daylight hours. Major construction activities will not be undertaken between sunset and sunrise or on weekends. Construction activity is specifically prohibited from using high-wattage lighting sources to illuminate work sites after sunset and before sunrise, with the exception of nighttime deliveries under the approved transportation control plan or other construction activities that require nighttime work for safety considerations.	During Construction	Altamont Winds	Altamont Winds and County	Review project plans. Inspect during construction.
AES-2a	Require site development review. New turbines along ridgelines or hilltops that have not previously been developed with commercial-scale wind turbines will not be allowed, unless a separate Site Development Review is completed that determines that the visual effects will be substantially avoided by distance from public view points (e.g., more than 2,000 feet), intervening terrain, screening landscaping, or compensatory improvements to equivalent and nearby (radius of 1 mile) scenic features, as approved by the Planning Director.	Prior to Construction	Altamont Winds	Altamont Winds and County	Review project plans. And specifications for compliance.
AES-2b	Maintain site free of debris and restore abandoned roadways. Project sites will be cleaned of all derelict equipment, wind turbine components not required for the project, and litter and debris from old turbines and past turbine operations. Such litter and debris may include derelict turbines, obsolete anemometers, unused electrical poles, and broken turbine blades. In addition, abandoned roads that are no longer in use on such parcels will be restored and hydroseeded to reclaim the sites and remove their visual traces from the viewscape, except in cases where the resource agencies (United States Fish and Wildlife Service [USFWS] and California Department of Fish and Wildlife [CDFW]) recommend that the features be left in place for resource protection. All parcels with new turbines will be maintained in such a manner through the life of project operations and until the parcels are reclaimed in accordance with the approved reclamation plan.	During Construction and Post Construction	Altamont Winds	Altamont Winds USFWS and CDFW	Review project plans and specifications for compliance. Inspect during construction. Verify long-term monitoring and reporting is initiated.
AES-2c	Screen surplus parts and materials. Surplus parts and materials that are kept onsite will be maintained in a neat and orderly fashion and screened from view. This can be accomplished by using a weatherproof camouflage material that can be draped over surplus parts and materials stockpiles. Draping materials will be changed out to accommodate for seasonal variations so that surplus materials are camouflaged in an effective manner when grasses are both green and brown.	During Construction and Post Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.
AES-4	No measure required.	N/A	N/A	N/A	N/A
AES-5	Analyze shadow flicker distance and mitigate effects or incorporate changes into project design to address shadow flicker. Where shadow flicker could result from the installation of wind turbines proposed near residences (i.e., within 500 meters [1,640 feet] in a generally east or west direction to account for seasonal variations), the project applicant will prepare a graphic model and study to evaluate shadow flicker impacts on nearby residences. No shadow flicker in excess of 30 minutes in a given day or 30 hours in a given year will be permitted. If it is determined that existing setback requirements as established by the County are not sufficient to prevent shadow flicker impacts on residences, Alameda County will require an increase in the required setback distances to ensure that residences are not affected. If any residence is affected by shadow flicker within the 30-minute/30-hour thresholds, the applicant will implement measures to minimize the effect, such as relocating the turbine; providing opaque window coverings, window awnings, landscape buffers, or a combination of these features to reduce flicker to acceptable limits for the affected receptor; or shutting down the turbine during the period shadow flicker would occur. Such measures may be undertaken in consultation with owner of the affected residence. If the shadow flicker study indicates that any given turbine would result in shadow flicker exceeding the 30-minute/30-hour thresholds and the property owner is not amenable to window coverings, window awnings, or landscaping and the turbine cannot be shut down during the period of shadow flicker, then the turbine will be relocated to reduce the effect to acceptable limits.	Prior to Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.
Agricultural and Forestry Resources					
AG-1	Avoid conversion of Prime Farmland. Project proponents will not place wind turbines or other related facilities/infrastructure in locations that would result in the permanent conversion of land that is Prime Farmland or Farmland of State Importance.	Prior to Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
Air Quality					
AQ-1	No measure required.	NA	NA	NA	NA
AQ-2a	Reduce construction-related air pollutant emissions by implementing applicable BAAQMD Basic Construction Mitigation Measures. The project proponents will require all contractors to comply with the following Bay Area Air Quality Management District (BAAQMD) requirements for all areas with active construction activities. • All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) will be watered as needed to maintain dust control onsite—approximately two times per day. • All haul trucks transporting soil, sand, or other loose material offsite will be covered. • All visible mud or dirt track-out onto adjacent public roads will be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited. • All vehicle speeds on unpaved roads will be limited to 15 mph. • All roadways, driveways, and sidewalks to be paved will be completed as soon as possible. Building pads will be laid as soon as possible after grading unless seeding or soil binders are used. • Idling times will be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage will be provided for construction workers at all access points. • All construction equipment will be maintained and properly tuned in accordance with manufacturer's specifications. All equipment will be checked by a certified visible emissions evaluator. • Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person will respond and take corrective action within 48 hours. The air district's phone number will also be visible to ensure compliance with applicable regulations.	During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.
AQ-2b	Reduce construction-related air pollutant emissions by implementing measures based on BAAQMD's Additional Construction Mitigation Measures. The project proponents will require all contractors to comply with the following BAAQMD requirements for all areas with active construction activities. • During construction activities, all exposed surfaces will be watered at a frequency adequate to meet and maintain fugitive dust control requirements of all relevant air quality management entities. • All excavation, grading, and/or demolition activities will be suspended when average wind speeds exceed 20 mph, as measured at the Livermore Municipal Airport. • Wind breaks (e.g., trees, fences) will be installed on the windward side(s) of actively disturbed areas of construction. Wind breaks should have at maximum 50% air porosity. • Vegetative ground cover (e.g., fast-germinating native grass seed) will be planted in disturbed areas as soon as possible and watered appropriately until vegetation is established. • If feasible and practicable, the simultaneous occurrence of excavation, grading, and ground-disturbing construction activities on the same area at any one time will be limited. • Construction vehicles and machinery, including their tires, will be cleaned prior to leaving the construction area to remove vegetation and soil. Cleaning stations will be established at the perimeter of the construction area. • Site accesses to a distance of 100 feet from the paved road will be treated with a 6 to 12 inch compacted layer of wood chips, mulch, or gravel. • Sandbags or other erosion control measures will be installed to prevent silt runoff to public roadways from sites with a slope greater than 1%. • The idling time of diesel powered construction equipment will be minimized to 2 minutes. • The project will develop a plan demonstrating that the off-road equipment (more than 50 horsepower) to be used in the construction project (i.e., owned, leased, and subcontractor vehicles) would achieve a project wide fleet-average 20% NOx reduction and 45% Particulate Matter (PM) reduction compared to the most recent Air Resources Board (ARB) fleet average. Acceptable options for reducing emissions include the use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, add-on devices such as particulate filters, and/or other options as such become available.	Before Construction, During Construction, and Post Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	• Use low Volatile Organic Compounds (i.e., Reactive Organic Gases [ROG]) coatings beyond the local requirements (i.e., Regulation 8, Rule 3: Architectural Coatings). • All construction equipment, diesel trucks, and generators will be equipped with Best Available Control Technology for emission reductions of NOx and PM. • All contractors will use equipment that meets ARB's most recent certification standard for off-road heavy duty diesel engines. Implementation of Mitigation Measures AQ-2a and AQ-2b would ensure that impacts related to fugitive dust emissions in the San Francisco Bay Area Air Basin would be less than significant. However, implementation of these measures would not reduce total ROG or NOx emissions to a less-than-significant level. This impact of total ROG and NOx emissions would be significant and unavoidable. Mitigation Measures AQ-2a and AQ-2b would not reduce the on-road emissions in the San Joaquin Valley Air Basin, but these emissions would not exceed San Joaquin Valley Air Pollution Control District's significance thresholds and are, therefore, less than significant.				
Biological Resources					
BIO-1a	Conduct surveys to determine the presence or absence of special-status plant species. Project proponents will conduct surveys for the special-status plant species within and adjacent to all project sites. All surveys will be conducted by qualified biologists in accordance with the appropriate protocols. Special-status plant surveys will be conducted in accordance with Protocols for *Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (California Department of Fish and Game 2009) during the season that special-status plant species would be evident and identifiable—i.e., during their blooming season. No more than 3 years prior to ground-disturbing repowering activities and during the appropriate identification periods for special-status plants, a qualified biologist (as determined by Alameda County) will conduct field surveys within decommissioning work areas, proposed construction areas, and the immediately adjacent areas to determine the presence of habitat for special-status plant species. The project proponent will submit a report documenting the survey results to Alameda County for review and approval prior to conducting any repowering activities. The report will include the location and description of all proposed work areas, the location and description of all suitable habitat for special-status plant species, and the location and description of other sensitive habitats (e.g., vernal pools, wetlands, and riparian areas). Additionally, the report will outline where additional species and/or habitat-specific mitigation measures are required. This report will provide the basis for any applicable permit applications where incidental take of listed species may occur.	Prior to Construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Conduct appropriate surveys and prepare appropriate reports.
BIO-1b	Implement best management practices to avoid and minimize impacts on special-status species. Project proponents will ensure that the following Best Management Practices (BMPs), in accordance with practices established in the East Alameda County Conservation Strategy (EACCS), will be incorporated into individual project design and construction documents. • Employees and contractors performing decommissioning and reclamation activities will receive environmental sensitivity training. Training will include review of environmental laws, mitigation measures, permit conditions, and other requirements that must be followed by all personnel to reduce or avoid effects on special-status species during construction activities. • Environmental tailboard trainings will take place on an as-needed basis in the field. These trainings will include a brief review of the biology of the covered species and guidelines that must be followed by all personnel to reduce or avoid negative effects on these species during decommissioning and reclamation activities. Directors, managers, superintendents, and the crew leaders will be responsible for ensuring that crewmembers comply with the guidelines. • Vehicles and equipment will be parked on pavement, existing roads, and previously disturbed areas to the extent practicable. • Off-road vehicle travel will be avoided. • Material will be stockpiled only in areas that do not support special-status species or sensitive habitats. • Grading will be restricted to the minimum area necessary. • Prior to ground-disturbing activities in sensitive habitats, project construction boundaries and access areas will be flagged and temporarily fenced during construction to reduce the potential for vehicles and equipment to stray into adjacent habitats. • Vehicles or equipment will not be refueled within 100 feet of a wetland, stream, or other waterway unless a bermed and lined refueling area (i.e., a created berm made of sandbags or other removable material) is constructed. • Erosion control measures will be implemented to reduce sedimentation in nearby aquatic habitat when activities are the source of potential	Prior to Construction and during construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	erosion. Plastic monofilament netting (erosion control matting) or similar material containing netting will not be used at the project. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds. • Significant earth moving-activities will not be conducted in riparian areas within 24 hours of predicted storms or after major storms (defined as 1-inch of rain or more). • The following will not be allowed at or near work sites for project activities: trash dumping, firearms, open fires (such as barbecues) not required by the activity, hunting, and pets (except for safety in remote locations).				
BIO-1c	Avoid and minimize impacts on special-status plant species by establishing activity exclusion zones. Where surveys determine that a special-status plant species is present in or adjacent to a project area, direct and indirect impacts of the project on the species will be avoided through the establishment of activity exclusion zones, within which no ground-disturbing activities will take place, including construction of new facilities, construction staging, or other temporary work areas. Activity exclusion zones for special-status plant species will be established around each occupied habitat site, the boundaries of which will be clearly marked with standard orange plastic construction exclusion fencing or its equivalent. The establishment of activity exclusion zones will not be required if no construction-related disturbances will occur within 250 feet of the occupied habitat. The size of activity exclusion zones may be reduced through consultation with a qualified biologist and with concurrence from CDFW based on site-specific conditions.	Prior to Construction and during construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Inspect during construction.
BIO-1d	Compensate for impacts on special-status plan species. All project proponents will avoid or minimize temporary and permanent impacts on special-status plants that occur on project sites and will compensate for impacts on special-status plant species. Although all impacts on large-flowered fiddleneck, diamond-petaled California poppy, and caper-fruited tropidocarpum will be avoided, impacts on other special-status plant species will be avoided to the extent feasible, and any unavoidable impacts will be addressed through compensatory mitigation. Where avoidance of impacts on a special-status plant species is infeasible, loss of individuals or occupied habitat of a special-status plant species occurrence will be compensated for through the acquisition, protection, and subsequent management in perpetuity of other existing occurrences at a 2:1 ratio (occurrences impacted: occurrences preserved). The project proponent will provide detailed information to the County and CDFW on the location of the preserved occurrences, quality of the preserved habitat, feasibility of protecting and managing the areas in-perpetuity, responsibility parties, and other pertinent information. If suitable occurrences of a special-status plant species are not available for preservation, then the project will be redesigned to remove features that would result in impacts on that species.	Prior to Construction and during construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-1e	Retain a biological monitor during ground-disturbing activities in environmentally sensitive areas. All project proponents will retain a qualified biologist (as determined by Alameda County) to conduct periodic monitoring of decommissioning, repowering, and reclamation activities that occur adjacent to sensitive biological resources (e.g., special-status species, sensitive vegetation communities, wetlands). Monitoring will occur during initial ground disturbance where sensitive biological resources are present and weekly thereafter or as determined by the County in coordination with a qualified biologist. The biologist will assist the crew, as needed, to comply with all project implementation restrictions and guidelines. In addition, the biologist will be responsible for ensuring that the project proponent or its contractors maintain exclusion areas adjacent to sensitive biological resources, and for documenting compliance with all biological resources– related mitigation measures.	Prior to Construction and during construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Inspect during construction
BIO-2	Prevent introduction, spread, and establishment of invasive plant species. To avoid and minimize the introduction and spread of invasive non-native plant species, all project proponents will implement the following BMPs. • Construction vehicles and machinery will be cleaned prior to entering the construction area. Cleaning stations will be established at the perimeter of the construction area along all construction routes or immediately offsite. • Vehicles will be washed only at approved areas. No washing of vehicles will occur at job sites. • To discourage the introduction and establishment of invasive plant species, seed mixtures and straw used within natural vegetation will be either rice straw or weed-free straw, as allowed by state and federal regulation of stormwater runoff. In addition, the project proponents will prepare and implement erosion and sediment control plans to control short-term and long-term erosion and sedimentation effects and to restore soils and vegetation in areas affected by construction activities (Mitigation Measures BIO-1b and WQ- 1). Prior to initiating any construction activities that will result in temporary impacts on natural communities, a restoration and monitoring plan will be developed for	Prior to Construction and during construction	Altamont Winds	Altamont Winds, USFWS, CDFW, and County	Review project plans and specifications for compliance. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	temporarily affected habitats in each project area (Mitigation Measure BIO-5c). Restoration and monitoring plans will be submitted to the County and CDFW for approval. These plans will include methods for restoring soil conditions and revegetating disturbed areas, seed mixes, monitoring and maintenance schedules, adaptive management strategies, reporting requirements, and success criteria. Following completion of project construction, the project proponents will implement the revegetation plans to restore areas disturbed by project activities to a condition of equal or greater habitat function than occurred prior to the disturbance.				
BIO-3a	Conduct pre-construction surveys for habitat for special-status wildlife species. No more than 3 years prior to ground-disturbing repowering activities, a qualified biologist (as determined by Alameda County) will conduct field surveys within decommissioning, repowering, and restoration work areas and their immediate surroundings to determine the presence of habitat for special-status wildlife species. The project proponent will submit a report documenting the survey results to Alameda County for review prior to conducting any repowering activities. The report will include the location and description of all proposed work areas, the location and description of all suitable habitat for special-status wildlife species, and the location and description of other sensitive habitats (e.g., vernal pools, wetlands, and riparian areas). Additionally, the report will outline where additional species- and/or habitat-specific mitigation measures are required. This report may provide the basis for any applicable permit applications where incidental take may occur.	Prior to Construction	Altamont Winds	Altamont Winds, CDFW, and County	Conduct surveys. Prepare and submit pertinent reports
BIO-3b	Implement measures to avoid, minimize, and mitigate impacts on vernal pool branchiopods and curved-footed hygrotus diving beetle. Where suitable habitat for listed vernal pool branchiopods and curved-footed hygrotus diving beetle are identified within 250 feet (or another distance as determined by a qualified biologist based on topography and other site conditions) of proposed work areas, the following measures will be implemented to ensure that the repowering projects do not have adverse impacts on listed vernal pool branchiopods or curved-footed hygrotus diving beetle. These measures are based on measures from the EACCS, with some modifications and additions. Additional conservation measures or conditions of approval may be required in applicable project permits (e.g., Endangered Species Act [ESA] incidental take permit). • Avoid all direct impacts on sandstone rock outcrop vernal pools. • Ground disturbance will be avoided from the first day of the first significant rain (1 inch or more) until June 1, or until pools remain dry for 72 hours and no significant rain is forecast on the day of such ground disturbance. • If vernal pools, clay flats, alkaline pools, ephemeral stock tanks (or ponds), sandstone pools, or roadside ditches are present within 250 feet of the work area (or another appropriate distance as determined by a qualified biologist on the basis of topography and other site conditions), the biologist will stake and flag an exclusion zone prior to construction activities. The width of the exclusion zone will be based on site conditions and will be the maximum practicable distance that ensures protection of the feature from direct and indirect effects of the project. Exclusion zones will be established around features whether they are wet or dry at the time. The exclusion zone will be fenced with orange construction zone and erosion control fencing (to be installed by construction crew). • No herbicide will be applied within 100 feet of exclusion zones, except when applied to cut stumps or frilled stems or injected into stems. No broadcast applications will be allowed. • Avoid modifying or changing the hydrology of aquatic habitats. • Minimize the work area for stream crossings and conduct work during the dry season (June 1 through the first significant rain of the fall/winter). • Install utility collection lines across perennial creeks by boring under the creek. Where impacts cannot be avoided or minimized, compensatory mitigation will be undertaken in accordance with mitigation ratios and requirements developed under the EACCS (Appendix C2). In the event that an incidental take permit is required, compensatory mitigation will be undertaken in accordance with the terms of the permit in consultation with USFWS.	Prior to Construction and during construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Inspect during construction.
BIO-4a	Implement measures to avoid or protect habitat for valley elderberry longhorn beetle. If it is determined through preconstruction surveys conducted pursuant to Mitigation Measure BIO-3a that elderberry shrubs are present within proposed work areas or within 100 feet of these areas, the following measures will be implemented to ensure that the proposed project does not have a significant impact on valley elderberry longhorn beetle (VELB). • Avoid removal of elderberry shrubs. • Elderberry shrubs/clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/VELB experience) will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the buffer areas. The buffer area distances will be proposed by the biologist and	Prior to Construction and during construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	approved by USFWS. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet (15.2 meters) along the perimeter of the buffer area fencing. The signs will contain the following information: This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment. • Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project proponent and USFWS.				
BIO-4b	Compensate for direct and indirect effects on valley elder berry longhorn beetle. If elderberry shrubs cannot be avoided and protected as outlined in Mitigation Measure 4a, the project proponent will obtain an incidental take permit from USFWS and compensate for the loss of any elderberry shrubs. Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. Surveys will be conducted in accordance with the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (U.S. Fish and Wildlife Service 1999). Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to USFWS in a biological assessment or an HCP. After receipt of an incidental take permit and before construction begins, the project proponent will compensate for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to an USFWS-approved conservation area. Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or more in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) will be replaced, in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings would be obtained from local sources. At the discretion of USFWS, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible, minimization ratios would be increased to offset the additional habitat loss. The relocation of the elderberry shrubs will be conducted according to USFWS-approved procedures outlined in the Conservation Guidelines (U.S. Fish and Wildlife Service 1999). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted. Evidence of valley elderberry longhorn beetle occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. The project proponent will be responsible for funding and providing monitoring reports to USFWS in each of the years in which a monitoring report is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.	Prior to Construction, During Construction, and Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Obtain permits. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-5a	Implement best management practices to avoid and minimize effects on special-status amphibians. All project proponents will ensure that BMPs and other appropriate measures, in accordance with measures developed for the EACCS, be incorporated into the appropriate design and construction documents. Implementation of some of these measures will require that the project proponent obtain incidental take permits from USFWS (California red-legged frog and California tiger salamander) and from CDFW (California tiger salamander only) before construction begins. Additional conservation measures or conditions of approval may be required in applicable project permits (e.g., ESA or California Endangered Species Act [CESA] incidental take authorization). The applicant will comply with the State of California State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) construction general requirements for stormwater. • Ground-disturbing activities will be limited to dry weather between April 15 and October 31. No ground-disturbing work will occur during wet weather. Wet weather is defined as when there has been 0.25 inch of rain in a 24-hour period. Ground disturbing activities halted due to wet weather may resume when precipitation ceases and the National Weather Service 72-hour weather forecast indicates a 30% or less chance of precipitation. No ground-disturbing work will occur during a dry-out period of 48 hours after the above referenced wet weather. • Where applicable, barrier fencing will be installed around the worksite to prevent amphibians from entering the work area. Barrier fencing will be removed within 72 hours of completion of work. • Before construction begins, a qualified biologist will locate appropriate relocation areas and prepare a relocation plan for special-status	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Conduct appropriate surveys. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	amphibians that may need to be moved during construction. The proponent will submit this plan to USFWS and CDFW for approval a minimum of 2 weeks prior to the start of construction. • A qualified biologist will conduct preconstruction surveys immediately prior to ground disturbing activities (including equipment staging, vegetation removal, grading). The biologist will survey the work area and all suitable habitats within 300 feet of the work area. If individuals (including adults, juveniles, larvae, or eggs) are found, work will not begin until USFWS and/or CDFW is contacted to determine if moving these life-stages is appropriate. If relocation is deemed necessary, it will be conducted in accordance with the relocation plan. Incidental take permits are required for relocation of California tiger salamander (USFWS and CDFW) and California red-legged frog (USFWS). Relocation of western spadefoot and foothill yellow-legged frog requires a letter from CDFW authorizing this activity. • No monofilament plastic will be used for erosion control. • All project activity will terminate 30 minutes before sunset and will not resume until 30 minutes after sunrise during the migration/active season from November 1 to June 15. Sunrise and sunset times are established by the U.S. Naval Observatory Astronomical Applications Department for the geographic area where the project is located. • Vehicles will not exceed a speed limit of 15 mph on unpaved roads within natural land cover types, or during off-road travel. • Trenches or holes more than 6 inches deep will be provided with one or more escape ramps constructed of earth fill or wooden planks and will be inspected by a qualified biologist prior to being filled. Any such features that are left open overnight will be searched each day prior to construction activities to ensure no covered species are trapped. Work will not continue until trapped animals have moved out of open trenches. • Work crews or the onsite biological monitor will inspect open trenches, pits, and under construction equipment and material left onsite in the morning and evening to look for amphibians that may have become trapped or are seeking refuge. • If special-status amphibians are found in the work area during construction and cannot or do not move offsite on their own, a qualified biologist who is USFWS and/or CDFW approved under a biological opinion and/or incidental take permit for the specific project, will trap and move special-status amphibians in accordance with the relocation plan. Relocation of western spadefoot and foothill yellow-legged frog requires a letter permit from CDFW authorizing this activity.				
BIO-5b	Compensate for loss of habitat for special-status amphibians. Where impacts on aquatic and upland habitat for special-status amphibians cannot be avoided or minimized, compensatory mitigation will be undertaken in accordance with mitigation ratios and requirements developed under the EACCS (Appendix C2). In the event that take authorization is required, compensatory mitigation will be undertaken in accordance with the terms of the authorization in consultation with USFWS and/or CDFW.	Prior to Construction, During Construction, and Post Construction	Altamont Winds	Altamont Winds and CDFW	Review project plans and specifications for compliance. Prepare appropriate reports. Obtain approval. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-5c	Restore disturbed annual grasslands. Within 30 days prior to any ground disturbance, a qualified biologist will prepare a Grassland Restoration Plan in coordination with CDFW and subject to CDFW approval, to ensure that temporarily disturbed annual grasslands and areas planned for the removal of permanent roads and turbine pad areas are restored to pre-project conditions. The Grassland Restoration Plan will include but not be limited to the following measures. • Gravel will be removed from areas proposed for grassland restoration. • To the maximum extent feasible, topsoil will be salvaged from within onsite work areas prior to construction. Imported fill soils will be limited to weed-free topsoil similar in texture, chemical composition, and pH to soils found at the restoration site. • Where appropriate, restoration areas will be seeded (hydroseeding is acceptable) to ensure erosion control. Seed mixes will be tailored to closely match that of reference site(s) within the program area and should include native or naturalized, noninvasive species sourced within the project area or from the nearest available location. • Reclaimed roads will be restored in such a way as to permanently prevent vehicular travel. The plan will include a requirement to monitor restoration areas annually (between March and October) for up to 3 years following the year of restoration. The restoration will be considered successful when the percent cover for restored areas is 70% absolute cover of the planted/seeded species compared to the percent absolute cover of nearby reference sites. No more than 5% relative cover of the vegetation in the restoration areas will consist of invasive plant species rated as “high” in Cal-IPC’s California Invasive Plant Inventory Database (http://www.cal-ipc.org). Remedial measures prescribed in the plan will include supplemental seeding, weed control, and other actions as determined necessary to achieve the long-term success criteria. Monitoring	Prior to Construction, During Construction, and Post Construction	Altamont Winds	Altamont Winds and CDFW	Review project plans and specifications for compliance. Prepare appropriate reports. Obtain approval. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	may be extended if necessary to achieve the success criteria or if drought conditions preclude restoration success. Other performance standards may also be required as they relate to special-status species habitat; these will be identified in coordination with CDFW and included in the plan. The project proponent will provide evidence that CDFW has reviewed and approved the Grassland Restoration Plan. Additionally, the project proponent will provide annual monitoring reports to the County by January 31 of each year, summarizing the monitoring results and any remedial measures implemented (if any are necessary) during the previous year.				
BIO-6	Conduct preconstruction surveys for western pond turtle and monitor construction activities if turtles are observed. If it is determined through preconstruction surveys conducted pursuant to Mitigation Measure BIO-3a that suitable aquatic or upland habitat for western pond turtle is present within proposed work areas, the following measures, consistent with measures developed for the EACCS, will be implemented to ensure that the proposed project does not have a significant impact on western pond turtle. • One week before and within 24 hours of beginning work in suitable aquatic habitat, a qualified biologist (one who is familiar with different species of turtles) will conduct surveys for western pond turtle. The surveys should be timed to coincide with the time of day and year when turtles are most likely to be active (during the cooler part of the day between 8 a.m. and 12 p.m. during spring and summer). Prior to conducting the surveys, the biologist should locate the microhabitats for turtle basking (logs, rocks, brush thickets) and determine a location to quietly observe turtles. Each survey should include a 30-minute wait time after arriving onsite to allow startled turtles to return to open basking areas. The survey should consist of a minimum 15-minute observation period for each area where turtles could be observed. • If western pond turtles are observed during either survey, a biological monitor will be present during construction activities in the aquatic habitat where the turtle was observed. The biological monitor also will be mindful of suitable nesting and overwintering areas in proximity to suitable aquatic habitat and will periodically inspect these areas for nests and turtles. • If one or more western pond turtles are found in the work area during construction and cannot or do not move offsite on their own, a qualified biologist will remove and relocate the turtle to appropriate aquatic habitat outside and away from the construction area. Relocation of western pond turtle requires a letter from CDFW authorizing this activity.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and CDFW	Conduct surveys. Obtain approval, if required. Prepare and submit pertinent plans, and conduct further inspection, if required.
BIO-7a	Implement best management practices to avoid and minimize effects on special-status reptiles. Where suitable habitat for Blainville's horned lizard, Alameda whipsnake, or San Joaquin coachwhip is identified in proposed work areas, all project proponents will ensure that BMPs and other appropriate measures, in accordance with measures developed for the EACCS, be incorporated into the appropriate design and construction documents. Implementation of some of these measures will require that the project proponent obtain incidental take permits from USFWS and CDFW (Alameda whipsnake) before construction begins. Additional conservation measures or conditions of approval may be required in applicable project permits (i.e., ESA incidental take permit). • A qualified biologist will conduct preconstruction surveys immediately prior to ground-disturbing activities (e.g., equipment staging, vegetation removal, grading) associated with the program. If any Blainville's horned lizards, Alameda whipsnakes, or San Joaquin coachwhips are found, work will not begin until they are moved out of the work area to a USFWS- and/or CDFW-approved relocation site. Incidental take permits from USFWS and CDFW are required for relocation of Alameda whipsnake. Relocation of Blainville's horned lizard and San Joaquin coachwhip requires a letter from CDFW authorizing this activity. • No monofilament plastic will be used for erosion control. • Where applicable, barrier fencing will be used to exclude Blainville's horned lizard, Alameda whipsnake, and San Joaquin coachwhip. Barrier fencing will be removed within 72 hours of completion of work. • Work crews or an onsite biological monitor will inspect open trenches and pits and under construction equipment and materials left onsite for special-status reptiles each morning and evening during construction. • Ground disturbance in suitable habitat will be minimized. • Vegetation within the proposed work area will be removed prior to grading. Prior to clearing and grubbing operations, a qualified biologist will clearly mark vegetation within the work area that will be avoided. Vegetation outside the work area will not be removed. Where possible hand tools (e.g., trimmer, chain saw) will be used to trim or remove vegetation. All vegetation removal will be monitored by the qualified biologist to minimize impacts on special-status reptiles. If special-status reptiles are found in the work area during construction and cannot or do not move offsite on their own, a qualified biologist who is USFWS- and/or CDFW-approved under an incidental take permit for the specific project will trap and move the animal(s) to a USFWS and/or CDFW-approved relocation area. Incidental take permits from USFWS and CDFW are required for relocation of Alameda whipsnake. Relocation of	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Obtain required permits and approval. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	Blainville's horned lizard and San Joaquin coachwhip requires a letter from CDFW authorizing this activity.				
BIO-7b	Compensate for loss of habitat for special-status reptiles. Where impacts on habitat for special-status reptiles cannot be avoided or minimized, compensatory mitigation will be undertaken in accordance with mitigation ratios and requirements developed under the EACCS (Appendix C2). In the event that incidental take permits are required for Alameda whipsnake, compensatory mitigation will be undertaken in accordance with the terms of permits in consultation with USFWS and CDFW.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated
BIO-8a	Implement measures to avoid and minimize potential impacts on special-status and non-special-status nesting birds. Where suitable habitat is present for raptors within 1 mile (within 2 miles for golden eagles) and for tree/shrub- and ground-nesting migratory birds (non-raptors) within 50 feet of proposed work areas, the following measures will be implemented to ensure that the proposed project does not have a significant impact on nesting special-status and non–special-status birds. • Remove suitable nesting habitat (shrubs and trees) during the non-breeding season (typically September 1–January 31) for nesting birds. • To the extent feasible, avoid construction activities in or near suitable or occupied nesting habitat during the breeding season of birds (generally February 1–August 31). • If construction activities (including vegetation removal, clearing, and grading) will occur during the nesting season for migratory birds, a qualified biologist will conduct pre-construction nesting bird surveys within 7 days prior to construction activities. The construction area and a 1-mile buffer will be surveyed for tree-nesting raptors (except for golden eagles), and a 50-foot buffer will be surveyed for all other bird species. • Surveys to locate eagle nests within 2 miles of construction will be conducted during the breeding season prior to construction. A 1-mile no-disturbance buffer will be implemented for construction activities to protect nesting eagles from disturbance. Through coordination with USFWS, the no-disturbance buffer may be reduced to 0.5 mile if construction activities are not within line-of-sight of the nest. • If an active nest (other than golden eagle) is identified near a proposed work area and work cannot be conducted outside the nesting season (February 1–August 31), a no-activity zone will be established around the nest by a qualified biologist in coordination with USFWS and/or CDFW. Fencing and/or flagging will be used to delineate the no-activity zone. To minimize the potential to affect the reproductive success of the nesting pair, the extent of the no-activity zone will be based on the distance of the activity to the nest, the type and extent of the proposed activity, the duration and timing of the activity, the sensitivity and habituation of the species, and the dissimilarity of the proposed activity to background activities. The no-activity zone will be large enough to avoid nest abandonment and will be between 50 feet and 1 mile from the nest, or as otherwise required by USFWS and/or CDFW.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Inspect during construction
BIO-8b	Implement measures to avoid and minimize potential impacts on western burrowing owl. Where suitable habitat for western burrowing owl is in or within 500 feet of proposed work areas, the following measures will be implemented to avoid or minimize potential adverse impacts on burrowing owls. • To the maximum extent feasible (e.g., where the construction footprint can be modified), construction activities within 500 feet of active burrowing owl burrows will be avoided during the nesting season (February 1–August 31). • A qualified biologist will conduct preconstruction take avoidance surveys for burrowing owl no less than 14 days prior to and within 24 hours of initiating ground-disturbing activities. The survey area will encompass the work area and a 500-foot buffer around this area. • If an active burrow is identified near a proposed work area and work cannot be conducted outside the nesting season (February 1–August 31), a no-activity zone will be established by a qualified biologist in coordination with CDFW. The no-activity zone will be large enough to avoid nest abandonment and will extend a minimum of 250 feet around the burrow. • If burrowing owls are present at the site during the non-breeding season (September 1– January 31), a qualified biologist will establish a no-activity zone that extends a minimum of 150 feet around the burrow. • If the designated no-activity zone for either breeding or non-breeding burrowing owls cannot be established, a wildlife biologist experienced in burrowing owl behavior will evaluate site-specific conditions and, in coordination with CDFW, recommend a smaller buffer (if possible) and/or other measure that still minimizes disturbance of the owls (while allowing reproductive success during the breeding season). The site-specific buffer (and/or other measure) will consider the type and extent of the proposed activity occurring near the occupied burrow, the duration and timing of the activity, the sensitivity and habituation of the owls, and the dissimilarity of the proposed activity to background activities. • If burrowing owls are present in the direct disturbance area and cannot be avoided during the non-breeding season (generally September 1	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Conduct surveys. Prepare appropriate plans, if required. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	through January 31), burrowing owls may be excluded from burrows through the installation of one-way doors at burrow entrances. A burrowing owl exclusion plan, prepared by the project proponent, must be approved by CDFW prior to exclusion of owls. One-way doors (e.g., modified dryer vents or other CDFW approved method) will be left in place for a minimum of 1 week and monitored daily to ensure that the owl(s) have left the burrow(s). Excavation of the burrow will be conducted using hand tools. During excavation of the burrow, a section of flexible plastic pipe (at least 3 inches in diameter) will be inserted into the burrow tunnel to maintain an escape route for any animals that may be inside the burrow. Owls will be excluded from their burrows as a last resort and only if other avoidance and minimization measures cannot be implemented. • Avoid destruction of unoccupied burrows outside the work area and place visible markers near burrows to ensure that they are not collapsed. • Conduct ongoing surveillance of the project site for burrowing owls during project activities. If additional owls are observed using burrows within 500 feet of construction, the onsite biological monitor will determine, in coordination with CDFW, if the owl(s) are or would be affected by construction activities and if additional exclusion zones are required.				
BIO-9	Compensate for the permanent loss of occupied habitat for western burrowing owl. If construction activities would result in the removal of occupied burrowing owl habitat (determined during preconstruction surveys described in Mitigation Measure BIO-8a), this habitat loss will be mitigated by permanently protecting mitigation land through a conservation easement or by implementing alternative mitigation determined through consultation with CDFW as described in its *Staff Report on Burrowing Owl Mitigation* (California Department of Fish and Game 2012:11–13). The project proponent will work with CDFW to develop the compensation plan, which will be subject to County review and approval.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-10a	Implement measures to avoid and minimize potential impacts on San Joaquin kit fox and American badger. Where suitable habitat is present for San Joaquin fit fox and American badger in and adjacent to proposed work areas, the following measures, consistent with measures developed in the EACCS, will be implemented to ensure that proposed projects do not have a significant impact on San Joaquin kit fox or American badger. *Implementation of some of these measures will require that the project proponent obtain incidental take permits from USFWS and CDFW (San Joaquin kit fox) before construction begins*. Implementation of state and federal requirements contained in such authorization may constitute compliance with corresponding measures in the PEIR. • To the maximum extent feasible, suitable dens for San Joaquin kit fox and American badger will be avoided. • All project proponents will retain qualified approved biologists (as determined by USFWS) to conduct a preconstruction survey for potential San Joaquin kit fox dens (U.S. Fish and Wildlife Service 2011). Resumes of biologists will be submitted to USFWS for review and approval prior to the start of the survey. • Preconstruction surveys for American badgers will be conducted in conjunction with San Joaquin kit fox preconstruction surveys. • As described in U.S. Fish and Wildlife Service 2011, the preconstruction survey will be conducted no less than 14 days and no more than 30 days before the beginning of ground disturbance, or any activity likely to affect San Joaquin kit fox. The biologists will conduct den searches by systematically walking transects through the project area and a buffer area to be determined in coordination with USFWS and CDFW. Transect distance should be based on the height of vegetation such that 100% visual coverage of the project area is achieved. If a potential or known den is found during the survey, the biologist will measure the size of the den; evaluate the shape of the den entrances, and note tracks, scat, prey remains, and recent excavations at the den site. The biologists will also determine the status of the dens and map the features. Dens will be classified in one of the following four den status categories defined by USFWS (U.S. Fish and Wildlife Service 2011). • Potential den: Any subterranean hole within the species' range that has entrances of appropriate dimensions and for which available evidence is sufficient to conclude that it is being used or has been used by a kit fox. Potential dens include (1) any suitable subterranean hole; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, ground squirrel) that otherwise has appropriate characteristics for kit fox use; or an artificial structure that otherwise has appropriate characteristics for kit fox use. • Known den: Any existing natural den or artificial structure that is used or has been used at any time in the past by a San Joaquin kit fox. Evidence of use may include historical records; past or current radiotelemetry or spotlighting data; kit fox sign such as tracks, scat, and/or prey remains; or other reasonable proof that a given den is being or has been used by a kit fox (USFWS discourages use of the terms active and inactive when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens often, with the result that the status of a given den may change frequently and abruptly). • Known natal or pupping den: Any den that is used, or has been used at any time in the past, by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for compliance. Conduct surveys. Prepare appropriate plans, if required. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES

	fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two; therefore, for purposes of this definition either term applies.
	• Known atypical den: Any artificial structure that has been or is being occupied by a San Joaquin kit fox. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.
	
	Written results of the survey including the locations of any potential or known San Joaquin kit fox dens will be submitted to USFWS within 5 days following completion of the survey and prior to the start of ground disturbance or construction activities.
	
	• After preconstruction den searches and before the commencement of repowering activities, exclusion zones will be established as measured in a radius outward from the entrance or cluster of entrances of each den. Repowering activities will be prohibited or greatly restricted within these exclusion zones. Only essential vehicular operation on existing roads and foot traffic will be permitted. All other repowering activities, vehicle operation, material and equipment storage, and other surface-disturbing activities will be prohibited in the exclusion zones. Barrier fencing will be removed within 72 hours of completion of work. Exclusion zones will be established using the following parameters.
	• Potential and atypical dens: A total of four or five flagged stakes will be placed 50 feet from the den entrance to identify the den location.
	• Known den: Orange construction barrier fencing will be installed between the work area and the known den site at a minimum distance of 100 feet from the den. The fencing will be maintained until construction-related disturbances have ceased. At that time, all fencing will be removed to avoid attracting subsequent attention to the den.
	• Natal/pupping den: USFWS will be contacted immediately if a natal or pupping den is discovered in or within 200 feet of the work area.
	  o Any occupied or potentially occupied badger den will be avoided by establishing an exclusion zone consistent with a San Joaquin kit fox potential burrow (i.e., four or five flagged stakes will be placed 50 feet from the den entrance).
	• In cases where avoidance is not a reasonable alternative, limited destruction of potential San Joaquin kit fox dens may be allowed as follows.
	  o Natal/pupping dens: Natal or pupping dens that are occupied will not be destroyed until the adults and pups have vacated the dens and then only after consultation with USFWS. Removal of natal/pupping dens requires incidental take authorization from USFWS and CDFW.
	  o Known dens: Known dens within the footprint of the activity must be monitored for 3 days with tracking medium or an infrared camera to determine current use. If no kit fox activity is observed during this period, the den should be destroyed immediately to preclude subsequent use. If kit fox activity is observed during this period, the den will be monitored for at least 5 consecutive days from the time of observation to allow any resident animal to move to another den during its normal activity. Use of the den can be discouraged by partially plugging its entrance(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied will the den be excavated under the direction of a biologist. If the fox is still present after 5 or more consecutive days of monitoring, the den may be excavated when, in the judgment of the biologist, it is temporarily vacant, such as during the fox's normal foraging activities. Removal of known dens requires incidental take authorization from USFWS and CDFW.
	  o Potential dens: If incidental take permits have been received (from USFWS and CDFW), potential dens can be removed (preferably by hand excavation) by biologist or under the supervision of a biologist without monitoring, unless other restrictions were issued with the incidental take permits. If no take authorizations have been issued, the potential dens will be monitored as if they are known dens. If any den was considered a potential den but was later determined during monitoring or destruction to be currently or previously used by kit foxes (e.g., kit fox sign is found inside), then all construction activities will cease and USFWS and CDFW will be notified immediately.
	• Nighttime work will be minimized to the extent possible. The vehicular speed limit will be reduced to 10 miles per hour during nighttime work.
	• Pipes, culverts, and similar materials greater than 4 inches in diameter will be stored so as to prevent wildlife species from using these as temporary refuges, and these materials will be inspected each morning for the presence of animals prior to being moved.
	• A representative appointed by the project proponent will be the contact for any employee or contractor who might inadvertently kill or injure a kit fox or who finds a dead, injured, or entrapped kit fox. The representative will be identified during environmental sensitivity training (Mitigation Measure BIO-1b) and his/her name and phone number will be provided to USFWS and CDFW. Upon such incident or finding, the representative will immediately contact USFWS and CDFW.
	
	The Sacramento USFWS office and CDFW will be notified in writing within 3 working days of the accidental death or injury of a San Joaquin kit fox during project-related activities. Notification must include the date, time, and location of the incident, and any other pertinent information.				

BIO-10b	Compensate for loss of suitable habitat for San Joaquin kit fox and America badger.	Prior to Construction and During	Altamont Winds	Altamont Winds, USFWS, and CDFW	Review project plans and specifications for

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	Where permanent impacts on habitat for San Joaquin kit fox and American badger cannot be avoided or minimized, compensatory mitigation will be undertaken in accordance with mitigation ratios and requirements developed under the EACCS (Appendix C2). In the event that incidental take permits are required for San Joaquin kit fox, compensatory mitigation will be undertaken in accordance with the terms of permits in consultation with USFWS and CDFW.	Construction			compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated
BIO-11a	Prepare a project-specific avian protection plan. All project proponents will prepare a project-specific Avian Protection Plan (APP) to specify measures and protocols consistent with the program-level mitigation measures that address avian mortality. The project-specific APPs will include, at a minimum, the following components. • Information and methods used to site turbines to minimize risk. • Documentation that appropriate turbine designs are being used. • Documentation that avian-safe practices are being implemented on project infrastructure. • Methods used to discourage prey for raptors. • A detailed description of the post-construction avian fatality monitoring methods to be used (consistent with the minimum requirements outlined in Mitigation Measure BIO-11g). • Methods used to compensate for the loss of raptors (consistent with the requirements of Mitigation Measure BIO-11h). Each project applicant will prepare and submit a draft project-specific APP to the County. The draft APP will be reviewed by the Technical Advisory Committee (TAC) for consistency and the inclusion of appropriate mitigation measures that are consistent with the PEIR and recommended for approval by the County. Each project applicant must have an approved Final APP prior to commercial operation.	Prior to Construction	Altamont Winds	Altamont Winds, County	Review project plans and specifications for compliance. Prepare appropriate report.
BIO-11b	Site turbines to minimize potential mortality of birds. Siting of turbines—using analyses of landscape features and location-specific bird use and behavior data to identify locations with reduced collision risk—may result in reduced fatalities (Smallwood et al. 2009). All project proponents will conduct a siting process and prepare a siting analysis to select turbine locations to minimize potential impacts on bird and bat species. Proponents will utilize existing data as well as collect new site-specific data as part of the siting analysis. Project proponents will utilize currently available guidelines such as the Alameda County Scientific Review Committee (SRC) guidelines for siting wind turbines (Alameda County SRC 2010) and/or other currently available research or guidelines to conduct siting analysis. Additionally, project proponents will use the results of previous siting efforts to inform the analysis and siting methods as appropriate such that the science of siting continues to be advanced. All project proponents will collect field data that identify or confirm the behavior, utilization, and distribution patterns of affected avian and bat species prior to the installation of turbines. Project proponents will collect and utilize available existing information, including but not necessarily limited to: siting reports and monitoring data from previously installed projects; published use and abundance studies and reports; and topographic features known to increase collision risk (trees, riparian areas, water bodies, and wetlands). Project proponents will also collect and utilize additional field data as necessary to inform the siting analysis for golden eagle. As required in Mitigation Measure BIO-8a, surveys will be conducted to locate golden eagle nests within 2 miles of proposed project areas. Siting of turbines within 2 miles of an active or alternative golden eagle nest or active golden eagle territory will be based on a site-specific analysis of risk based on the estimated eagle territories, conducted in consultation with USFWS. Project proponents will utilize methods (i.e., computer models) to identify dangerous locations for birds and bats based on site-specific risk factors informed by the information discussed above. The project proponents will compile the results of the siting analyses for each turbine and document these in the project-level APP, along with the specific location of each turbine.	Prior to Construction	Altamont Winds	Altamont Winds, USFWS, County	Review project plans and specifications for compliance.
BIO-11c	Use turbine designs that reduce avian impacts. Use of turbines with certain characteristics is believed to reduce the collision risk for avian species. Project proponents will implement the design-related measures listed below. • Turbine designs will be selected that have been shown or that are suspected to reduce avian fatalities, based on the height, color, configuration, or other features of the turbines. • Turbine design will limit or eliminate perching opportunities. Designs will include a tubular tower with internal ladders; external catwalks,	Prior to Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	railings, or ladders will be prohibited. • Turbine design will limit or eliminate nesting or roosting opportunities. Openings on turbines will be covered to prevent cavity-nesting species from nesting in the turbines. • Lighting will be installed on the fewest number of turbines allowed by Federal Aviation Administration (FAA) regulations, and all pilot warning lights will fire synchronously. Turbine lighting will employ only red or dual red-and-white strobe, strobe-like, or flashing lights (U.S. Fish and Wildlife Service 2012). All lighting on turbines will be operated at the minimum allowable intensity, flashing frequency, and quantity allowed by FAA (Gehring et al. 2009; U.S. Fish and Wildlife Service 2012). Duration between flashes will be the longest allowable by the FAA.				
BIO-11d	Incorporate avian-safe practices into design of turbine-related infrastructure. All project proponents will apply the following measures when designing and siting turbine-related infrastructure. These measures will reduce the risk of bird electrocution and collision. • Permanent meteorological stations will avoid use of guy wires. If it is not possible to avoid using guy wires, the wires will be at least 4/0 gauge to ensure visibility and will be fitted with bird deterrent devices. • All permanent meteorological towers will be unlit unless lighting is required by FAA. If lighting is required, it will be operated at the minimum allowable intensity, flashing frequency, and quantity allowed by FAA. • To the extent possible, all powerlines will be placed underground. However, lines may be placed aboveground immediately prior to entering the substation. All aboveground lines will be fitted with bird flight diverters or visibility enhancement devices (e.g., spiral damping devices). When lines cannot be placed underground, appropriate avian protection designs must be employed. As a minimum requirement, the collection system will conform to the most current edition of the Avian Power Line Interaction Committee guidelines to prevent electrocutions. • Lighting will be focused downward and minimized to limit skyward illumination. Sodium vapor lamps and spotlights will not be used at any facility (e.g., laydown areas, substations) except when emergency maintenance is needed. Lighting at collection facilities, including substations, will be minimized using downcast lighting and motion-detection devices. The use of high-intensity lighting; steady-burning or bright lights such as sodium vapor, quartz, or halogen; or other bright spotlights will be minimized. Where lighting is required it will be designed for the minimum intensity required for safe operation of the facility. Green or blue lighting will be used in place of red or white lighting.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance.
BIO-11e	Retrofit existing infrastructure to minimize risk to raptors. Any existing power lines in a specific project area that are owned by the wind project operator and that are associated with electrocution of an eagle or other raptor will be retrofitted within 30 days to make them raptor-safe according to Avian Power Line Interaction Committee guidelines. All other existing structures to remain in a project area during repowering will be retrofitted, as feasible, according to specifications of Mitigation Measure BIO-11c prior to repowered turbine operation.	During Construction and Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance.
BIO-11f	Discourage prey for raptors. All project proponents will apply the following measures when designing and siting turbine-related infrastructure. These measures are intended to minimize opportunities for fossorial mammals to become established and thereby create a prey base that could become an attractant for raptors. • Rodenticide will not be utilized on the project site to avoid the risk of raptors scavenging the remains of poisoned animals. • Boulders (rocks more than 12 inches in diameter) excavated during project construction may be placed in aboveground piles in the project area so long as they are more than 500 meters (1,640 feet) from any turbine. Existing rock piles created during construction of first- and second-generation turbines will also be moved at least 500 meters (1,640 feet) from turbines. • Gravel will be placed around each tower foundation to discourage small mammals from burrowing near turbines.	During Construction and Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Verify plans for long-term maintenance are initiated.
BIO-11g	Implement post-construction avian fatality monitoring for all repowering projects. A post-construction monitoring program will be conducted at each repowering project for a minimum of 3 years beginning on the commercial operation date (COD) of the project. Monitoring may continue beyond 3 years if construction is completed in phases. Moreover, if the results of the first 3 years indicate that baseline fatality rates (i.e., non-repowered fatality rates) are exceeded, monitoring will be extended until the average annual fatality rate has dropped below baseline fatality rates for 2 years, and to assess the effectiveness of adaptive management measures specified in Mitigation Measure BIO-11i. An additional 2 years of monitoring will be implemented at year 10 (i.e., the tenth anniversary of the COD). Project proponents will provide access to qualified third parties authorized by the County to conduct any additional monitoring after the initial 3-year monitoring period has expired and	Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term monitoring are initiated.

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	before and after the additional 2-year monitoring period, provided that such additional monitoring utilizes scientifically valid monitoring protocols. A TAC will be formed to oversee the monitoring program and to advise the County on adaptive management measures that may be necessary if fatality rates substantially exceed those predicted for the project (as described below in Mitigation Measure BIO-11i). The TAC will have a standing meeting, which will be open to the public, every 6 months to review monitoring reports produced by operators in the program area. In these meetings, the TAC will discuss any issues raised by the monitoring reports and recommend to the County next steps to address issues, including scheduling additional meetings, if necessary. The TAC will comprise representatives from the County (including one or more technical consultants, such as a biostatistician, an avian biologist, and a bat biologist), and wildlife agencies (CDFW, USFWS). Additional TAC members may also be considered (e.g., a representative from Audubon, a landowner in the program area, a representative of the operators) at the discretion of the County. The TAC will be a voluntary and advisory group that will provide guidance to the County Planning Department. To maintain transparency with the public, all TAC meetings will be open to the public, and notice of meetings will be given to interested parties. The TAC will have three primary advisory roles: (1) to review and advise on project planning documents (i.e., project-specific APPs) to ensure that project-specific mitigation measures and compensatory mitigation measures described in the PEIR are appropriately and consistently applied, (2) to review and advise on monitoring documents (protocols and reporting) for consistency with the mitigation measures, and (3) to review and advise on implementation of the adaptive management plans. Should fatality monitoring reveal that impacts exceed the baseline thresholds established in the PEIR, the TAC will advise the County on requiring implementation of adaptive management measures as described in Mitigation Measure BIO-11i. The County will have the decision-making authority, as it is the organization issuing the conditional use permits. However, the TAC will collaboratively inform the decisions of the County. Operators are required to provide for avian use surveys to be conducted within the project area boundaries for a minimum of 30 minutes duration. Surveyors will be qualified and trained and subject to approval by the County. Carcass surveys will be conducted at every turbine for projects with 20 or fewer turbines. For projects with more than 20 turbines, such surveys will be required at a minimum of 20 turbines, and a sample of the remaining turbines may be selected for carcass searches. The operator will be required to demonstrate that the sampling scheme and sample size are statistically rigorous and defensible. Where substantial variation in terrain, land cover type, management, or other factors may contribute to significant variation in fatality rates, the sampling scheme will be stratified to account for such variation. The survey protocol for sets and subsets of turbines, as well as proposed sampling schemes that do not entail a search of all turbines, must be approved by the County in consultation with the TAC prior to the start of surveys. The search interval will not exceed 14 days for the minimum of 20 turbines to be surveyed; however, the search interval for the additional turbines (i.e., those exceeding the 20-turbine minimum) that are to be included in the sampling scheme may be extended up to 28 days or longer if recommended by the TAC. The estimation of detection probability is a rapidly advancing field. Carcass placement trials, broadly defined, will be conducted to estimate detection probability during each year of monitoring. Sample sizes will be large enough to potentially detect significant variation by season, carcass size, and habitat type. Operators will be required to submit copies of all raw data forms to the County annually, will supply raw data in a readily accessible digital format to be specified by the County, and will prepare raw data for inclusion as appendices in the annual reports. The intent is to allow the County to conduct independent analyses and meta-analyses of data across the Altamont Pass Wind Resource Area (APWRA), and to supply these data to the regulatory agencies if requested. Annual reports submitted to the County will provide a synthesis of all information collected to date. Each report will provide an introduction; descriptions of the study area, methods, and results; a discussion of the results; and any suitable recommendations. Reports will provide raw counts of fatalities, adjusted fatality rates, and estimates of project-wide fatalities on both a per MW and per turbine basis.				
BIO-11h	Compensate for the loss of raptors and other avian species, including golden eagles, by contributing to conversation efforts. To promote the conservation of raptors and other avian species, project proponents will compensate for raptor fatalities estimated within their project areas. Mitigation will be provided in 10-year increments, with the first increment based on the estimates (raptors/MW/year) provided in the PEIR for the Vasco Winds Project or the project-specific EIR for future projects. The Vasco Winds fatality rates were selected because the Vasco turbines are the most similar to those likely to be proposed for future repowering projects and consequently represent the best available fatality estimates. Each project	Prior to Construction, During Construction, and Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term measures are

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	proponent will conduct post-construction fatality monitoring for at least 3 years beginning at project startup (date of commercial operation) and again for 2 years at year 10, as required under Mitigation Measure BIO-11g, to estimate the average number of raptors taken each year by each individual project. The project proponent will compensate for this number of raptors in subsequent 10-year increments for the life of the project (i.e., three 10-year increments) as outlined below. Mitigation Measure BIO-11g also requires additional fatality monitoring at year 10, as required under Mitigation Measure BIO-11g, to estimate the average number of raptors taken each year by each individual project. The project proponent will compensate for this number of raptors in subsequent 10-year increments for the life of the project (i.e., three 10-year increments) as outlined below. Mitigation Measure BIO-11g also requires additional fatality monitoring at year 10 of the project. The results of the first 3 years of monitoring and/or the monitoring at year 10 may lead to revisions of the estimated average number of raptors taken, and mitigation provided may be adjusted accordingly on a one-time basis within each of the first two 10-year increments, based on the results of the monitoring required by Mitigation Measure BIO-11g, in consultation with the TAC. Prior to the start of operations, project proponents will submit for County approval an avian conservation strategy, as part of the project-specific APP outlined in Mitigation Measure BIO- 11a, outlining the estimated number of raptor fatalities based on the number and type of turbines being constructed, and the type or types of compensation options to be implemented. Project proponents will use the avian conservation strategy to craft an appropriate strategy using a balanced mix of the options presented below, as well as considering new options suggested by the growing body of knowledge during the course of the project lifespan, as supported by a Resource Equivalency Analysis (REA) (see example in Appendix C3) or similar type of compensation assessment acceptable to the County that demonstrates the efficacy of proposed mitigation for impacts on raptors. The County Planning Director, in consultation with the TAC, will consider, based on the REA, whether the proposed avian conservation strategy is adequate, including consideration of whether each avian mitigation plan incorporates a landscape-scale approach such that the conservation efforts achieve the greatest possible benefits. Compensation measures as detailed in an approved avian conservation strategy must be implemented within 1 year of the date of commercial operations. Avian conservation strategies will be reviewed and may be revised by the County every 10 years, and on a one-time basis in each of the two 10-year increments based on the monitoring required by Mitigation Measure BIO-11g. • Retrofitting high-risk electrical infrastructure. USFWS's ECP Guidelines outline a compensatory mitigation strategy using the retrofit of high-risk power poles (poles known or suspected to electrocute and kill eagles). USFWS has developed an REA (U.S. Fish and Wildlife Service 2013a) as a tool to estimate the compensatory mitigation (number of retrofits) required for the take of eagles. The REA takes into account the current understanding of eagle life history factors, the effectiveness of retrofitting poles, the expected annual take, and the timing of implementation of the pole retrofits. The project proponents may need to contract with a utility or a third-party mitigation account (such as the National Fish and Wildlife Foundation) to retrofit the number of poles needed as demonstrated by a project-specific REA. If contracting directly, the project proponent will consult with utility companies to ensure that high-risk poles have been identified for retrofitting. Proponents will agree in writing to pay the utility owner/operator to retrofit the required number of power poles and maintain the retrofits for 10 years and will provide the County with documentation of the retrofit agreement. The first retrofits will be based on the estimated number of eagle fatalities as described above in this measure or as developed in the project-specific EIR for future projects. Subsequent numbers of retrofits required for additional 10-year durations will be based on the results of project-specific fatality monitoring as outlined in Mitigation Measure BIO-11g. If fewer eagle fatalities are identified through the monitoring, the number of future required retrofits may be reduced through a project-specific REA. Although retrofitting poles has not been identified as appropriate mitigation for other large raptors, they would likely benefit from such efforts, as they (particularly red-tailed and Swainson's hawks) constitute the largest non-eagle group to suffer electrocution on power lines (Avian Power Line Interaction Committee 2006). • Measures outlined in an approved Eagle Conservation Plan and Bird and Bat Conservation Strategy. Project proponents may elect to apply for programmatic eagle take permits from USFWS. The programmatic eagle take permit process currently involves preparation of an Eagle Conservation Plan (ECP) and a Bird and Bat Conservation Strategy (BBCS). The ECP specifies avoidance and minimization measures, advanced conservation practices, and compensatory mitigation for eagles—conditions that meet USFWS's criteria for issuance of a permit. The BBCS outlines measures being implemented by the applicant to avoid and minimize impacts on migratory birds, including raptors. If programmatic eagle take permits are obtained by project proponents, those permit terms, including the measures outlined in the approved ECP and BBCS, may constitute an appropriate conservation measure for estimated take of golden eagles and other raptors, provided such terms are deemed by the County to be comparable to or more protective of raptors than the other options listed herein. • Contribute to raptor conservation efforts. Project proponents will contribute funds, in the amount of $580/raptor fatality, in 10-year increments to local and/or regional conservation efforts designed to protect, recover, and manage lands for raptors, or to conduct research involving methods to reduce raptor fatalities or increase raptor productivity. The $580 amount is based on the average cost to rehabilitate one raptor at the California Raptor Center, affiliated with the UC Davis School of Veterinary Medicine, which receives more than 200 injured or ill raptors annually (Stedman pers. comm.). Ten-year installments are more advantageous than more frequent installments for planning and budgeting purposes.				initiated

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	The funds will be contributed to an entity or entities engaged in these activities, such as the East Bay Regional Park District and the Livermore Area Regional Park District. Conservation efforts may include constructing and installing nest boxes and perches, conducting an awareness campaign to reduce the use of rodenticide, and conducting research to benefit raptors. The specific conservation effort to be pursued will be submitted to the County for approval as part of the avian conservation strategy review process. The donation receipt will be provided to the County as evidence of payment. The first contributions for any given project will be based on the estimated number of raptor fatalities as described above in this measure or as developed in the project-specific EIR for future projects. Funds for subsequent 10-year installments will be provided on the basis of the average annual raptor fatality rates determined through post-construction monitoring efforts, allowing for a one-time adjustment within each 10-year increment after the results of the monitoring efforts are available. If fewer raptor fatalities are detected through the monitoring effort, the second installment amount may be reduced to account for the difference between the first estimated numbers and the monitoring results. • Contribute to regional conservation of raptor habitat. Project proponents may address regional conservation of raptor habitat by funding the acquisition of conservation easements within the APWRA or on lands in the same eco-region outside the APWRA, subject to County approval, for the purpose of long-term regional conservation of raptor habitat. Lands proposed for conservation must be well-managed grazing lands similar to those on which the projects have been developed. Project proponents will fund the regional conservation and improvement of lands (through habitat enhancement, lead abatement activities, elimination of rodenticides, and/or other measures) using a number of acres equivalent to the conservation benefit of the raptor recovery and conservation efforts described above, or as determined through a project-specific REA (see example REA in Appendix C3). The conservation lands must be provided for compensation of a minimum of 10 years of raptor fatalities, as 10-year increments will minimize the transaction costs associated with the identification and conservation of lands, thereby increasing overall cost effectiveness. The conservation easements will be held by an organization whose mission is to purchase and/or otherwise conserve lands, such as The Trust for Public Lands, The Nature Conservancy, California Rangeland Trust, or the East Bay Regional Parks District. The project proponents will obtain approval from the County regarding the amount of conserved lands, any enhancements proposed to increase raptor habitat value, and the entity holding the lands and/or conservation easement. • Other Conservation Measures Identified in the Future. As noted above, additional conservation measures for raptors may become available in the future. Conservation measures for raptors are currently being developed by USFWS and nongovernmental organizations (e.g., American Wind Wildlife Institute)—for example, activities serving to reduce such fatalities elsewhere, and enhancing foraging and nesting habitat. Additional options for conservation could include purchasing credits at an approved mitigation bank, credits for the retirement of windfarms that are particularly dangerous to birds or bats, the curtailment of prey elimination programs, and hunter-education programs that remove sources of lead from the environment. Under this option, the project proponent may make alternative proposals to the County for conservation measures—based on an REA or similar compensation assessment—that the County may accept as mitigation if they are deemed by the County to be comparable to or more protective of raptor species than the other options described herein.				
BIO-11i	Implement an avian adaptive management program. If fatality monitoring described in Mitigation Measure BIO-11g results in an estimate that exceeds the preconstruction baseline fatality estimates (i.e., estimates at the non-repowered turbines as described in the PEIR) for any focal species or species group (i.e., individual focal species, all focal species, all raptors, all non-raptors, all birds combined), project proponents will prepare a project-specific adaptive management plan within 2 months following the availability of the fatality monitoring results. These plans will be used to adjust operation and mitigation to the results of monitoring, new technology, and new research to ensure that the best available science is used to minimize impacts to below baseline. Project-specific adaptive management plans will be reviewed by the TAC, revised by project proponents as necessary, and approved by the County. The TAC will take current research and the most effective impact reduction strategies into account when reviewing adaptive management plans and suggesting measures to reduce impacts. The project-specific adaptive management plans will be implemented within 2 months of approval by the County. The plans will include a stepped approach whereby an adaptive measure or measures are implemented, the results are monitored for success or failure for a year, and additional adaptive measures are added as necessary, followed by another year of monitoring, until the success criteria are achieved (i.e., estimated fatalities are below the baseline). Project proponents should use the best measures available when the plan is prepared in consideration of the specific adaptive management needs. For example, if only one threshold is exceeded, such as golden eagle fatalities, the plan and measures used will target that species. As set forth in other agreements in the APWRA, project proponents may also focus adaptive management measures on individual or multiple turbines if those turbines are shown to cause a significantly disproportionate number of fatalities. In general, the following types of measures will be considered by the TAC, in the order they are presented below; however, the TAC may recommend any	Prior to Construction and Post Construction	Altamont Winds	Altamont Winds and USFWS	Review project plans and specifications for compliance. Prepare appropriate report. Verify appropriate framework is in place, and plans for long-term measures are initiated.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	of these or other measures that are shown to be successful in reducing the impact. • ADMM-1: Visual Modifications. The project proponent could paint a pattern on a proportion of the turbine blades. The proportion and the pattern of the blades to be painted will be determined by the County in consultation with the TAC. USFWS recommends testing measures to reduce motion smear—the blurring of turbine blades due to rapid rotation that renders them less visible and hence more perilous to birds in flight. Suggested techniques include painting blades with staggered stripes or painting one blade black. The project proponent will conduct fatality studies on a controlled number of painted and unpainted turbines. The project proponent will coordinate with the TAC to determine the location of the painted turbines, but the intent is to implement this measure in areas that appear to be contributing most to the high number of fatalities detected. • ADMM-2: Anti-Perching Measures. The County will consult with the TAC regarding the use of anti-perching measures to discourage bird use of the area. The TAC will use the most recent research and information available to determine, on a case-by–case basis, if anti-perching measures will be an effective strategy to reduce impacts. If determined to be feasible, anti-perching devices will be installed on artificial structures, excluding utility poles, within 1 mile of project facilities (with landowner permission) to discourage bird use of the area. • ADMM-3: Prey Reduction. The project proponent will implement a prey reduction program around the most hazardous turbines. Examples of prey reduction measures may include changes in grazing practices to make the area less desirable for prey species, active reduction through direct removal of prey species, or other measures provided they are consistent with management goals for threatened and endangered species. • ADMM-4: Implementation of Experimental Technologies. Project proponents can deploy experimental technologies at their facilities to test their efficacy in reducing turbine-related fatalities. Examples may include, but are not limited to, visual deterrents, noise deterrents, and active radar systems. • ADMM-5: Turbine Curtailment. If post-construction monitoring indicates patterns of turbine-caused fatalities—such as seasonal spikes in fatalities, topographic or other environmental features associated with high numbers of fatalities, or other factors that can potentially be manipulated and that suggest that curtailment of a specific turbine's operation would result in reducing future avian fatalities—the project operator can curtail operations of the offending turbine or turbines. Curtailment restrictions would be developed in coordination with the TAC and based on currently available fatality data, use data, and research. • ADMM-6: Cut-in Speed Study. Changes in cut-in speed could be conducted to see if changing cut-in speeds from 3 meters per second to 5 meters per second (for example) would significantly reduce avian fatalities. The proponent will coordinate with the TAC in determining the feasibility of the measure for the particular species affected as well as the amount of the change in the cut-in speed. • ADMM-7: Real-Time Turbine Curtailment. The project proponent can employ a real-time turbine curtailment program designed in consultation with the TAC. The intent would be to deploy a biologist to monitor onsite conditions and issue a curtailment order when raptors are near operating turbines. Alternatively, radar, video, or other monitoring measures could be deployed in place of a biological monitor if there is evidence to indicate that such a system would be as effective and more efficient than use of a human monitor.				
BIO-12a	Conduct bat roost surveys. Prior to development of any repowering project, a qualified bat biologist will conduct a roost habitat assessment to identify potential colonial roost sites of special-status and common bat species within 750 feet of the construction area. If suitable roost sites are to be removed or otherwise affected by the proposed project, the bat biologist will conduct targeted roost surveys of all identified sites that would be affected. Because bat activity is highly variable (both spatially and temporally) across the landscape and may move unpredictably among several roosts, several separate survey visits may be required. Surveys will be repeated at different times of year if deemed necessary by the bat biologist to determine the presence of seasonally active roosts (hibernacula, migratory stopovers, maternity roosts).Appropriate field methods will be employed to determine the species, type, and vulnerability of the roost to construction disturbance. Methods will follow best practices for roost surveys such that species are not disturbed and adequate temporal and spatial coverage is provided to increase likelihood of detection. Roost surveys may consist of both daylight surveys for signs of bat use and evening/night visit(s) to conduct emergence surveys or evaluate the status of night roosts. Survey timing should be adequate to account for individual bats or species that might not emerge until well after dark. Methods and approaches for determining roost occupancy status should include a combination of the following components as the biologist deems necessary for the particular roost site. • Passive and/or active acoustic monitoring to assist with species identification. • Guano traps to determine activity status. • Night-vision equipment.	Prior to Construction	Altamont Winds	Altamont Winds and CDFW	Conduct surveys. Prepare and submit pertinent reports.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	• Passive infrared camera traps. At the completion of the roost surveys, a report will be prepared documenting areas surveyed, methods, results, and mapping of high-quality habitat or confirmed roost locations.				
BIO-12b	Avoid removing or disturbing bat roosts. • Active bat roosts will not be disturbed, and will be provided a minimum buffer of 500 feet where preexisting disturbance is moderate or 750 feet where preexisting disturbance is minimal. Confirmation of buffer distances and determination of the need for a biological monitor for active maternity roosts or hibernacula will be obtained in consultation with CDFW. At a minimum, when an active maternity roost or hibernaculum is present within 750 feet of a construction site, a qualified biologist will conduct an initial assessment of the roost response to construction activities and will recommend buffer expansion if there are signs of disturbance from the roost. • Structures (natural or artificial) showing evidence of significant bat use within the past year will be left in place as habitat wherever feasible. Should such a structure need to be removed or disturbed, CDFW will be consulted to determine appropriate buffers, timing and methods, and compensatory mitigation for the loss of the roost. • All project proponents will provide environmental awareness training to construction personnel, establish buffers, and initiate consultation with CDFW if needed. • Artificial night lighting within 500 feet of any roost will be shielded and angled such that bats may enter and exit the roost without artificial illumination and the roost does not receive artificial exposure to visual predators. • Tree and vegetation removal will be conducted outside the maternity season (April 1– September 15) to avoid disturbance of maternity groups of foliage-roosting bats. • If a maternity roost or hibernaculum is present within 500 feet of the construction site where pre-existing disturbance is moderate or within 750 feet where preexisting disturbance is minimal, a qualified biological monitor will be onsite during groundbreaking activities.	During Construction	Altamont Winds	Altamont Winds and CDFW	Review project plans, specifications, and reports for compliance. Inspect during construction.
BIO-13	No measure required.	N/A	N/A	N/A	N/A
BIO-14a	Site and select turbines to minimize potential mortality of bats. All project proponents will use the best information available to site turbines and to select from turbine models in such a manner as to reduce bat collision risk. The siting and selection process will take into account bat use of the area and landscape features known to increase collision risk (trees, edge habitats, riparian areas, water bodies, and wetlands). Measures include but are not limited to siting turbines the greatest distance feasible up to 500 meters (1,640) feet from still or flowing bodies of water, riparian habitat, known roosts, and tree stands (California Bat Working Group 2006:6). To generate site-specific "best information" to inform turbine siting and operation decisions, a bat habitat assessment and roost survey will be conducted in the project area to identify and map habitat of potential significance to bats, such as potential roost sites (trees and shrubs, significant rock formations, artificial structures) and water sources. Turbine siting decisions will incorporate relevant bat use survey data and bat fatality records published by other projects in the APWRA. Roost surveys will be carried out according to the methods described in Mitigation Measure-BIO-12a.	Prior to Construction	Altamont Winds	Altamont Winds and CDFW	
BIO-14b	Implement post-construction bat fatality monitoring program for all repowering projects. A scientifically defensible, post-construction bat fatality monitoring program will be implemented to estimate actual bat fatalities and determine if additional mitigation is required. Bat-specific modifications to the 3-year post-construction monitoring program described in Mitigation Measure BIO-11g, developed in accordance with California Energy Commission CEC guidelines (CEC) (2007) and with appropriate recommendations from California Bat Working Group guidelines (2006), will be implemented. In addition to the requirements outlined in Mitigation Measure BIO-11g, the following two bat-specific requirements will be added. • Include on the TAC at least one biologist with significant expertise in bat research and wind energy impacts on bats. • Conduct bat acoustic surveys concurrently with fatality monitoring in the project area to estimate nightly, seasonal, or annual variations in relative activity and species use patterns, and to contribute to the body of knowledge on seasonal bat movements and relationships between bat activity, environmental variables, and turbine fatality. Should emerging research support the approach, these data may be used to generate site-specific predictive models to increase the precision and effectiveness of mitigation measures (e.g., the season-specific, multivariate	Prior to Construction	Altamont Winds	Altamont Winds and CDFW	Review project plans and specifications for compliance. Prepare appropriate report. Verify appropriate framework is in place, and plans for long-term measures are initiated.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	models described by Weller and Baldwin 2011:11). Acoustic bat surveys will be designed and data analysis conducted by qualified biologists with significant experience in acoustic bat survey techniques. Methods will be informed by the latest available guidelines (CEC 2007); California Bat Working Group guidelines, 2006), except where best available science supports technological or methodological updates. High-quality, sensitive acoustic equipment will be used to produce data of sufficient quality to generate species identifications. Survey design and methods will be scientifically defensible and will include, at a minimum, the following elements. o Acoustic detectors will be installed at multiple stations to adequately sample range of habitats in the project area for both resident and migratory bats. The number of detector arrays installed per project site will incorporate emerging research on the density of detectors required to adequately meet sampling goals and inform mitigation approaches (Weller and Baldwin 2011:10). o Acoustic detector arrays will sample multiple airspace heights including as close to the repowered rotor swept area as possible Vertical structures used for mounting may be preexisting or may be installed for the project (e.g., temporary or permanent meteorological towers). o Surveys will be conducted such that data are collected continuously from early July to early November to cover the activity transition from maternity to migration season and determine if there is elevated activity during migration. Survey season may be adjusted to more accurately reflect the full extent of the local migration season and/or season(s) of greatest local bat fatality risk, if scientifically sound data support doing so. o Anticipated adaptive management goals, such as determining justifiable timeframes to reduce required periods of cut-in speed adjustments, will be reviewed with the TAC and incorporated in designing the acoustic monitoring and data analysis program. Modifications to the fatality search protocol will be implemented to obtain better information on the number and timing of bat fatalities (e.g., Johnston et al. 2013:85). Modifications to the fatality search protocol will be implemented to obtain better information on the number and timing of bat fatalities (e.g., Johnston et al. 2013:85). Modifications will include decreases in the transect width and search interval for a period of time coinciding with high levels of bat mortality, i.e., the fall migration season (roughly August to early November, or as appropriate in the view of the TAC). The nature of bat-specific transect distance and search intervals will be determined in consultation with the TAC and will be guided by scientifically sound and pertinent data on rates of bat carcass detection at wind energy facilities (e.g., Johnston et al. 2013:54–55) and site-specific data from APWRA repowering project fatality monitoring programs as these data become available. Other methods to achieve the goals of the bat fatality monitoring program while avoiding prohibitive costs may be considered subject to approval by the TAC, if these methods have been peer reviewed and evidence indicates the methods are effective. For example, if project proponents wish to have the option of altering search methodology to a newly developed method, such as searching only roads and pads (Good et al. 2011:73), a statistically robust field study to index the results of the methodology against standard search methods will be conducted concurrently to ensure site-specific, long-term validity of the new methods. Finally, detection probability trials will utilize bat carcasses to develop bat-specific detection probabilities. Care should be taken to avoid introducing novel disease reservoirs; such avoidance will entail using onsite fatalities or using carcasses obtained from within a reasonably anticipated flight distance for that species.				
BIO-14c	Prepare and publish annual monitoring on the finding of bat use of the project area and fatality monitoring results. Annual reports of bat use results and fatality monitoring will be produced within 3 months of the end of the last day of fatality monitoring. Special-status bat species records will be reported to CNDDB.	Post Construction	Altamont Winds	Altamont Winds and CDFW	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term measures are initiated. Prepare appropriate reports.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
BIO-14d	Develop and implement a bat adaptive management plan. In concert with Mitigation Measure BIO-14b, all project proponents will develop adaptive management plans to ensure appropriate, feasible, and current incorporation of emerging information. The goals of the adaptive management plans are to ensure that the best available science and emerging technologies are used to assess impacts on bats, and that impacts are minimized to the greatest extent possible while maximizing energy production. The project-specific adaptive management plans will be used to adjust operation and mitigation to incorporate the results of project area monitoring and new technology and research results when sufficient evidence exists to support these new approaches. These plans will be reviewed by the TAC and approved by the County. All adaptive management measures will be implemented within a reasonable timeframe, sufficient to allow the measures to take effect in the first fall migration season following the year of monitoring in which the adaptive management threshold was crossed. Adaptive Mitigation Measures (ADMMs) may be modified by the County in consultation with the TAC to take into account current research, site-specific data, and the most effective impact reduction strategies. ADMMs will include a scientifically defensible, controlled research component and minimum post-implementation monitoring time to evaluate the effectiveness and validity of the measures. The minimum monitoring time will consist of three sequential fall seasons of the bat-specific mortality monitoring program covering the 3–4 months of the year in which the highest bat mortality has been observed: likely August–November. The start and end dates of the 3–4 months of bat-specific mortality monitoring period will be based on existing fatality data and in consultation with the TAC. Determining a fatality threshold to trigger adaptive management is not straightforward, as insufficient information exists on the status and vitality of the populations of migratory bat species subject to mortality in the APWRA. The low estimate of anticipated bat fatality rates is from the Vasco Winds project in the APWRA. Applying this rate programmatically would result in an estimate of 21,000 bats killed over the 30-year life of the program. The high estimate is from the Montezuma Hills Wind Resource Area. Applying this rate programmatically would result in an estimate of 49,050 bats killed over the 30-year life of the program. Bats are slow to reproduce, and turbines may be more likely to kill adult bats than juveniles, suggesting that a conservative approach is warranted. Accordingly, an initial adaptive management threshold will be established using the low fatality estimates, or 1.679 fatalities/MW/year, to ensure that the most conservative trigger for implementation of adaptive management measures is adopted. If post-construction fatality monitoring results in a point estimate for the bat fatality rate that exceeds the 1.679 fatalities/MW/year threshold by a statistically significant amount, then, in consultation with the TAC, ADMM-7 and ADMM-8 (described below) for bats will be implemented. It is important to note that neither the high nor the low estimate speaks to the ability of bat populations to withstand the associated levels of take. The initial fatality rate threshold triggering adaptive management may be modified by the TAC if appropriate and if such adaptation is supported by the best available science. The TAC may direct implementation of adaptive management measures for other appropriate reasons, such as an unexpectedly and markedly high fatality rate observed for any bat species, or special-status species being killed in unexpectedly high numbers. ADMMs for bats may be implemented using a stepped approach until necessary fatality reductions are reached, and monitoring methods must be revised as needed to ensure accurate measurement of the effectiveness of the ADMMs. Additional ADMMs for bats should be developed as new technologies or science supports doing so. • ADMM-7: Seasonal Turbine Cut-in Speed Increase. Cut-in speed increases offer the most promising and immediately available approach to reducing bat fatalities at fourth-generation wind turbines. Reductions in fatalities (53–87%) were observed when increasing modern turbine cut-in speed to 5.0–6.5 m/s (Arnett et al. 2009:3; Good et al. 2012:iii). While implementing this measure immediately upon a project's commencement would likely reduce bat fatalities, that assumption is not yet supported by conclusive data. Moreover, without establishing baseline fatality at repowered projects, there would be no way to determine the effectiveness of the approach or whether the costs of increased cut-in speeds (and consequent power generation reductions) were providing fatality reductions. Cut-in speed increases will be implemented as outlined below, with effectiveness assessed annually. • The project proponent will increase cut-in speed to 5.0 m/s from sunset to sunrise during peak migration season (generally August–October). If this is ineffective, the project proponent will increase turbine cut-in speed by annual increments of 0.5 m/s until target fatality reductions are achieved. • The project proponent may refine site-specific migration start dates on the basis of pre- and post-construction acoustic surveys and ongoing review of dates of fatality occurrences for migratory bats in the APWRA. • The project proponent may request a shorter season of required cut-in speed increases with substantial evidence that similar levels of mortality	Post Construction	Altamont Winds	Altamont Winds, CDFW, and County	Review project plans and specifications for compliance. Prepare appropriate report. Verify appropriate framework is in place, and plans for long-term measures are initiated.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	reduction could be achieved. Should resource agencies and the TAC find there is sufficient support for a shorter period (as low as 8 weeks), evidence in support of this shorter period will be documented for the public record and the shorter period may be implemented. • The project proponent may request a shorter season of required cut-in speed increases with substantial evidence that similar levels of mortality reduction could be achieved. Should resource agencies and the TAC find there is sufficient support for a shorter period (as low as 8 weeks), evidence in support of this shorter period will be documented for the public record and the shorter period may be implemented. • The project proponent may request shorter nightly periods of cut-in speed increases with substantial evidence from defensible onsite, long-term post-construction acoustic surveys indicating predictable nightly timeframes when target species appear not to be active. Target species are here defined as migratory bats or any other species appearing repeatedly in the fatality records. • The project proponent may request exceptions to cut-in speed increases for particular weather events or wind patterns if substantial evidence is available from onsite acoustic or other monitoring to support such exceptions (i.e., all available literature and onsite surveys indicate that bat activity ceases during specific weather events or other predictable conditions). • In the absence of defensible site-specific data, mandatory cut-in speed increases will commence on August 1 and continue through October 31, and will be in effect from sunset to sunrise. • ADMM-8: Emerging Technology as Mitigation. The project proponent may request, with consultation and approval from agencies, replacement or augmentation of cut-in speed increases with developing technology or another mitigation approach that has been proven to achieve similar bat fatality reductions. The project proponent may also request the second tier of adaptive management to be the adoption of a promising but not fully proven technology or mitigation method. These requests are subject to review and approval by the TAC and must include a controlled research component designed by a qualified principal investigator so that the effectiveness of the method may be accurately assessed. Some examples of such emerging technologies and research areas that could be incorporated in adaptive management plans are listed below. • The use of acoustic deterrents (Arnett et al. 2013:1). • The use of altitude-specific radar, night vision and/or other technology allowing bat use monitoring and assessment of at-risk bat behavior (Johnston et al. 2013: 90-91) if research in these areas advances sufficiently to allow effective application of these technologies. • Application of emerging peer-reviewed studies on bat biology (such as studies documenting migratory corridors or bat behavior in relation to turbines) that support specific mitigation methods.				
BIO-14e	Compensate for expenses incurred by rehabilitating injured bats. The cost of reasonable, licensed rehabilitation efforts for any injured bats taken to wildlife care facilities from the program area will be assumed in full by project proponents.	Prior to Construction and Post Construction	Altamont Winds	Altamont Winds and CDFW	Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated
BIO-15	Compensate for the loss of alkali meadow habitat. If alkali meadow habitat is filled or disturbed as part of a repowering project, the project proponent will compensate for the loss of this habitat to ensure no net loss of habitat functions and values. Compensation ratios will be based on site-specific information and determined through coordination with state and federal agencies (CDFW, USFWS, and United States Army Corps of Engineers [USACE]). Unless specified otherwise by a resource agency, the compensation will be at a minimum 1:1 ratio (1 acre restored or created for every 1 acre filled) and may be a combination of onsite restoration/creation, offsite restoration, and mitigation credits. A restoration and monitoring plan will be developed and implemented. The plan will describe how alkali meadow habitat will be created and monitored.	Prior to Construction and Post Construction	Altamont Winds	Altamont Winds, USFWS, CDFW, USACE	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-16	Compensate for the loss of riparian habitat. If riparian habitat is filled or removed as part of a project, the project proponent will compensate for the loss of riparian habitat to ensure no net loss of habitat functions and values. Compensation ratios will be based on site-specific information and determined through coordination with state and federal agencies (CDFW, USFWS, and USACE). The compensation will be at a minimum 1:1 ratio (1 acre restored or created for every 1 acre filled) and may be a combination of onsite restoration/creation, offsite restoration, and mitigation credits. A restoration and monitoring plan will be developed and implemented. The plan will describe how riparian habitat will be created and monitored.	Prior to Construction and Post Construction	Altamont Winds	Altamont Winds, USFWS, CDFW, USACE	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
BIO-17	No measure required.	N/A	N/A	N/A	N/A

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BIO-18	Compensate for the loss of wetlands. If wetlands are filled or disturbed as part of a project, the project proponent will compensate for the loss to ensure no net loss of habitat functions and values. Compensation ratios will be based on site-specific information and determined through coordination with state and federal agencies (CDFW, USFWS, and USACE). The compensation will be at a minimum 1:1 ratio (1 acre restored or created for every 1 acre filled) and may be a combination of onsite restoration/creation, offsite restoration, and mitigation credits. A restoration and monitoring plan will be developed and implemented. The plan will describe how wetlands will be created and monitored.	Prior to Construction and Post Construction	Altamont Winds	Altamont Winds, USFWS, CDFW, USACE	Review project plans and specifications for compliance. Verify appropriate framework is in place, and plans for long-term preservation and monitoring is initiated.
Cultural					
CUL-1a	Avoid historic resources. Where feasible, avoid historic resources in design and layout of a proposed project in the program area.	Prior to Construction	Altamont Winds	Altamont Winds	Review project plans and specifications for compliance.
CUL-1b	Appropriate recordation of historic resources. If Mitigation Measure CUL-1a is determined to be infeasible, the significantly affected historic resource should be recorded following the guidelines of National Park Service (NPS), Historic American Buildings Survey (HABS), or Historic American Engineering Record (HAER). The recordation documentation must be provided to NPS, the State Historic Preservation Officer, and local repositories as determined by Alameda County. The documentation with a HABS or HAER report will include written data, a photography record with large-format rectified photography, and, depending on the level of significance of the resource, an architectural drawing set. The standards for these recordation components are defined in NPS guidance, and the level of recordation is determined by Alameda County in consultation with other lead agencies, if required. There are three standard levels of HABS and HAER recordation defined by the NPS.	Prior to Construction	Altamont Winds	Altamont Winds, NPS, and County	Review project plans and specifications for compliance. If applicable, prepare appropriate documentation.
CUL-2a	Conduct a preconstruction cultural field survey and cultural resources inventory and evaluation. Alameda County will require applicants to retain qualified personnel to conduct an archaeological field survey of the program area to determine whether significant resources exist within the program area. The inventory and evaluation will include the documentation and result of these efforts, the evaluation of any cultural resources identified during the survey, and cultural resources monitoring, if the survey identifies that it is necessary.	Prior to Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Conduct appropriate literature research and field surveys. Inspect during construction, if necessary. Prepare appropriate reports.
CUL-2b	Develop a treatment plan for any identified significant cultural resources. If any significant resources are identified through the preconstruction survey, a treatment plan that could include site avoidance, capping, or data recovery will be developed and implemented.	Prior to Construction	Altamont Winds	Altamont Winds and County	Prepare pertinent plans, if necessary.
CUL-2c	Conduct worker awareness training for archaeological resources prior to construction. Prior to the initiation of any site preparation and/or the start of construction, the project applicant will ensure that all construction workers receive training overseen by a qualified professional archaeologist who is experienced in teaching non-specialists, to ensure that forepersons and field supervisors can recognize archaeological resources (e.g., areas of shellfish remains, chipped stone or ground-stone, historic debris, building foundations, human bone) in the event that any are discovered during construction.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Prepare appropriate plans. Inspect during construction.
CUL-2d	Stop work if cultural resources are encountered during ground-disturbing activities. The project applicant will ensure that construction specifications include a stop-work order if prehistoric or historic-era cultural resources are unearthed during ground-disturbing activities. If such resources are encountered, the project applicant will immediately halt all activity within 100 feet of the find until a qualified archaeologist can assess the significance of the find. Prehistoric materials might include obsidian and chert flaked-stone tools (e.g., projectile	During Construction	Altamont Winds	Altamont Winds and County	Inspect during construction. Prepare any required plans, if necessary.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	points, knives, scrapers) or tool-making debris; culturally darkened soil ("midden") containing heat-affected rocks and artifacts; stone milling equipment (e.g., mortars, pestles, handstones, or milling slabs); and battered-stone tools, such as hammerstones and pitted stones. Historic period materials might include stone, concrete, or adobe footings and walls; filled wells or privies; and deposits of metal, glass, and/or ceramic refuse. If the find is determined to be potentially significant, the archaeologist, in consultation with the Native American representative (if appropriate), will develop a treatment plan that could include site avoidance, capping, or data recovery.				
CUL-3	Stop work if human remains are encountered during ground-disturbing activities The project applicant will ensure the construction specifications include a stop-work order if human remains are discovered during construction or demolition. There will be no further excavation or disturbance of the site within a 100-foot radius of the location of such discovery, or any nearby area reasonably suspected to overlie adjacent remains. The Alameda County Coroner will be notified and will make a determination as to whether the remains are Native American. If the Coroner determines that the remains are not subject to his authority, he will notify the Native American Heritage Commission (NAHC), who will attempt to identify descendants of the deceased Native American. If no satisfactory agreement can be reached as to the disposition of the remains pursuant to this state law, then the landowner will re-inter the human remains and items associated with Native American burials on the property in a location not subject to further subsurface disturbance. A final report will be submitted to Alameda County. This report will contain a description of the mitigation program and its results, including a description of the monitoring and testing resources analysis methodology and conclusions and a description of the disposition/curation of the resources.	During Construction	Altamont Winds	Altamont Winds, County, and NAHC	Review project plans and specifications for compliance. Inspect during construction. Prepare any required plans, if necessary.
Geology, Soils, Mineral Resources, and Paleontological Resources					
GEO-1	Conduct site-specific geotechnical investigation and implement design recommendations in subsequent geotechnical report. Prior to construction activities at any site, the project proponent will retain a geotechnical firm with local expertise in geotechnical investigation and design to prepare a site-specific geotechnical report. This report will be prepared by a licensed geotechnical engineer or engineering geologist and will be submitted to the County building department as part of the approval process. This report will be based on data collected from subsurface exploration, laboratory testing of samples, and surface mapping and will address the following issues. • Potential for surface fault rupture and turbine site location: The geotechnical report will investigate the Greenville, Corral Hollow-Carnegie, and the Midway faults (as appropriate to the location) and determine whether they pose a risk of surface rupture. Turbine foundations and power collection systems will be sited according to recommendations in this report. • Strong ground shaking: The geotechnical report will analyze the potential for strong ground shaking in project area and provide turbine foundation design recommendations, as well as recommendations for power collection systems. • Slope failure: The geotechnical report will investigate the potential for slope failure (both seismically and non-seismically induced) and develop site-specific turbine foundation and power collection system plans engineered for the terrain, rock and soil types, and other conditions present at the program area in order to provide long-term stability. • Expansive soils: The geotechnical report will assess the soil types in the program area and determine the best engineering designs to accommodate the soil conditions. • Unstable cut or fill slopes: The geotechnical report will address geologic hazards related to the potential for grading to create unstable cut or fill slopes and make site-specific recommendations related to design and engineering.	Prior to Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Conduct appropriate literature research and field surveys. Prepare appropriate reports.
GEO-7a	Retain a qualified professional paleontologist to monitor significant ground-disturbing activities The applicant will retain a qualified professional paleontologist as defined by the Society of Vertebrate Paleontology's Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources (2010) to monitor activities with the potential to disturb sensitive paleontological resources. Data gathered during detailed project design will be used to determine the activities that will require the presence of a monitor. In general, these activities include any ground-disturbing activities involving excavation deeper than 3 feet in areas with high potential to contain sensitive paleontological resources. Recovered fossils will be prepared so that they can be properly documented. Recovered fossils will then be curated at a facility that will properly house and label them, maintain the association between the fossils and field data about the fossils' provenance, and make the information available to the scientific community.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction. Prepare documentation and curation, if required.
GEO-7b	Educate construction personnel in recognizing fossil material	During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for

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<tr><td></td><td>The applicant will ensure that all construction personnel receive training provided by a qualified professional paleontologist experienced in teaching non-specialists to ensure that they can recognize fossil materials in the event any are discovered during construction.</td><td></td><td></td><td></td><td>compliance. Inspect during construction.</td></tr>
<tr><td>GEO-7c</td><td>Stop work if substantial fossil remains are encountered during construction

If substantial fossil remains (particularly vertebrate remains) are discovered during earth disturbing activities, activities within 100 feet of the find will stop immediately until a state-registered professional geologist or qualified professional paleontologist can assess the nature and importance of the find and a qualified professional paleontologist can recommend appropriate treatment. Treatment may include preparation and recovery of fossil materials so that they can be housed in an appropriate museum or university collection and may also include preparation of a report for publication describing the finds. The applicant will be responsible for ensuring that recommendations regarding treatment and reporting are implemented.</td><td>During Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance. Inspect during construction. Prepare documentation, notification, and curation, if required.</td></tr>
<tr><td colspan="6">Greenhouse Gas Emissions</td></tr>
<tr><td>GHG-2a</td><td>Implement best available control technology for heavy-duty vehicles

The applicant will require existing trucks/trailers to be retrofitted with the best available technology and/or ARB-approved technology consistent with the ARB Truck and Bus Regulation

(California Air Resources Board 2011). The ARB Truck and Bus Regulation applies to all diesel-fueled trucks and buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds.

Starting January 1, 2015, the applicant must replace lighter trucks (GVWR of 14,001 to 26,000 pounds) with engines that are 20 years or older with newer trucks. The Applicant has the option to install a PM filter retrofit on a lighter truck by 2014 to make the truck exempt from replacement until January 1, 2020, and any lighter truck equipped with a PM filter retrofit prior to July 2011 would receive credit toward the compliance requirements for a heavier truck or bus in the same fleet.

Starting January 1, 2012, the applicant is required to meet the engine model year schedule shown below for heavier trucks (GVWR greater than 26,000 pounds). To comply with the schedule, the applicant will install the best available PM filter on 1996 model year and newer engines and would replace the vehicle 8 years later. The Applicant will replace trucks with 1995 model year and older engines starting in 2015. Replacements with 2010 model year or newer engines meets the final requirements, but the applicant could also replace trucks with used trucks that would have a future compliance date on the schedule. For example, a replacement with a 2007 model year engine complies until 2023. By 2023 all trucks and buses must have 2010 model year engines with few exceptions.

<table>
<tr><th colspan="2">ENGINE MODEL YEAR SCHEDULE FOR HEAVIER TRUCKS</th></tr>
<tr><th>Engine Year</th><th>Requirement from January 1</th></tr>
<tr><td>Pre-1994</td><td>No requirements until 2015, then 2010 engine</td></tr>
<tr><td>1994–1995</td><td>No requirements until 2016, then 2010 engine</td></tr>
<tr><td>1996–1999</td><td>PM filter from 2012 to 2020, then 2010 engine</td></tr>
<tr><td>2000–2004</td><td>PM filter from 2013 to 2021, then 2010 engine</td></tr>
<tr><td>2005–2006</td><td>PM filter from 2014 to 2022, then 2010 engine</td></tr>
<tr><td>2007–2009</td><td>No requirements until 2023, then 2010 engine</td></tr>
<tr><td>2010</td><td>Meets final requirements</td></tr>
</table>

In addition, the applicant could comply with a phase-in option that would allow the applicant to decide which vehicles to retrofit or replace, regardless of engine model year. The applicant must report information about all heavier trucks starting January 31, 2012, to use this option.

The Applicant could comply by demonstrating that trucks have met the percentage requirement each year as shown in the table below. For example, by 2012 the applicant's fleet would need to have PM filters on 30% of the heavier trucks in the fleet. This option counts 2007 model year and newer engines originally equipped with PM filters toward compliance and would reduce the overall number of retrofit PM filters needed. Any engine with a PM filter regardless of model year would be compliant until at least 2020. Beginning January 1, 2020, all heavier trucks would need to meet the requirements</td><td>Prior to Construction and During Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance. Inspect during construction.</td></tr>
</table>

<table>
<tr><th>NUMBER</th><th>MITIGATION MEASURE</th><th>TIME FRAME FOR IMPLEMENTATION</th><th>RESPONSIBLE IMPLEMENTATION PARTY</th><th>RESPONSIBLE MONITORING PARTY</th><th>MONITORING ACTIVITIES</th></tr>
<tr><td></td><td>specified in the Compliance Schedule for Heavier Trucks.

PHASE-IN OPTION FOR HEAVIER TRUCKS
Compliance Date — Vehicles with PM Filters
1-Jan-12 — 30%
1-Jan-13 — 60%
1-Jan-14 — 90%
1-Jan-15 — 90%
1-Jan-16 — 100%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>GHG-2b</td><td>Install low SF6 leak rate circuit breakers and monitoring

The applicant will ensure that any new circuit breaker installed at a substation has a guaranteed SF6 leak rate of 0.5% by volume or less. The applicant will provide Alameda County with documentation of compliance, such as specification sheets, prior to installation of the circuit breaker. In addition, the applicant will monitor the SF6-containing circuit breakers at the substation consistent with Scoping Plan Measure H-6 for the detection and repair of leaks.</td><td>Prior to Construction, During Construction, and Post Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance. Inspect during construction. Verify long-term monitoring and reporting is initiated.</td></tr>
<tr><td>GHG-2c</td><td>Require new construction to use building materials containing recycled content

The applicant will require the construction of all new substation and other permanent buildings to incorporate materials for which the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 10% of the total value of the materials in the project.</td><td>Prior to Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance.</td></tr>
<tr><td>GHG-2d</td><td>Comply with construction and demolition debris management ordinance

The applicant will comply with the County's revised Green Building Ordinance regarding construction and demolition debris as follows: (1) 100% of inert waste and 50% wood/vegetative/scrap metal, not including Alternative Daily Cover and unsalvageable material, will be put to other beneficial uses at landfills, and (2) 100% of inert materials (concrete and asphalt) will be recycled or put to beneficial reuse.</td><td>Prior to Construction and During Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance. Inspect during construction.</td></tr>
<tr><td colspan="6">Hazards and Hazardous Materials</td></tr>
<tr><td>HAZ-4</td><td>Perform a Phase I Environmental Site Assessment prior to construction activities and remediate if necessary

Prior to construction, the project proponent will conduct a Phase I environmental site assessment in conformance with the American Society for Testing and Materials Standard Practice E1527-05. All environmental investigation, sampling, and remediation activities associated with properties in the project area will be conducted under a work plan approved by the regulatory oversight agency and will be conducted by the appropriate environmental professional consistent with Phase I site assessment requirements as detailed below. The results of any investigation and/or remediation activities conducted in the project area will be included in the project-level EIR.

• A Phase I environmental site assessment should, at a minimum, include the components listed below.
• An onsite visit to identify current conditions (e.g., vegetative dieback, chemical spill residue, presence of above- or underground storage tanks).
• An evaluation of possible risks posed by neighboring properties.
• Interviews with persons knowledgeable about the site's history (e.g., current or previous property owners, property managers).
• An examination of local planning files to check prior land uses and any permits granted.
• File searches with appropriate agencies (e.g., State Water Resources Control Board, fire department, County health department) having oversight authority relative to water quality and groundwater and soil contamination.
• Examination of historical aerial photography of the site and adjacent properties.
• A review of current and historic topographic maps of the site to determine drainage patterns.
• An examination of chain-of-title for environmental liens and/or activity and land use limitations.</td><td>Prior to Construction and During Construction</td><td>Altamont Winds</td><td>Altamont Winds and County</td><td>Review project plans and specifications for compliance. Conduct surveys. Prepare and submit appropriate report. Inspect during construction.</td></tr>
</table>

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	If the Phase I environmental site assessment indicates likely site contamination, a Phase II environmental site assessment will be performed (also by an environmental professional). A Phase II environmental site assessment would comprise the following. • Collection of original surface and/or subsurface samples of soil, groundwater, and building materials to analyze for quantities of various contaminants. • An analysis to determine the vertical and horizontal extent of contamination (if the evidence from sampling shows contamination). If contamination is uncovered as part of Phase I or II environmental site assessments, remediation will be required. If materials such as asbestos-containing materials, lead-based paint, or PCB-containing equipment are identified, these materials will be properly managed and disposed of prior to or during the demolition process. Any contaminated soil identified on a project site must be properly disposed of in accordance with Department of Toxic Substances Control regulations in effect at the time. Hazardous wastes generated by the proposed project will be managed in accordance with the California Hazardous Waste Control Law (HSC, Division 20, Chapter 6.5) and the Hazardous Waste Control Regulation (Title 22, CCR, Division 4.5). If, during construction/demolition of structures, soil or groundwater contamination is suspected, the construction/demolition activities will cease and appropriate health and safety procedures will be implemented, including the use of appropriate personal protective equipment (e.g., respiratory protection, protective clothing, helmets, and goggles).				
HAZ-5	Coordinate with the Contra Costa ALUC prior to final design If wind turbines are proposed to be constructed within the Byron Airport influence area zones, the project proponent will coordinate and consult with the Contra Costa County Airport Land Use Commission (ALUC) and request review and obtain approval of the final design and placement of wind turbines. In addition, the project proponent will incorporate any ALUC recommendations in to the final design.	Prior to Construction	Altamont Winds	Altamont Winds and ALUC	Review project plans and specifications for compliance. Obtain approval, if necessary
Hydrology and Water Quality					
WQ-1	Comply with NPDES requirements Project contractors will obtain coverage under the General Construction Permit before the onset of any construction activities, because all projects will entail disturbance of 1 acre or more. A Stormwater Pollution Prevention Plan (SWPPP) will be developed by a qualified engineer or erosion control specialist in accordance with the appropriate Board's requirements for System NPDES compliance and implemented prior to the issuance of any grading permit before construction. The SWPPP will be kept onsite during construction activity and will be made available upon request to representatives of the Regional Water Boards. Compliance and coverage with the Storm Water Management Program and General Construction Permit will require controls of pollutant discharges that utilize BMPs and technology to reduce erosion and sediments to meet water quality standards. BMPs may consist of a wide variety of measures taken to reduce pollutants in stormwater and other nonpoint-source runoff. Measures range from source control, such as reduced surface disturbance, to the treatment of polluted runoff, such as detention basins. BMPs to be implemented as part of the Storm Water Management Program and General Construction Permit (and SWPPP) may include the following practices. • Temporary erosion control measures (such as silt fences, staked straw bales/wattles, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, and temporary revegetation or other ground cover) will be employed to control erosion from disturbed areas. • Use a dry detention basin (which is typically dry except after a major rainstorm, when it will temporarily fill with stormwater), designed to decrease runoff during storm events, prevent flooding, and allow for off-peak discharge. Basin features will include maintenance schedules for the periodic removal of sediments, excessive vegetation, and debris that may clog basin inlets and outlets. • Cover or apply nontoxic soil stabilizers to inactive construction areas (previously graded areas inactive for 10 days or more) that could contribute sediment to waterways. • Enclose and cover exposed stockpiles of dirt or other loose, granular construction materials that could contribute sediment to waterways.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, county, and RWQCB	Review project plans and specifications for compliance. Obtain permits. Prepare pertinent plans. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
	• Ensure that no earth or organic material will be deposited or placed where it may be directly carried into a stream, marsh, slough, lagoon, or body of standing water. • Prohibit the following types of materials from being rinsed or washed into the streets, shoulder areas, or gutters: concrete, solvents and adhesives, thinners, paints, fuels, sawdust, dirt, gasoline, asphalt and concrete saw slurry, and heavily chlorinated water. • Ensure that grass or other vegetative cover will be established on the construction site as soon as possible after disturbance. The contractor will select a combination of BMPs (consistent with Section A of the Construction General Permit) that is expected to minimize runoff and remove contaminants from stormwater discharges. The final selection of BMPs will be subject to approval by the San Francisco Bay Regional Water Board and the Central Valley Water Board. The contractor will verify that a Notice of Intent has been filed with the State Water Board and that a SWPPP has been developed before allowing construction to begin. The contractor will perform inspections of the construction area, to verify that the BMPs specified in the SWPPP are properly implemented and maintained. The contractor will notify the appropriate Regional Water Board immediately if there is a noncompliance issue and will require compliance. If necessary, the contractor or their agent will require that additional BMPs be designed and implemented if those originally constructed do not achieve the identified performance standard.				
Land Use and Planning					
No applicable measures.					
Noise					
NOI-1	Perform project-specific noise studies and implement measures to comply with County noise standards The applicant for any proposed repowering project will retain a qualified acoustic consultant to prepare a report that evaluates noise impacts associated with operation of the proposed wind turbines. This evaluation will include a noise monitoring survey to quantify existing noise conditions at noise sensitive receptors located within 2,000 feet of any proposed turbine location. This survey will include measurement of the daily A-weighted Ldn values over a 1-week period and concurrent logging of wind speeds at the nearest meteorological station. The study will include a site-specific evaluation of predicted operational noise levels at nearby noise sensitive uses. If operation of the project is predicted to result in noise in excess of 55 dBA (Ldn) where noise is currently less than 55 dBA (Ldn) or result in a 5 dB increase where noise is currently greater than 55 dBA (Ldn), the applicant will modify the project, including selecting new specific installation sites within the program area, to ensure that these performance standards will not be exceeded. Methods that can be used to ensure compliance with these performance standards include but not limited to increasing the distance between proposed turbines and noise sensitive uses and the use of alternative turbine operational modes to reduce noise. Upon completion of the evaluation, the project applicant will submit a report to the County demonstrating how the project will comply with these performance standards. After review and approval of the report by County staff, the applicant will incorporate measures as necessary into the project to ensure compliance with these performance standards.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.
NOI-2	Employ noise-reducing practices during decommissioning and new turbine construction Project applicants will employ noise-reducing construction practices so that construction noise does not exceed Alameda County noise ordinance standards. Measures to limit noise may include the following: • Prohibit noise-generating activities before 7 a.m. and after 7 p.m. on any day except Saturday or Sunday, and before 8 a.m. and after 5 p.m. on Saturday or Sunday. • Locate equipment as far as practical from noise sensitive uses. • Require that all construction equipment powered by gasoline or diesel engines have sound-control devices that are at least as effective as those originally provided by the manufacturer and that all equipment be operated and maintained to minimize noise generation. • Use noise-reducing enclosures around noise-generating equipment where practicable. • Implement other measures with demonstrated practicability in reducing equipment noise upon prior approval by the County. In no case will the applicant be allowed to use gasoline or diesel engines without muffled exhausts.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds and County	Review project plans and specifications for compliance. Inspect during construction.

NUMBER	MITIGATION MEASURE	TIME FRAME FOR IMPLEMENTATION	RESPONSIBLE IMPLEMENTATION PARTY	RESPONSIBLE MONITORING PARTY	MONITORING ACTIVITIES
Population and Housing					
No applicable measures.					
Public Services					
No applicable measures.					
Recreation					
No applicable measures.					
Transportation/Traffic					
TRA-1	Develop and implement a construction traffic control plan Prior to starting construction-related activities, the Applicant shall prepare and implement a Traffic Control Plan (TCP) that will reduce or eliminate impacts associated with the proposed program. The TCP shall adhere to Alameda County and Caltrans requirements, and must be submitted for review and approval of the County Public Works Department prior to implementation. The TCP shall include the following elements. The County and Caltrans may require additional elements to be identified during their review and approval of the TCP. • Schedule construction hours to minimize concentrations of construction workers commuting to/from the project site during typical peak commute hours (7 a.m. to 9 a.m. and 4 p.m. to 6 p.m.). • Limit truck access to the project site during typical peak commute hours (7 a.m. to 9 a.m. and 4 p.m. to 6 p.m.). • Require that written notification be provided to contractors regarding appropriate haul routes to and from the program area, as well as the weight and speed limits on local county roads used to access the program area. • Provide access for emergency vehicles to and through the program area at all times. • When lane/road closures occur during delivery of oversized loads, provide advance notice to local fire, police, and emergency service providers to ensure that alternative evacuation and emergency routes are designated to maintain service response times. • Provide adequate onsite parking for construction trucks and worker vehicles. • Require suitable public safety measures in the program area and at the entrance roads, including fences, barriers, lights, flagging, guards, and signs, to give adequate warning to the public of the construction and of any dangerous conditions that could be encountered as a result thereof. • Complete road repairs on local public roads as needed during construction to prevent excessive deterioration. This work may include construction of temporary roadway shoulders to support any necessary detour lanes. • Repair or restore the road right-of-way to its original condition or better upon completion of the work. • Coordinate program-related construction activities, including schedule, truck traffic, haul routes, and the delivery of oversized or overweight materials, with Alameda County, Caltrans, and affected cities to identify and minimize overlap with other area construction projects.	Prior to Construction and During Construction	Altamont Winds	Altamont Winds, County, and Caltrans	Review project plans and specifications for compliance. Inspect during construction.
Utilities and Service Systems					
No applicable measures.					

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Appendix B. Summary of Mortality Data in the Altamont Pass Wind Resource Area

Table B-1. Summary of Mortality Data in the APWRA

Attribute	Orloff and Flannery (1992)	Smallwood and Thelander (various reports)	Smallwood and Thelander (2005)	Smallwood and Thelander (2008)	WEST (2008)	Smallwood and Karas (2009)[a]	Ventus Environmental Solutions, Inc. (2016)	ICF (2016)	HT Harvey and Associates (2018)
Start Date	1989	March 1998	March 1998	March 1998	April 2005	October 2005	May 2012	2005	September 2016
End Date	1991	September 2002 November 2002-May 2003	September 2001	September 2002 November 2002-May 2003	February 2007	October 2007	May 2015	2013	September 2017
Total Years	2 years/6 seasons	5 years (approx.)	3.5 years (approx.)	5 years (approx.)	2 years (approx.)	2 years	3 years	8 years	1 Year (Years 2-3 pending)
Total Number of Turbines Selected	1,169	1,526/2,548	1,526	1,526/2,548	31	2,650 (approx.)	34	mean of 2,297/year (2005-2009) mean of 1,323/year (2010-2012)	48
Total Carcasses Found	182	1,162	652	1,157	56 bird casualties 4 bat casualties	4,087	Year 1 – unknown Year 2 – 66 (includes bats) Year 3 – 57 (includes bats)	5,530 (excluding bats)	332 (birds) 229 (bats)
Total Raptors/Year (adjusted)	Year 1 – 429 Year 2 - 186	1,300	835	1,127	17.8 (including incidental finds)	2,232	50 (average of Years 1-3)	595-1,084/year	112
Total Birds/Year (adjusted)	Not presented	4,721	4,272 (excl. bats)	2,710	83 (small to moderate sized birds)	9,297	210 (average of Years 1-3)	2,593-6,107/year	549
Mean Search Interval	3.5 or 7 days	53 days (set 1) 90 days (set 2)	53 days	Not Explicitly Stated	33 days	Average of 38 days	7 days and 28 days	Average of 37 days	7 days and 28 days
Search Distance	100-200 feet	50 meters	50 meters	50 meters	75 meters	50-75 meters	105 meters	50-75 meters	105 meters
Included old birds in sample?	No, birds limited to those that died within 1 week	Birds >90 days excluded	Birds >90 days excluded	Birds >90 days excluded	Remaining trial carcasses removed at end of trial period (60-64 days)	Yes	< 90 days	Yes	Birds greater than relevant survey interval (7 days or 30 days) excluded
Carcass Removal Adjustment Factor	Yes, trials conducted	Used modified values from Erickson et al. 2003	Used modified values from Erickson et al. 2003	Used values derived from meta-analysis in Smallwood (2007)	Carcass persistence trials conducted	Used values from Smallwood (2007)	Carcass persistence trials conducted in Year 2	Tracked native carcasses found during fatality surveys	Integrated searcher efficiency and carcass persistence trials conducted Year 1
Searcher Efficiency Adjustment Factor	Yes, trials conducted	Used values derived from Orloff and Flannery (1992), Erickson et al. 2003; and Johnson et al. 2002	Used values from Orloff and Flannery (1992)	Used values from Smallwood (2007)	Searcher efficiency trials conducted	Used values from Smallwood (2007)	Searcher efficiency trials conducted in Year 2	Used values from Smallwood (2007)	Integrated searcher efficiency and carcass persistence trials conducted Year 1

[a] Values presented are from 2005-2007 of the ICF fatality study period only (ICF 2010).

Appendix C. Summit Wind Repower Project Avian Micrositing Reports

CONFIDENTIALITY AGREEMENT
Summit Wind Project, Altamont Pass, California

THIS **CONFIDENTIALITY AGREEMENT** (**"Agreement"**), dated **13 December 2013** (the **"Effective Date"**), between **Altamont Winds LLC**, an Idaho limited liability company, and **Shawn Smallwood,** a sole proprietorship, each in connection with Confidential Information (as defined below) provided by it or on its behalf, a **"Discloser"** and, in connection with the Confidential Information received by it or on its behalf, a **"Recipient"**, and generically, a **"Party"**, and together, the **"Parties"**.

WHEREAS, each Party to this Agreement may be receiving from the other Party, including but not limited to, its officers, directors, partners, owners, managers, agents, employees, affiliates, subsidiaries, members or representatives, including advisors, consultants, and legal counsel (collectively, **"Representatives"**) information of a confidential and non-public nature for use by it and its Representatives in connection with its evaluation of a possible business transaction, involving the proposed Summit wind project, a repowering project located in Altamont Pass (near Livermore), California (the **"Transaction"**), and the Parties desire to protect the confidentiality of such information in accordance with the terms of this Agreement.

NOW, THEREFORE, in consideration of the mutual covenants contained in this Agreement, the Parties hereby agree as follows:

1. Confidential Information Defined. Each Party may receive certain non-public and confidential information from the other Party or its Representatives, including but not limited to, business, technical, and financial information, or other confidential or proprietary information, in each case relating to the Transaction. All such business, technical, financial or other information thus supplied and designated in writing by the Discloser as **"confidential"** is hereinafter called the **"Confidential Information"**. Information conveyed orally shall be covered hereunder to the extent designated as "confidential" at the time of such oral conveyance and reduced to writing and so designated by the Discloser within fifteen (15) calendar days of disclosure. Further, any photos or videos taken of the proposed Summit wind project and/or any related facilities shall all be defined as Confidential Information hereunder. In addition, any and all drawings, specifications, reports, studies, manuals, and/or documents (the **"Confidential Documents"**) created by either Party are all defined as Confidential Information hereunder, and shall be returned to Discloser or destroyed by Recipient within the expiration term of this Agreement pursuant to Section 6 below, except as otherwise agreed in writing.

2. Nondisclosure Obligation. The Recipient shall keep all Confidential Information received by it confidential and shall not disclose such information, in whole or in part, to any person other than its Representatives on a need-to-know basis, without the express written consent of the Discloser, provided, that each such Representative first agrees to keep such information confidential in accordance with this Agreement. The Recipient shall notify the Discloser immediately following discovery of any unauthorized disclosure of Confidential Information by it or its Representatives. The Recipient shall be responsible for any breach of the terms of this Agreement by the Recipient or any one or more of its Representatives. The Confidential Information shall be used by the Recipient solely in connection with its evaluation of a potential Transaction, and shall not be used for the Recipient's own benefit or for any other purpose. For the purpose of complying with the obligations set forth herein, the Recipient shall use efforts commensurate with those it employs for the protection of comparable sensitive information of its own, but in no case less than a reasonable degree of care.

3. Exceptions to Confidentiality. (a) This Agreement imposes no obligation upon the Recipient with respect to any Confidential Information disclosed under this Agreement that: (i) was in the Recipient's possession before receipt from the Discloser or its Representatives; (ii) is or becomes a matter of public knowledge through no fault or violation of the Recipient; (iii) is rightfully received by the Recipient from a third party who, to the Recipient's knowledge, is not under a duty of confidentiality to the Discloser; or (iv) is independently developed by the Recipient or its Representatives.

(b) The Recipient may disclose Confidential Information to the extent such disclosure is required by legal or regulatory authority; provided, however, that the Recipient shall give prompt written notice of any such request for such information to the Discloser, and agrees to provide reasonable cooperation to the Discloser, at the Discloser's expense, to the extent legally permissible and practicable, to assist Discloser with Discloser's challenge of the request or limitation of the scope thereof.

4. No Representations, No Further Obligations, and No Warranties. All disclosures made hereunder are at the sole discretion of the Discloser. It is understood that this Agreement does not obligate the Recipient to enter into any further agreements or to proceed with any potential Transaction or any other possible relationship or other transaction with the Discloser. The Discloser expressly disclaims all covenants, warranties and/or representations pertaining to the accuracy or completeness of the Confidential Information, whether express or implied, including, without limitation, implied warranties of merchantability and fitness for a particular purpose. The Discloser shall have no liability to the Recipient arising out of the use of Confidential Information supplied under this Agreement except to the extent set forth in a subsequent definitive agreement duly and fully executed by the Parties with respect to any potential Transaction.

5. Destruction of Information. The Confidential Information and Confidential Documents shall be returned to Discloser or destroyed by Recipient within the expiration term of this Agreement, as defined in Section 6 below, except as otherwise agreed in writing. Further, prior to the expiration of this Agreement, upon Discloser's written request, the Recipient shall immediately destroy (followed by written confirmation) all copies of the Confidential Information, except that one copy may be retained in the files of the Recipient's legal counsel, if required. Notwithstanding the return, retention or destruction of the Confidential Information, the Recipient and its Representatives will continue to be bound by its obligations of confidentiality and other obligations hereunder.

6. Termination. This Agreement covers only Confidential Information that is disclosed on or after the Effective Date. The Recipient's obligations with respect to the Confidential Information received under this Agreement expire on the earlier of (a) the **third (3rd)** anniversary of the Effective Date or (b) the full execution and delivery of a definitive agreement containing confidentiality provisions between the Parties in connection with any potential Transaction.

7. Notices. All notices, demands and other communications required or permitted to be given under this Agreement shall be in writing to the Parties at the respective addresses set forth below such Party's signature to this Agreement or at such other address as a respective Party may designate from time to time pursuant to a notice delivered to the other Party in the manner required herein, and shall be deemed to be made or given: when personally delivered; when given by e-mail, upon receipt of an electronic return receipt or any other written acknowledgement of receipt; or three business days after being mailed by registered or certified United States mail, postage prepaid, return receipt requested; or two business days after being delivered to a reputable express courier service for overnight priority delivery.

8. Remedies. The Recipient acknowledges that money damages may not be a sufficient remedy for any breach of this Agreement, and that, accordingly, in the event of any such breach or threatened breach, the Discloser may be entitled to seek equitable relief, including an injunction or specific performance, without prejudiced to any other rights and remedies otherwise available to the Discloser.

9. Governing Law. This Agreement is made under, and shall be construed and enforced in accordance with, the laws of the State of California, and any legal action or proceeding with respect to this Agreement shall be brought in the state or federal courts located in Alameda County, California.

10. Entire Agreement. This Agreement contains the entire understanding between the Parties with respect to the subject matter and supersedes any prior agreement or understanding with respect to the subject matter hereof.

11. No Assignment. This Agreement may not be assigned by either Party unless prior written consent is obtained from the other Party.

12. Counterparts. This Agreement may be signed in counterparts, each of which may be deemed an original, and all of which together constitute one and the same agreement.

13. Authorization and Binding Obligations. Each Party represents to the other Party that the execution, delivery and performance of this Agreement have been duly authorized, and this Agreement has been duly executed and delivered by the signatory so authorized, and the obligations contained herein constitute the valid and binding obligations of such Party.

14. Non-Waiver. Waiver by either Party of any breach or the failure by the other Party to enforce any of the provisions of this Agreement at any time shall not in any way affect, limit or waive the right of either Party thereafter to enforce and compel strict compliance with each and every condition hereof.

15. Severability. If any one or more provisions of this Agreement are determined to be invalid, illegal or unenforceable in any respect, the remaining provisions of this Agreement shall remain in effect and shall not be affected.

16. Waiver of Trial by Jury. Each Party hereto hereby knowingly, voluntarily and intentionally waives the right such Party may have to a trial by jury with respect to any litigation based hereon, or arising out of, under or in connection with this Agreement. This provision is a material inducement for the Parties entering into this Agreement.

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IN WITNESS WHEREOF, the Parties have executed this Agreement on the date first written above.

ALTAMONT WINDS LLC

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CONFIDENTIAL

EARLY ASSESSMENT OF WIND TURBINE LAYOUT IN SUMMIT WIND PROJECT

K. Shawn Smallwood

11 August 2014

Altamont Winds LLC ("AW") requested my assessment of its proposed wind turbine layout as part of its Summit Wind project. The Summit Wind project would replace about 400 KCS56-100 KW wind turbines with about 30 2.1 MW modern wind turbines. I visited the proposed wind turbine sites several times during January through April 2014, each additional time in response to changes made by AW to the project layout, some changes proposed by me to reduce avian hazards. I rated proposed wind turbine addresses for collision hazard, similar to how the Alameda County Scientific Review Committee ("SRC") rated turbines in 2007 through 2009. My ratings differed from the SRC's ratings by not considering collision hazard posed by the status of adjacent wind turbines, because the new turbines will be much farther apart. I also allowed the ratings to vary continuously from 0 (lowest hazard) through 10 (highest hazard). Another difference between my ratings and those of the SRC was that I was more knowledgeable about golden eagle collision risk than I was in 2007 to 2009, as I have since developed predictive models of collision risk, I have validated the models to some extent, and I have since spent many hours observing golden eagle flights in the Altamont Pass Wind Resource Area ("APWRA") as part of directed research to develop improved predictive models.

I am confident that the Summit Wind project will reduce the average number of golden eagle fatalities per year in the APWRA. Only one wind turbine will operate in Summit Wind for every 21 turbines that operated between the 1980s until now. Furthermore, the new wind turbines will shift the rotor–swept areas to higher off the ground, from a range of 9.3 to 33.4 m above ground among the old 100-KW wind turbines with an 18 m rotor diameter on 18.3 m and 24.4 m towers to a range of 41.5 m to 138.5 m above ground among the new wind turbines with a 97 m rotor diameter on 90 m towers. The greater height above ground should reduce collision rates. Also, repowering will provide the opportunity to more carefully site the turbines. Given the experience of the repowered Buena Vista Wind Energy Project and the Vasco Winds Energy Project, there is no reason to expect that Summit Wind will cause the same level or increased golden eagle fatalities. However, repowering cannot prevent all golden eagle fatalities, as the project area is heavily used by golden eagles.

The Summit Wind project area happens to be used intensively by golden eagles for foraging and social interactions. Golden eagles of all age groups fly in this area. Given the level of golden eagle activity in the project area, it should be expected that golden eagles will collide with the new wind turbines in Summit Wind. A bald eagle was also taken by a KCS56-100 turbine nearby the proposed turbine address 25, so there will be some potential for taking additional bald eagles, as well. However, the collision rate in the new project should be lower than it has been since the 1980s, and I believe that I can help minimize the collision rate to the degree possible by helping to site the wind turbines where golden eagles less often fly or less often perform behaviors suspected to associate with collisions.

During my first two visits to the project site, I found some wind turbines were planned where the topography would deflect winds, such as within ridge saddles and at the apices of concave slope features declining to the southwest or northwest (the prevailing wind directions). Deflected (or funneled) winds can destabilize golden eagle flights, and the loss of flight control can contribute to wind turbine collisions. Ridge saddles are also often used as passage points by golden eagles crossing ridges or ridge crests. I recommended that all wind turbines in ridge saddles be relocated, and that wind turbines at the apices of concave slope features declining southwest or northwest be shifted away from the aspect of the slope that faces the deflected winds, if possible.

Some wind turbines were also planned for breaks in slope. I recommended that these turbines be relocated because golden eagles often target breaks in slope for crossing ridge features. Related to breaks in slope as a hazard, I also examined proposed wind turbine sites for likely changes to the local topography that will be caused by grading for access roads and turbine pads. The grading can create breaks in slope, which would be best minimized or avoided by AW. In Table 1, I noted where I thought the grading could create collision hazards.

My recommendations on the initial turbine sites were communicated to AW by telephone because AW often had engineers either in the field or at the planning table making adjustments while I was on site. AW was responsive to my earlier recommendations, having since relocated wind turbines that I initially rated 9, 9.5, and 10. My current recommendations go to the turbine sites as they were planned on 24 March and 8 April 2014 (Table 1). I am certain that this more recent layout would be safer to golden eagles than would have been the layout prior to my site visits and AW's decisions to relocate turbines. However, two of the new sites could take disproportionate numbers of eagles, and those would be 32 and 33.

In Table 1, I also cautioned against sites where the SRC rated old-generation wind turbines high for collision hazard. An example was turbine 19 (as of 24 March 2014), where the SRC rated all of the old turbines on that knoll 8.5 out of 10. In my opinion, a modern wind turbine on that knoll will present less of a hazard to golden eagles than did the earlier wind turbines, but AW will still have to be concerned about how the SRC will react to a wind turbine proposed at this site.

Some of the proposed wind turbine sites were difficult for me to predict golden eagle collision rates. Turbine 19, again, was a good example of a topographic setting that left me wondering what the impact might be. Other examples were turbines 1, 2, 3, 8, and 18. Turbines 8 and 19 were planned for the peaks of knolls, which are where I would normally recommend turbines, but these knolls are lower than the larger ridge structures to the west. Golden eagles crossing the ridges from the west will have had to achieve a minimum altitude to clear the ridge structures, and the subsequent flight paths could put them at the same altitude as the rotor planes of these turbines unless the eagles decide to ascend or descend prior to reaching the turbines. Turbines 1 and 18 are near the intersections of ridge features with larger topographic features just to the north. I suspect that eagles might cross the ridges at these intersections, but I am unsure about the levels of collision risk at these locations. Turbines 2 and 3 are low on the slope, which I normally would recommend against, but these turbines are low on the eastern slope of a large hill. I am unsure about the collision risk posed by these turbines.

Where I am less confident in my risk assessments, the pending collision hazard models might help. My GIS analyst and I are nearly ready to develop map-based collision risk models based on the directed behavior surveys being performed across the APWRA, including at multiple behavior stations located within the Summit Wind project area. We have finished measuring slope attributes in 25 million analytical grid cells overlayed on a digital elevation model of the APWRA, although there are two additional measurements that we agreed should be made. It is possible that we will have a model prepared within the next one to two months. The model will support the locations where my ratings of collision hazard were relatively low, and it will add confidence to hazard predictions applied to other wind turbines.

Where I saw opportunities for safer siting, I made recommendations in Table 1. Another approach to reducing collision hazard would be to use a larger wind turbine so that fewer sites need to be used.

I need to caution that my assessment was focused on golden eagle collision hazards. I made a few notes about potential hazards to red-tailed hawks, but I really did focus on golden eagles.

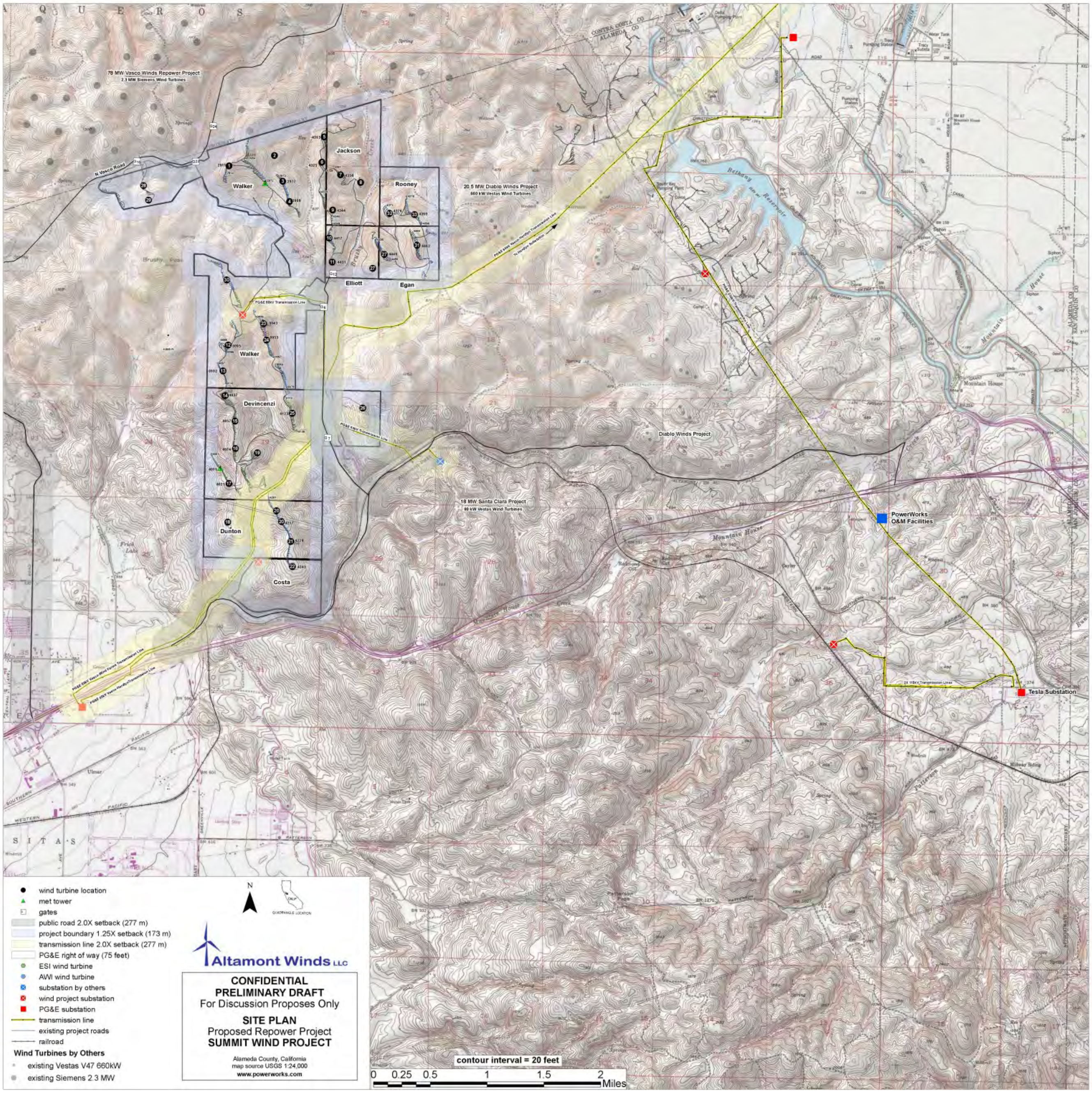
Bat fatalities could also emerge as an issue, especially around the larger hills at turbine addresses 1 through 4, and Alt30. On the other hand, the old-generation wind turbines might already be taking bats at rates that are similar to rates that would be noticed on the larger pads and access roads of modern wind turbines. More research is needed on bat impacts at old and new wind turbines.

In summary, turbines 17, 32, and 33 will probably be implicated with disproportionate numbers of eagle fatalities due to the terrain settings in which they would be installed. I cannot recommend these sites. Turbine 18 could also be a problem for the same reason, but I remain unsure about it. Turbine Alt28 also poses high collision hazard based on topography, although eagle activity has not been as intense here as at the other turbines already mentioned in this paragraph.

Table 1. Early assessment of proposed wind turbine locations in the Summit Wind project, including hazard ratings and recommendations and comments on the proposed locations. I worked with several site plans as the project layout evolved, but the addresses below refer specifically to the layout of 7 April 2014, which is attached as an Exhibit below.

Address	Rating	Recommendation/Comment
1	7	Within slight break in slope/d/saddle. Move south 20 m.
2	7	Low on slope on east side of large hill
3	8	Knoll by often-used saddle. Move E-SE to max 30 m.
4	5	Gently declining ridgeline. Minimize cut in slope due grading.
5	7.5	Will cut slope of narrow ridge in between saddle (east) and NW concave slope (west). Move upslope 40 to 60 m.
6	7	Near major saddle, though on local crest
7	8	Catches southwest winds
8	7.5	Lower terrain; heavy eagle traffic through here.
9	7.5	Knoll between saddles at apices of concave slopes. Move to 4343 or 4340
10	5	Knoll, but low terrain
11	7	Low terrain near trees; likely problem for red-tailed hawks
12	8	N side of heavily used saddle. Move N to middle of peak.
13	8.5	N side of saddle. Intense eagle activity. Move N to peak.
14	7	Peak, but intense eagle activity here
15	7	Peak, but intense eagle activity here
16	6.5	Local ridge crest, but near major saddle.
17	9.5	Next to saddle that is intensely used by eagles.
18	7	Low terrain near break in slope
19	8.5	Peak downwind of major saddle. Intense traffic through here. All turbines removed from hill were rated 8.5 by SRC.
20	4	No issue.
Alt 20	7.5	Local peak within complex saddles. Move south to knoll.
21	6.5	Local peak between two saddles
22	4	No issue.
23	6.5	Slight grade; will cut into south side of slope
24	5	No issue.
25	5	No issue.
26	6	On peak, but near saddle. Move 20 m south.
Alt 27	8.5	Saddle. Move north to local ridge crest.
Alt 28	9	Break in slope. Move to bench nearer Vasco Rd.
Alt 29	7.5	Near break in slope. Move 10 m north to old pad.
Alt 30	8.5	Apex of SW concave slope and near rock formations and trees.
27	7	Peak, but intense eagle activity here
31	7	Peak, but intense eagle activity here
32	9.5	Low on declining east-west ridge, immediately west of north-south saddle crossing. Intense eagle use observed here.
33	9	Just west of saddle atop SW slope. Intense eagle traffic here.

EXHIBIT 1: Site Plan



SITING WIND TURBINES TO MINIMIZE RAPTOR COLLISIONS AT SUMMIT WINDS REPOWERING PROJECT, ALTAMONT PASS WIND RESOURCE AREA

K. Shawn Smallwood and Lee Neher

8 December 2016

EXECUTIVE SUMMARY

Map-based collision hazard models were prepared as a set of tools to help guide the careful siting of proposed new wind turbines as part of the repowering effort at Summit Winds in the Alameda County portion of the Altamont Pass Wind Resource Area (APWRA). Similar collision hazard models were prepared for the Tres Vaqueros and Vasco Winds repowering projects in Contra Costa County and for the Patterson Pass, Golden Hills, Golden Hills North and Sand Hill repowering projects in Alameda County. After three years of fatality monitoring following construction, it was found that the repowering of Vasco Winds reduced fatalities of raptors as well as all birds as a group. This newest set of models for Summit Winds benefit from the lessons learned at Vasco Winds, as well as from many additional data collected through 2015 and the emergence of dependent variables and predictor variables that we believe result in superior collision hazard models. The new models were derived from an additional four years of fatality monitoring data, including monitoring with much shorter fatality search intervals at repowered, modern wind turbines as well as at some old-generation wind turbines. And like the models developed for Sand Hill and Golden Hills North, the golden eagle collision hazard model was partly derived from GPS/GSM telemetry data transmitted by golden eagles (*Aquila chrysaetos*) flying within the APWRA.

Our collision hazard model for golden eagle was derived from 121,259 GPS/GSM telemetry positions within the APWRA, from thousands of behavior records made during visual scans across many stations in the APWRA 2012 through 2015, and from fatality rates at monitored wind turbines from 1998 through 2015. Our collision hazard models for red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) were derived from thousands of behavior records and from estimates of fatality rates at wind turbines. Our collision hazard model for burrowing owl (*Athene cunicularia*) was derived from 5 years of burrowing owl surveys in 46 plots located throughout the APWRA, as well as from estimates of fatality rates at wind turbines.

Based on our models, we predict fatality reductions of golden eagles, red-tailed hawks, American kestrels, burrowing owls and all birds as a group. Given the airspace that will be opened up to safe golden eagle traffic, we believe the golden eagle fatality rate will lessen even though collision risk is predicted to be relatively high at some turbine locations. American kestrel fatalities will likely lessen due to the elimination of the many small wind turbines that not only caused collision fatalities but also entrapped kestrels in hollow tubes of the lattice towers and within the turbine machinery. Burrowing owl fatalities should decline by at least 90%. Based on our experience at Vasco Winds, the fatality rates of bats might increase from the old wind turbines at Summit Winds. However, the fatality monitoring performed at Summit Winds was inadequate for detecting bat fatalities so it will be difficult to determine the repowering project's effects on bats.

INTRODUCTION

Salka LLC plans to install up to 26 wind turbines as part of its Summit Winds repowering project in the Alameda County portion of the Altamont Pass Wind Resource Area ("APWRA"), California. Careful siting of wind turbines is one of the principal measures available to minimize raptor fatalities caused by collisions with the turbines (Smallwood and Thelander 2004, Smallwood and Karas 2009, Smallwood and Neher 20010a,b, Smallwood et al. 2016). The objective of this approach is to carefully site new wind turbines to minimize the frequencies at which raptors of various species encounter the wind turbines while flying, but most especially while performing specific types of flight behaviors, such as golden eagles chasing or fleeing other birds or flying low across ridge-like topographic features, or red-tailed hawks or American kestrels hovering or kiting in deflected updrafts. In this study we developed simple Fuzzy Logic (FL) models (Tanaka 1997) of raptor activity quantified from behavior data collected across the APWRA between 13 November 2012 and 29 October 2015, and at behavior studies performed at Sand Hill sites between 30 April 2012 and 5 March 2015 and Patterson Pass between 15 October 2013 and 24 September 2014. The behaviors used in the modeling effort were derived from the results of Smallwood et al. (2009b), and an example application of the FL modeling approach can be seen in Smallwood et al. (2009a, 2016).

The Fuzzy Logic approach is a rule-based system useful with noisy data or with zero-dominated data sets, and is applied to events occurring within classes that are assumed to have graduated rather than sharp boundaries (Tanaka 1997). The rules consist of assigning likelihood values of an event occurring, which in the case of this study would be the likelihood of a bird performing a specific behavior within a cell of an analytical grid laid over the project area. Likelihood values can range 0 to 1 for each predictor variable, depending on how far a value of the predictor variable differs from the mean where the event has been recorded. The magnitude of each deviation from the mean is assessed by the analyst based on error levels, data distribution, and the analyst's knowledge of the system. In our case, the events were of birds flying over terrain characterized by suites of slope conditions, or of fatalities at wind turbines associated with specific slope conditions, or of burrowing owl burrows associated with specific slope conditions.

The study goal was to accurately predict the locations where golden eagles, red-tailed hawks, American kestrels and burrowing owls are most likely to perform flight behaviors putting these species at greater risk of collision with wind turbines, so that new wind turbines can be sited to avoid these locations to the degree reasonably feasible. Achieving this goal depended on our understanding of how these species use terrain and wind, and how they perceive and react to wind turbines. It also depended on understanding patterns of fatality rates in the APWRA, so we also developed fatality rate models for golden eagle, red-tailed hawk, American kestrel, and burrowing owl. Our model results were interpreted in tandem with Smallwood's familiarity with conditions associated with proposed wind turbine locations. By carefully siting the wind turbines to minimize collision risk, the Summit Winds project should prove safer to raptors than the wind turbines being replaced. The Summit Winds micro-siting also benefits from what was learned at the Vasco Winds repowering project, which was micro-sited using a similar approach and monitored for collision fatalities for three years (Brown et al. 2013, 2014, 2016).

Our map-based models are intended to help guide micro-siting. The models are only as predictive as our understanding of wind turbine collisions and our ability to measure terrain features bearing on collision risk. Although research and monitoring efforts in the APWRA have set the pace worldwide (Orloff and Flannery 1992, Smallwood and Thelander 2008, Smallwood et al. 2009b, Brown et al. 2016, ICF International 2016), there remains considerable uncertainty over collision mechanisms. Certain behavior patterns correlate with collision fatality rates (Smallwood et al. 2009b), but correlations are often confounded by the unmeasured, unobserved factors. And whereas we know that collision risk is influenced by interactions between landscape and wind, wind turbine micro-siting cannot be guided by anything more detailed than measurable terrain features and prevailing wind directions. Assuming that the prevailing wind directions are primarily from the southwest and secondarily from the northwest, and assuming that the avian behavior and fatality data reflect these prevailing wind directions, we weighted terrain features for collision risk based on whether wind turbines would be sited on or atop them. However, when the wind shifts directions to the northeast or from the southeast, as examples, then the birds shift their activity patterns and collision risks also change. There is no way for us to micro-site wind turbines to minimize risk posed by all wind directions.

As another example of the limitations of our models, we examined the locations of golden eagle model prediction failures – sites of existing or past wind turbine sites where collision risk was predicted lowest but where fatality rates were relatively high. A pattern that quickly emerged from these sites was their occurrence on steeply declining ridge features, which is a terrain condition that we have not measured and could not incorporate into a model. We measured slope (elevation change relative to distance change) within analytical grid cells and across entire slope faces from valley bottom to ridge crest, but we did not measure slope along ridge features because this measurement did not occur to us until examining the model prediction failures. If we had another month to prepare collision hazard models, we could measure and use ridgeline slopes. Of course, any remaining model prediction failures would likely lead us to additional as-yet-unmeasured terrain features. Our models express our current understanding and ability to measure collision factors, and should be interpreted in combination with expert opinion.

Assumptions and limitations aside, we feel that this iteration of collision hazard models in the APWRA qualifies as our best and most predictive. We recommend siting the new wind turbines as far as reasonably feasible from hazard classes 3 and 4, but we also recommend considering expert input on the siting of each wind turbine to account for factors not considered in the models. As a general rule, we recommend not siting wind turbines in relatively low terrain, or in ridge saddles, breaks in slope or on terrain located east (prevailing downwind) of major ridge saddles or breaks in slope.

METHODS

On-site Assessments

One of us (Smallwood) visited the proposed repowering project area to assess the collision hazard associated with proposed wind turbine sites. Smallwood visited the sites proposed in the initial layout in 2014, and except for turbine 28, he visited the sites proposed in the most recent layout in October 2016. Smallwood rated collision hazard on a scale of 0 to 10 using criteria adopted by the Alameda County Scientific Review Committee in 2007/2008 and 2010. He recommended changes to the original turbine layouts prior to the development of collision hazard models.

Predictive Models

Multiple types of data were needed to develop collision hazard models. For developing collision hazard models of golden eagle, red-tailed hawk, and American kestrel, flight behavior data were collected and then related to terrain. For golden eagles, we also made use of GPS/GSM telemetry data collected from 18 golden eagles fitted with transmitters and flying over portions of the Altamont Pass Wind Resource Area (Bell and Nowell 2015). For burrowing owls, we recorded burrow locations and later related them to terrain. For all four raptor species, we estimated fatality rates among individual wind turbines monitored throughout the APWRA and over various time periods since 1998. And of course the terrain needed to be measured, and this was done using imagery, digital elevation models, and geoprocessing steps to bring objectivity to decisions about where a slope transitions from trending towards concavity to trending towards convexity, as an example. All of these data and the steps used to integrate them are covered in the following paragraphs. We begin with the biological survey data before describing the development of our digital elevation model (DEM) and terrain measurements, but we present the methods used for processing the GPS/GSM telemetry data until after the section on terrain measurements because we relied on our terrain measurements to screen the telemetry data for inclusion in the analysis.

Behavior data

Culminating 14 years of behavior surveys and utilization surveys in the APWRA (Smallwood et al. 2004, 2005, 2009b,c; Smallwood 2013), a new methodology was developed for behavior monitoring to benefit the development of wind turbine collision hazard models. The earlier behavior surveys recorded avian behaviors that were unmapped (Smallwood and Thelander 2004, 2005; Smallwood et al. 2009b), so no spatial analysis was possible. The mapping of bird locations emerged in 2002, but the 2002 approach was integrated with utilization surveys that were focused primarily on counting birds to estimate relative abundance. This mixing of objectives impinged on both objectives – on both the counting of birds and the mapping of their behavior patterns. On-the-minute mapping of bird locations and behaviors yielded only crude spatial patterns for only a few site-repetitive behaviors such as perching, kiting and hovering. After comparing use rates to fatality rates and seeing no significant spatial or inter-annual relationships between the two rates, it was decided to focus more on the behavior patterns to predict collision hazards. New methods were formulated to map flight behaviors.

We gathered behavior data from 15 stations at Sand Hill, 9 stations in Patterson Pass, and 36 stations across the rest of the APWRA, the latter of which were funded by NextEra as mitigation for the Vasco Winds repowering project (Figure 1). Of the 36 stations funded by NextEra as mitigation, 21 were selected from those that had been ranked from 1st through 30th in order of the number of first observations per hour per km^3 of visible airspace out to the maximum survey radius at each station during use surveys performed by the Alameda County Avian Monitor from 2005 through 2009. To these 21 stations we added another 15 to Vasco Caves Regional

Preserve, Northern Territories, Vasco Winds Energy Project, and the Buena Vista Wind Energy Project in Contra Costa County, where the Alameda County Avian Monitor had little coverage. The 15 stations at Sand Hill were optimized to observe how golden eagles and other raptors behave in the airspace around Ogin's before-after, control-impact (BACI) experimental treatment plots designed to test the avian safety of a new wind turbine model that was ultimately not installed. Seven of the NextEra mitigation stations happened to be located within the Summit Winds project, and another station was located just outside the project boundary.

Behavior sessions at Sand Hill lasted 30 minutes each, and elsewhere they lasted 1 hour each. Between 30 April 2012 and 5 March 2015 there were 2,002 surveys completed for 1,001 hours (126,084 birds tracked). The maximum survey radius depended on the printed map image extent and how far the observer felt comfortable estimating the bird's spatial location and height above ground. Map extents rarely permitted survey distances of >300 m. One of us (Smallwood) recorded all of the behavior data within Patterson Pass, and additional behavior data were collected at NextEra mitigation sites by Smallwood, Erika Walther, Elizabeth Leyvas, Skye Standish, Brian Karas, and Harvey Wilson.

The 9 Patterson Pass stations were surveyed 167 times (167 hours) from 15 October 2013 to 24 September 2014 (5,712 birds tracked). The 36 NextEra mitigation stations were surveyed 928 times (928 hours) from 13 November 2012 through 29 October 2015 (27,552 birds tracked). Between all three studies, 2,096 hours of behavior surveys (159,348 birds tracked) provided the data used for developing collision hazard models reported herein.

Each bird was recorded onto image-based maps of the survey area as point features connected by vector lines depicting the bird's flight path (Figures 2-5). Height above ground, behavior, and time into the session was recorded into Tascam digital voice recorders fitted with windjammers designed to reduce noise buffeting by high winds. Point features were recorded as often as the observer could record attribute data into the voice recorder. One objective of the behavior sessions was to obtain high quality flight paths and summaries of flight behaviors of individual birds using the surveyed airspace, and it was notably not to count birds, although it was likely that just as many raptors were recorded as would have been counted based on the use survey protocols.

Another objective of the behavior surveys was to learn how birds interact with wind turbines when they approached the wind turbines. Special attention was given to the bird's flight whenever it flew within 50 m of a wind turbine and, in the opinion of the observer, faced the possibility of colliding with the wind turbine. During this time, the bird's approach angle to the turbine was recorded, as well as any changes in flight direction, flight height, behavior, interactions with other birds, and the wind turbine's operating status. Whenever special attention was directed to such flights, the flight observation was termed an "event," or a wind turbine interaction event.

At the start of each behavior session, the observer identified which wind turbines in the survey area were operating, as well as temperature, wind direction, average and maximum wind speed, and percentage cloud cover. Behavior data were transcribed to electronic spreadsheets within 24 hours of collection. Mapped bird location points and line features representing the bird's flight path were then digitized into the GIS.

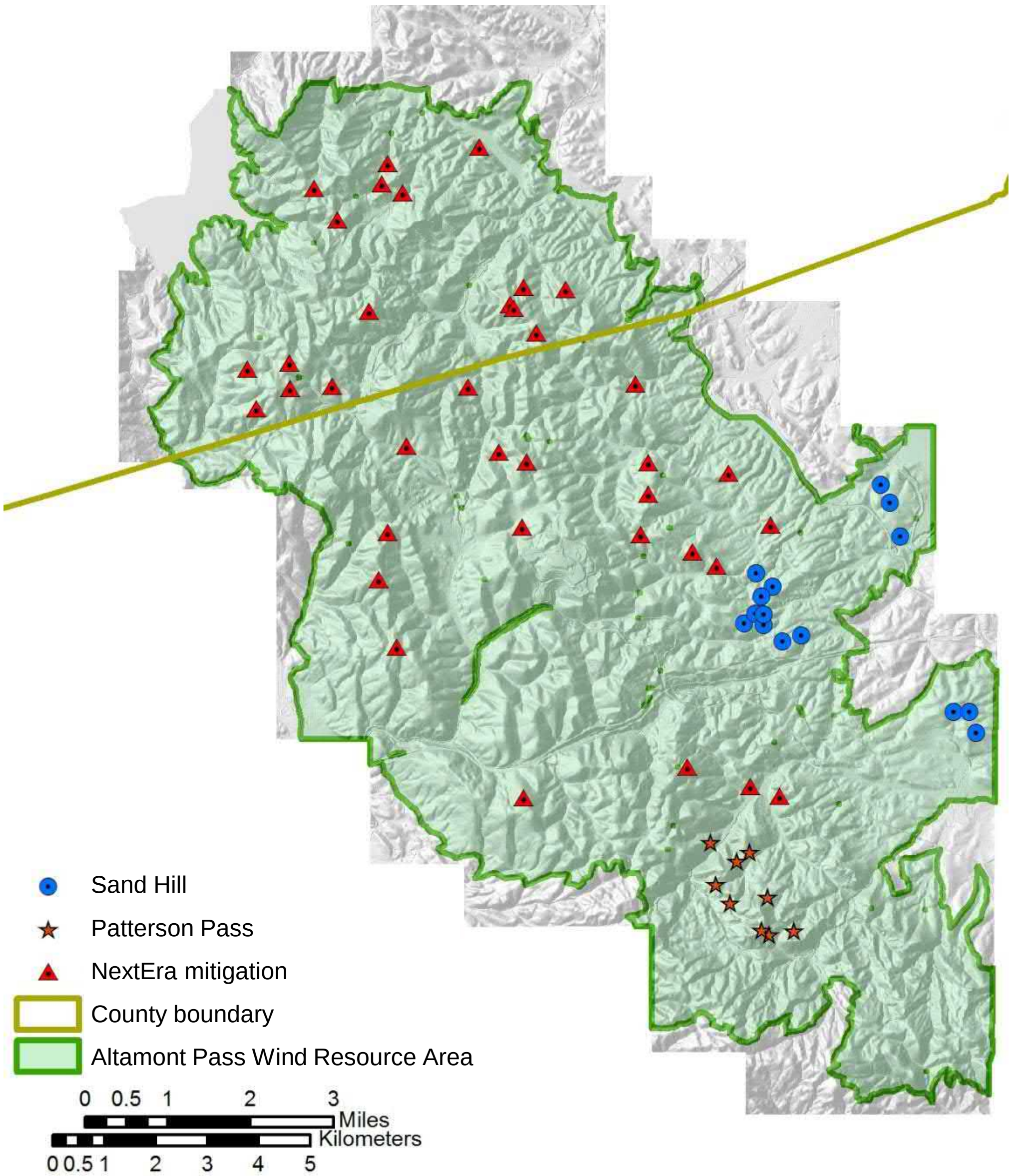


***Figure 1**. Locations of behavior observation stations used for 30 min and 60 min visual scans to track individual birds and record behaviors and flight heights along the way.*

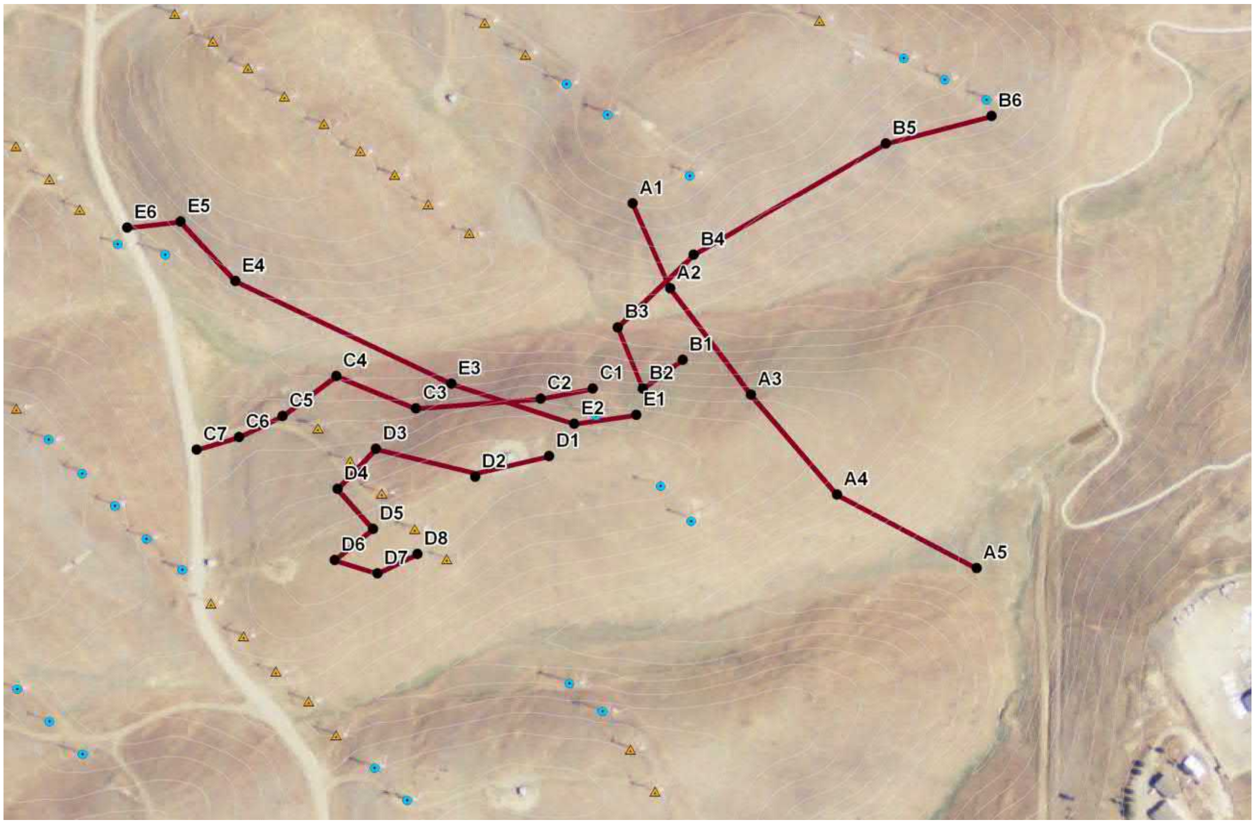


Figure 2. *Example of how birds were tracked visually during behavior surveys. Flight attributes were recorded at points, which were later connected by line segments representing a flight path. In this case 5 flight paths were recorded, A through E, and at each number associated with a point we also recorded behavior, height above ground, social group size and, when appropriate, wind turbine events. For example, D4 would likely have involved a wind turbine event*.

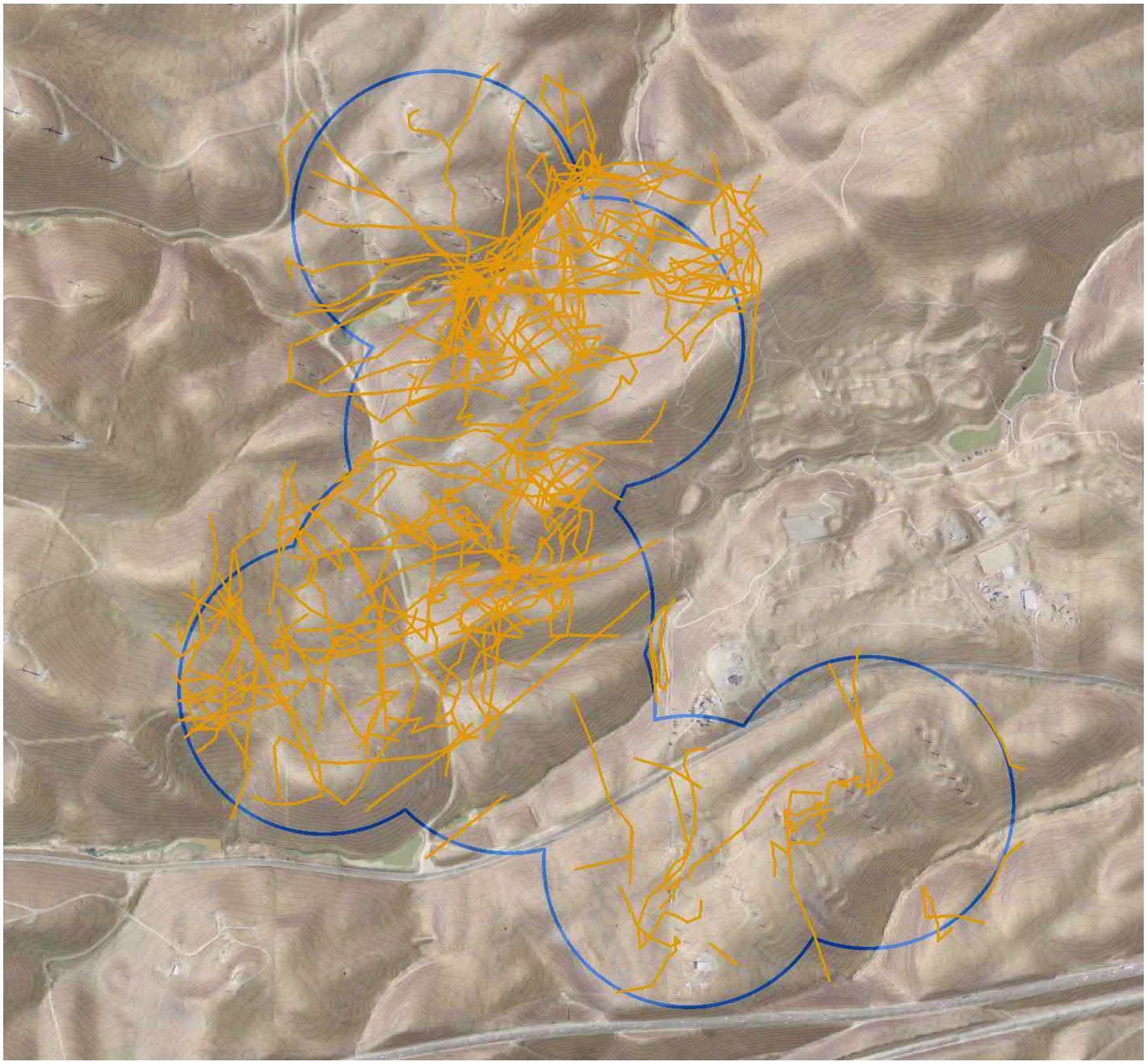


***Figure 3**. Golden eagle flight paths recorded during 3 years of visual scans for behavior patterns within a portion of the Sand Hill project area, 2012-2015.*

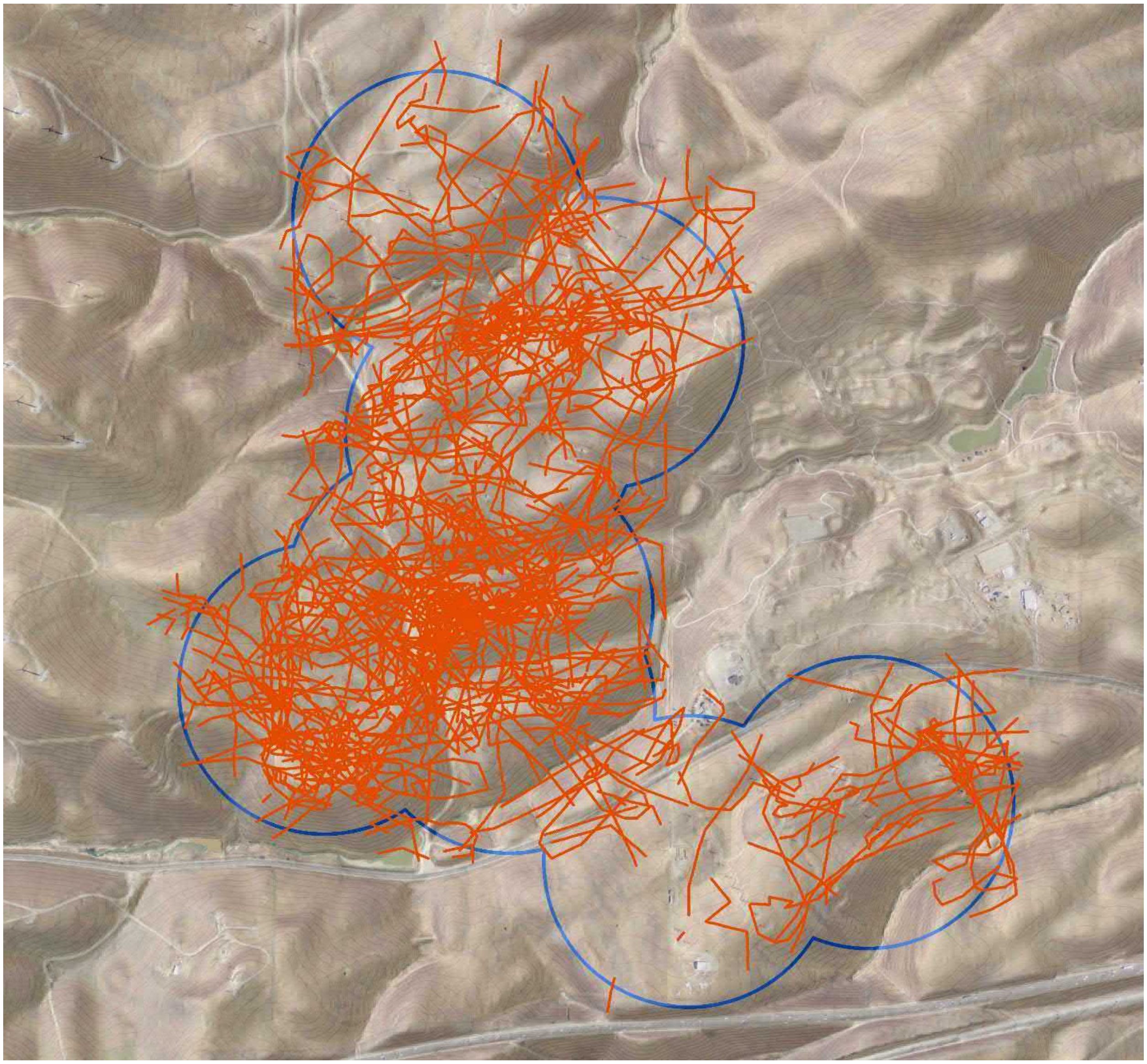


Figure 4. *Red-tailed hawk flight paths recorded during 3 years of visual scans for behavior patterns within a portion of the Sand Hill project area, 2012-2015.*

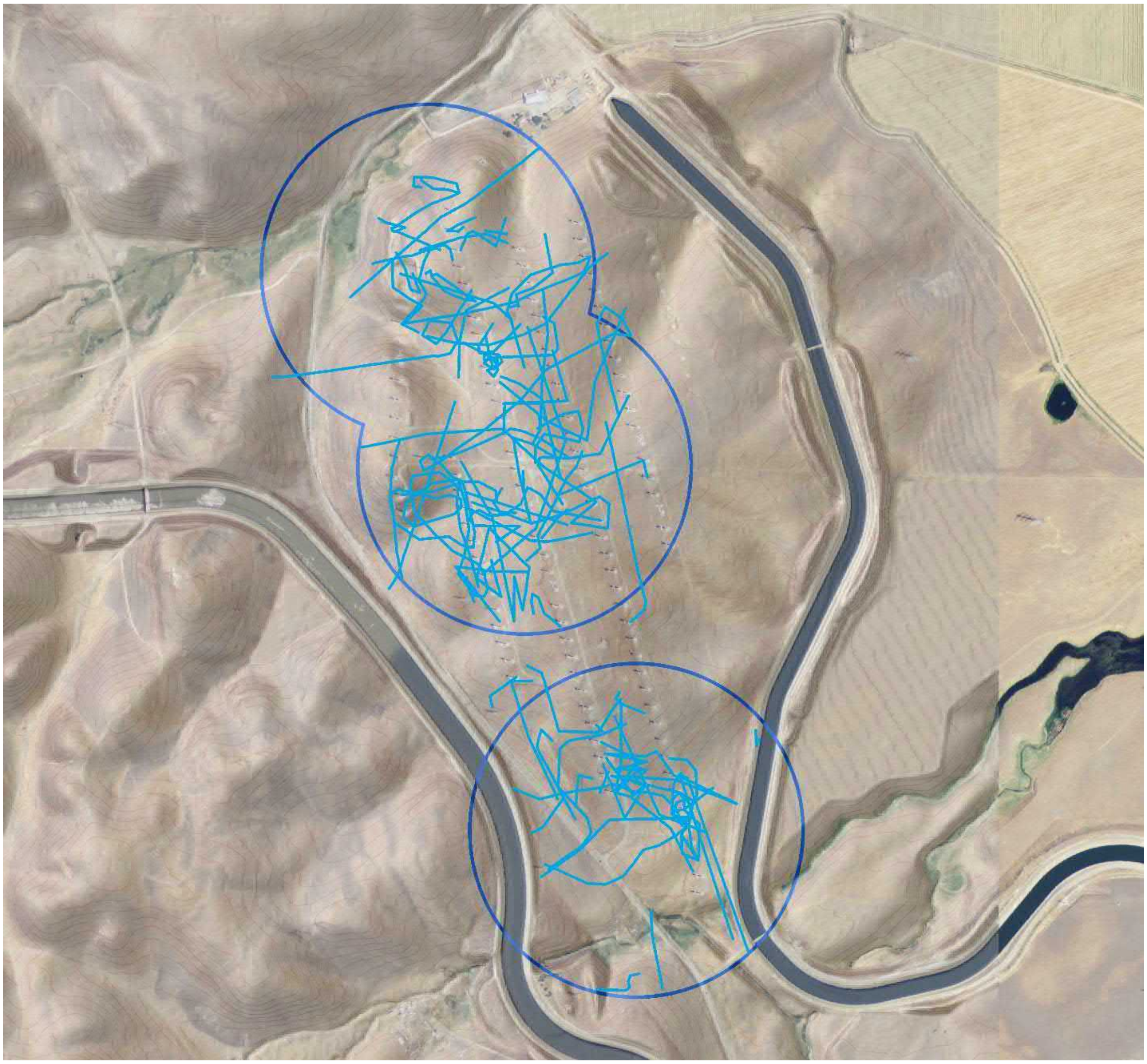


Figure 5. *American kestrel flight paths recorded during 3 years of visual scans for behavior patterns within a portion of the Sand Hill project area, 2012-2015.*

Burrowing owl burrows

Burrowing owl burrows (Figure 6) were mapped in sampling plots throughout the APWRA using a Trimble GeoXT GPS, both during the nesting season (Smallwood et al. 2013) and throughout the year in 2011 (Figure 7). Additional burrow mapping efforts were made in follow-up visits during breeding seasons of 2012-2015. Most of the burrows that were mapped were nest burrows, but refuge burrows were also included in the data pool. No satellite burrows (alternate nest burrows) were used in the analysis because satellite burrows are merely nearby extensions of nest burrows.

***Figure 6**. Example of a burrowing owl nest burrow, including an adult (top) and chicks.*

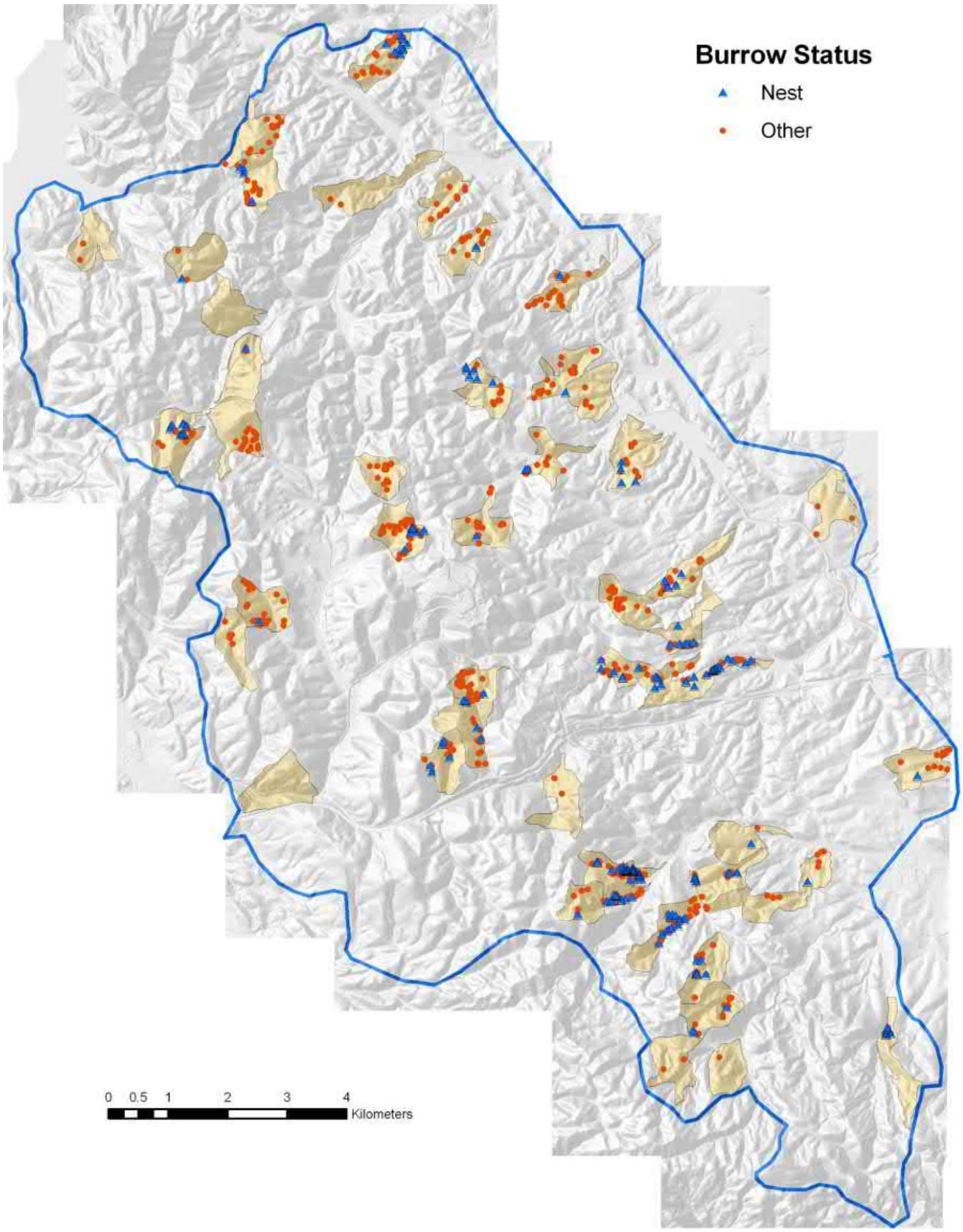


***Figure 7**. Burrowing owl sampling plots (tan color) and 2011 nest and refuge burrow locations (as examples) within the Altamont Pass Wind Resource Area (blue polygon).*

Fatality rates

We estimated annual fatality rates at all old generation wind turbines that were searched at least one year between the years 1998 through 2011 in the APWRA. All fatality rates were adjusted for search detection and carcass persistence rates that were averaged among wind projects where trials were performed in similar grassland environments as compared to the APWRA (see Smallwood 2013). Fatality rates were also adjusted for variation in the maximum search radius around wind turbines (Smallwood 2013). Finally, we adjusted fatality rates for monitoring duration to account for a potential bias warned about in Smallwood and Thelander (2004:App. A). This bias is actually two biases in one, and it applies more to comparing fatality rates among individual wind turbines than it does to wind projects. The adjustments are shown in Figure 8.

Going to the first portion of the bias, as the number of fatalities is averaged into more years of survey effort, the resulting ratio of fatalities to years will decrease inversely with increasing number of years for some turbines where fatalities were found, simply because a relatively constant numerator (number of fatalities) is divided by a constantly changing denominator (years). If an eagle fatality is found at a wind turbine monitored over one year, the fatality rate would be 1 eagle death per year, but if this turbine is monitored over 10 years and no more eagle fatalities are found, then the fatality rate would be 0.1 eagle deaths per year. At a wind turbine monitored over 10 years, the measured rate should be regarded as reasonably reliable. But a fatality rate of 1 eagle per year measured at a wind turbine monitored only over 1 year should be regard as much less reliable because it remains unknown whether additional eagle fatalities would be found at that turbine had it been monitored over more years. Monitored over 10 years, this turbine might yield a fatality rate of 1 or more eagle deaths per year or only 0.1 eagle deaths per year, an uncertainty range of 10-fold or greater.

Going to the second portion of the bias, some fatality rates will represent false zeros where wind turbines were monitored for only one or a few years and no fatalities were found. Assuming a golden eagle fatality rate of 0.1 deaths per MW per year and assuming for this example that fatality risk is equal among 100-KW wind turbines in a project area, then the monitoring duration sufficient to register a single golden eagle fatality at the average wind turbine would be 100 years. A reasonable assumption would be that false zeroes are common for golden eagle fatality rate estimates in the APWRA. This bias, or both biases together, was partially corrected by fitting an inverse function to the data, and then multiplying the ratio of observed to predicted values by the predicted value at 10 years of monitoring (Figure 8). In other words, all fatality rates at individual wind turbines were adjusted to a common 10-year period of monitoring, even if they had been monitored only one year, 4 years, or 10 years, etc. (We note that the fatality rate metric in this case excluded the turbine's rated capacity, MW.) Our adjustment reduces the magnitude of mathematical artefact caused by high fatality rates at wind turbines monitored briefly, but it does not adjust for false zeroes at wind turbines monitored briefly.

Fatality rates adjusted for duration of monitoring were related to terrain measurements and terrain features to identify associations useful for developing predictive collision hazard models. The terrain features and terrain measurements used were those associated with the wind turbines where fatality rates had been recorded (Figure 9).

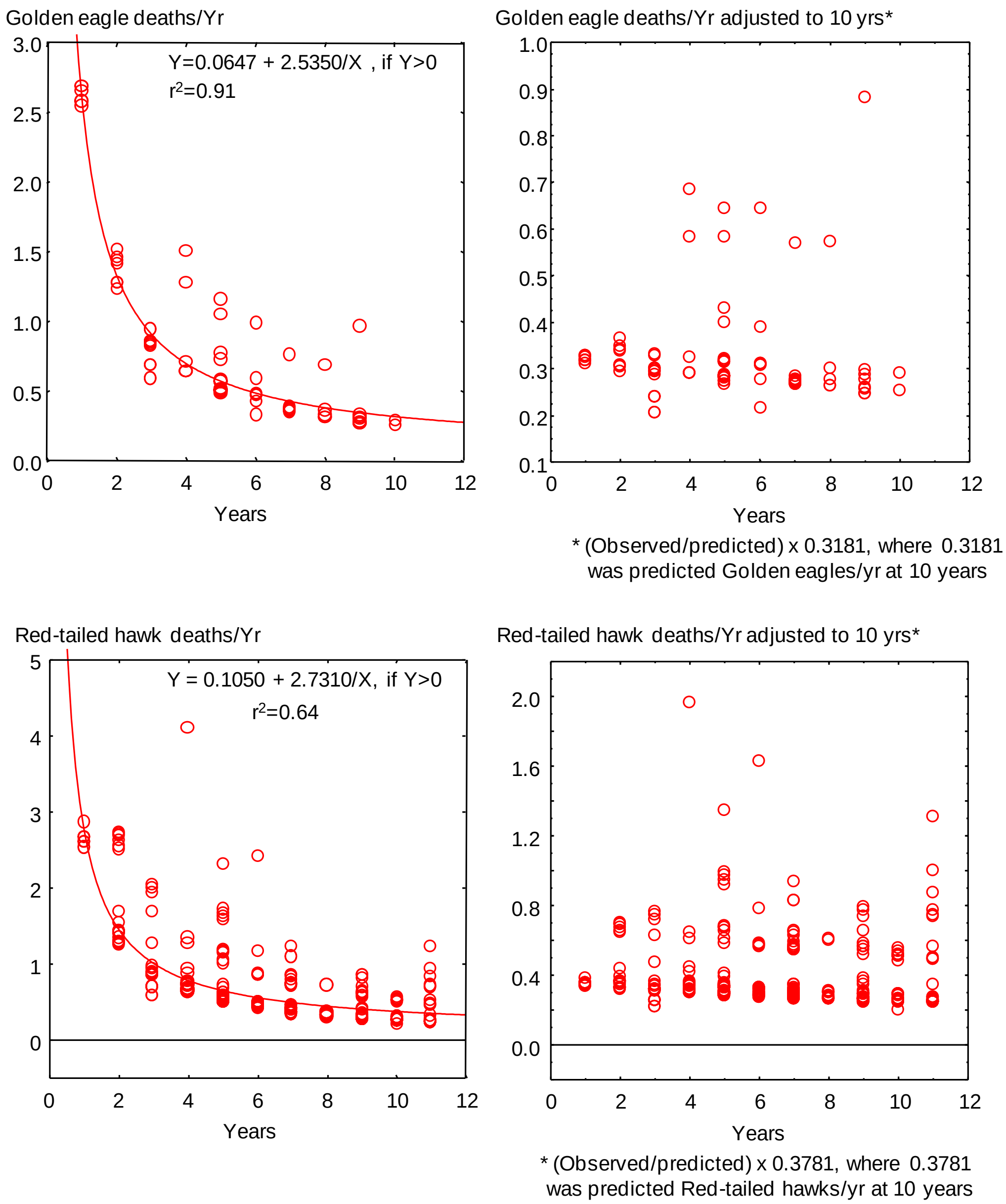


Figure 8a. *Mean annual fatalities/year at turbines where fatalities were found declined inversely with the number of years used in the denominator for golden eagle and red-tailed hawk (left graphs), so fitting inverse functions to the data removed the effect of number of years on the metric (right graphs).*

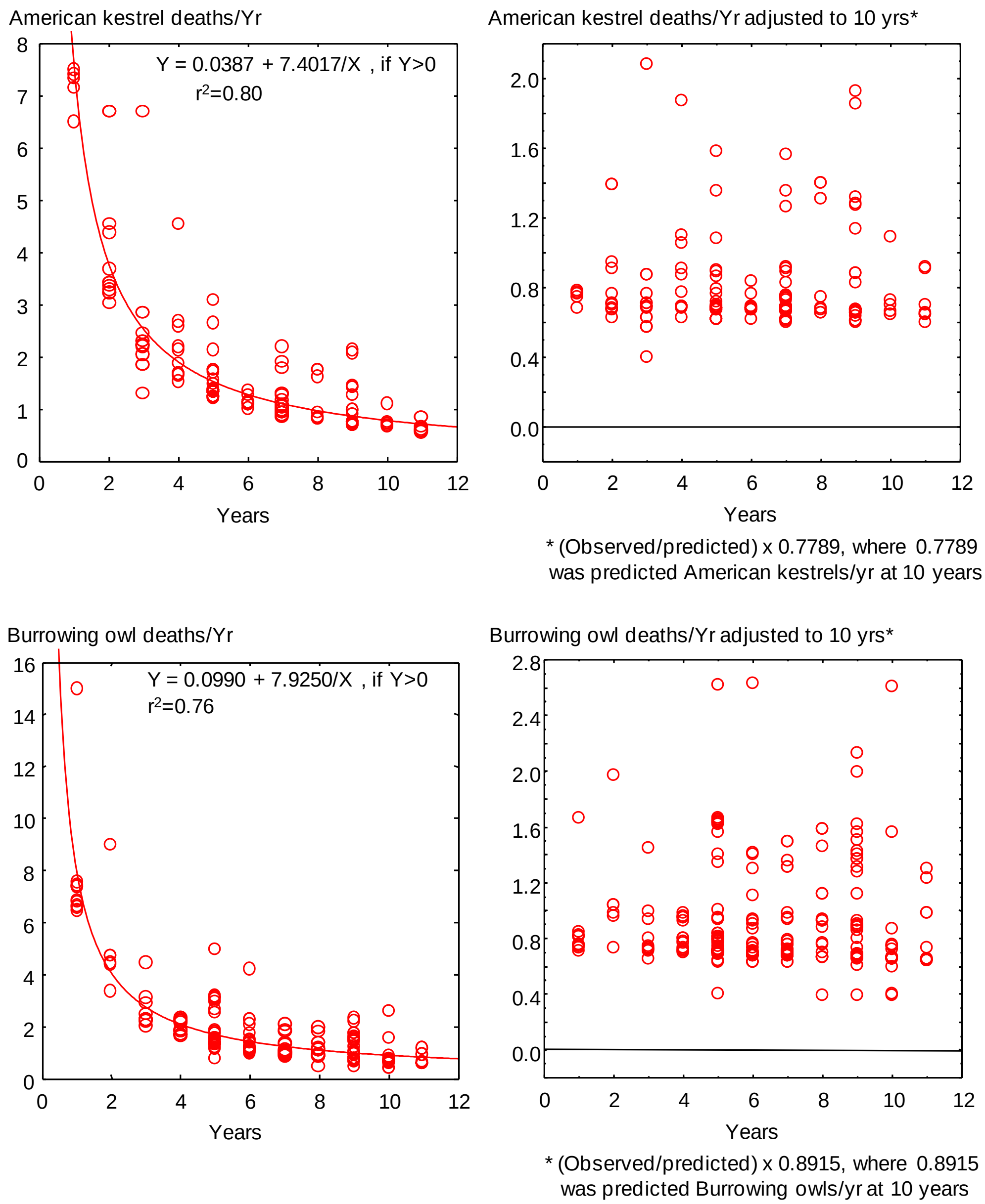


Figure 8b. *Mean annual fatalities/year at turbines where fatalities were found declined inversely with the number of years used in the denominator for American kestrel and burrowing owl (left graphs), so fitting inverse functions to the data removed the effect of number of years on the metric (right graphs).*

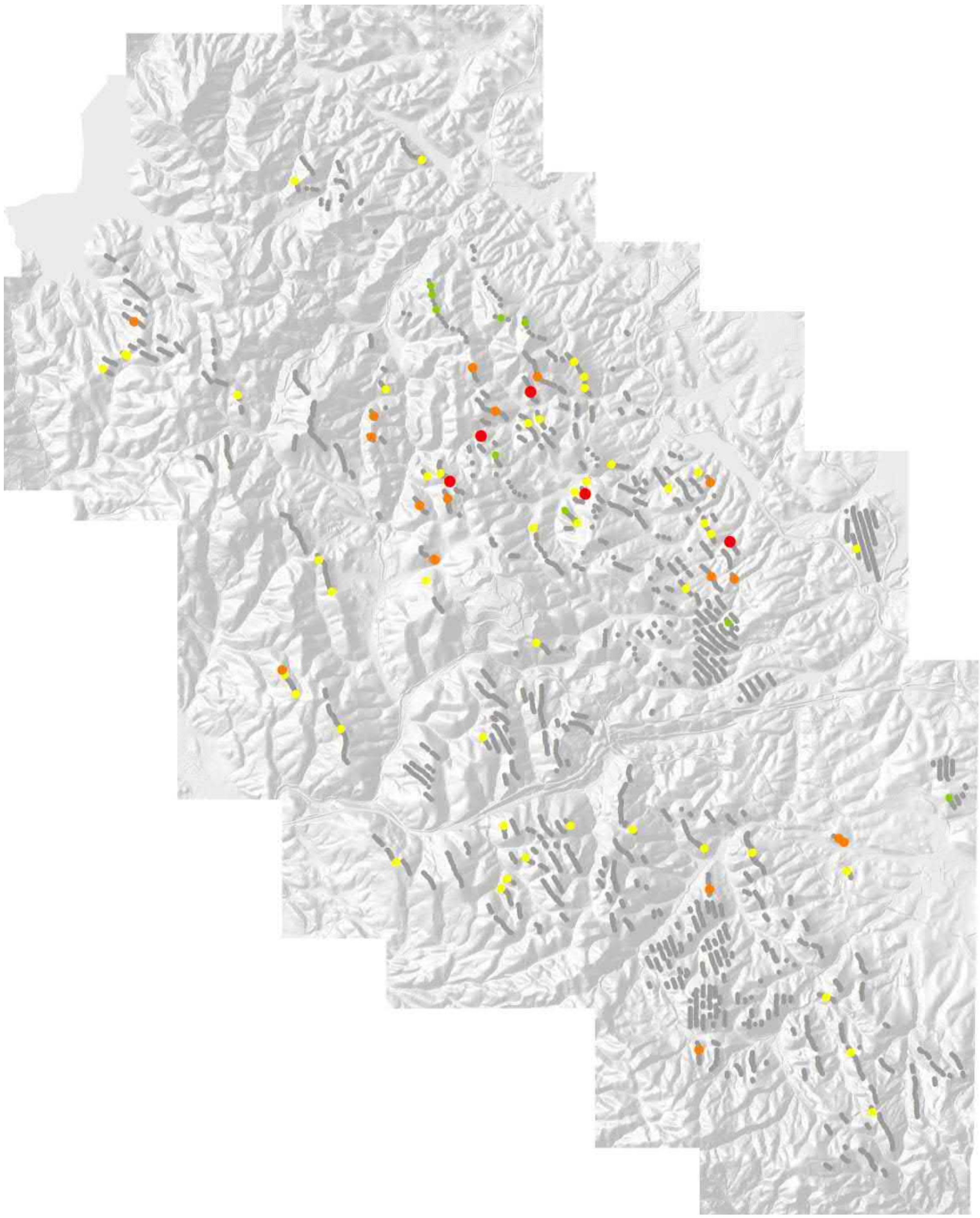


Figure 9. *Golden eagle fatality rates at Altamont Pass wind turbines, 1998 through 2010, adjusted for the duration of monitoring where gray circles represent monitored wind turbines where eagle fatalities were not found and colored circles represent adjusted fatality rates from lowest (yellow) to highest (red).*

Digital Elevation Model

Two separate digital elevation model (DEM) grids were utilized for this project. The geoprocessing tasks were performed using a 10 foot cell size DEM created by combining DEMs obtained from Contra Costa and Alameda Counties. These data sets were produced using LIDAR data and ARC TIN software by Mapcon Mapping Inc. during 2007-2008. The border of the APWRA was used as a mask to produce the APWRA DEM composed of 25,440,000 10x10-foot cells. This DEM was then converted to a cell centroid point feature class and each point assigned a unique membership number.

All derived parameters were calculated for the entire APWRA DEM and attributed into the cell centroid point feature class. An aggregated 792-m buffer served as our mask (limit) for analyzing previously collected bird data against the DEM parameters. The 792-m radius was converted to a 2,600 foot radius and an additional 200 feet was added to buffer modeling data for geoprocessing and to ensure that all bird observations would be covered.

The statistical analyses within the APWRA were limited (masked) to data within the areas searched for raptors within the behavior study areas, for burrowing owl burrows within the burrowing owl sampling plots, and for fatality rates among the wind turbines that were monitored at least one year (and the grid cells on which the turbines were located). The resulting analytical grids within the behavior survey areas were composed of a 7,548,578 (30%) subset of the 10x10-foot centroid point feature class serving as the study area for the behavior surveys, and a 393,555 subset serving as the study area for the behavior surveys restricted to 10-m buffered ridge-like features. These analytical grids were used to develop and test predictive models.

The same geoprocessing steps were used to characterize terrain attributes as reported in Smallwood and Neher (2010a,b). We used the Curvature function in the Spatial Analysis extension of ArcGIS 10.2 to calculate the curvature of a surface at each cell centroid. A positive curvature indicated the cell surface was upwardly convex, a negative curvature indicated the cell surface was upwardly concave, and zero indicated the cell surface was flat. Curvature data (-51 to 38) were classified using Natural Breaks (Jenks) with 3 classes of curvature – convex, concave and mid-range. Break values were visually adjusted to minimize the size of the mid-range class. A series of geoprocessing steps was used, 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 (expressed as 1 or 0, respectively, for the variable *Curve*, and 2 and 1 respectively, for the variable *RidgeValley*, which will appear in the models below). Convex surface areas consisted primarily of ridge crests and peaks, hereafter referred to as ridges, and 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 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. We applied flow direction and flow accumulation functions to ridges by multiplying the DEM by -2 to reverse the flow. Line features representing 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. Lines representing ridges and valleys were also clipped to identify the major valleys and major ridges, or the topographic features dominating the local skyline and local drainage systems (Figure 10).

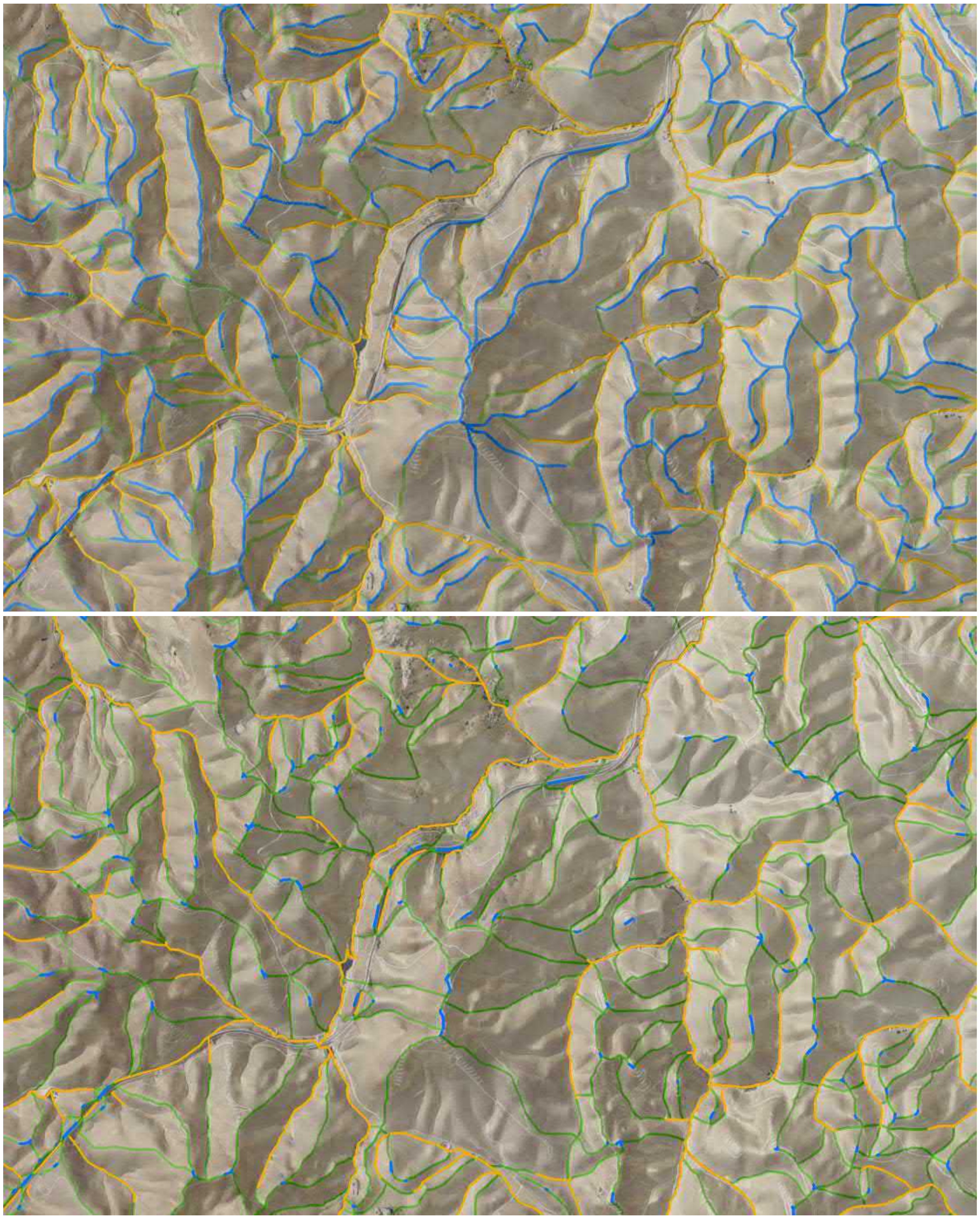


Figure 10. *Valley bottoms (gold) and ridge crests (blue) for all terrain (top) and major terrain (bottom) features.*

We used the two-foot slope analysis grid to create polygons with relatively gentle slope. We used a Standard Deviation classification 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*.

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 same measurements were made to major valleys and major ridges.

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, the grid cell's position on the slope was measured as the average of the percentage distance and the percentage elevation to the ridge top. This mean percentage was named *percent up slope*, and provided a more robust expression of the grid cell's position on the slope (Figure 11). The same measurements were made to major valleys and major ridges, leading to the variable we named *percent up major terrain slope*. Thus, on a small hill adjacent to a major hill in the area, a grid cell could be 90% under *percent up slope* and only 30% under *percent up major terrain slope*.

Percent up slope did not distinguish a grid cell's position between slopes on large hills versus medium or small-sized hills, so the local topographic influence of the feature where each cell was located was expressed by the variable *hill size*, which was the elevation difference between the nearest valley bottom polygon and nearest prominent ridge top polygon. *Major hill size* was the elevation difference between the nearest major valley bottom and nearest major ridge top.

Breaks in slope were characterized with the ratio of *slope to gross slope*, and the ratio *gross slope to major gross slope* was also calculated. Additional ratios included *local to major hill size*, *local to major ridge elevation*, and *local to major valley elevation*.

Each DEM grid cell was classified by *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.

The study area was divided into smaller polygons of land with like aspect, creating a predictor variable termed *Subwatershed Orientation*. Existing sub-watershed polygons already had been created between ridgelines and valley bottom lines. These watershed polygons were further divided by reviewing the existing 2-foot hypsography (contour) data and then dividing them into orientation polygons where the overall orientation of the contours changed. An orientation line feature layer was digitized with a line for each new polygon following the best observed orientation of that polygon's contours. Python scripts attributed the new line with its compass orientation, e.g., N, NNE, NE. These lines were non-directional, so a compass value could be either the returned value or the direction 180 degrees opposite. These same scripts calculated a perpendicular compass direction to the returned orientation line direction. The perpendicular orientation direction had two possible values, differing by 180 degrees based on which side of the ridge the line described. A reference point within each orientation polygon was georeferenced by scripts to a generalized aspect grid of the study area. The scripts determined the correct perpendicular orientation and calculated the compass direction of the orientation polygon.

Using similar steps, a predictor variable termed *Ridge Orientation* was created. Ridgelines were buffered by 10 feet and the resulting ridgeline polygons classified by orientation: north to south, north-northwest to south-southeast, northwest to southeast, west-northwest to east-southeast, west to east, west-southwest to east-northeast, southwest to northeast, and south-southwest to north-northeast. Flight paths crossing ridgelines were related to these Ridge Orientation polygons in use and availability analysis.

We represented *ridgeline slope* as the difference between maximum and minimum elevation of grid cells within buffered ridgelines (as above) divided by the total length of the ridgeline polygon. We were hoping to characterize the slope of individual ridge features, but our ridgeline polygons often spanned multiple ridge features, often from one side of a hill across the top to the other side. Whereas we obtained a crude representation of change in elevation along ridge features, we did not measure the slope of individual ridge features.

We also derived a variable named *ridge context*, which was categorized ridge features by their elevation difference and distance from *major ridges* (see Figure 10). We subtracted the elevation of local ridges from the elevation of major ridges and we plotted the elevation differences against the distances between the local and major ridges. After fitting a regression line to the plot to isolate the data above the trend line, we rated *ridge context* as 1 for local ridges at least 790 m from major ridges, 2 for local ridges between 440 and 790 m distant and at least 40 m lower than major ridges, 3 for local ridges between 250 and 440 m distant and at least 26 m lower than major ridges, 4 for local ridges between 170 and 250 m distant and at least 18 m lower than major ridges, 5 for local ridges between 100 and 170 m distant and at least 10 m lower than major ridges, 6 for local ridges between 25 and 45 m distant and at least 4 m lower than major ridges or for local ridges between 45 and 75 m distant and at least 6 m lower than major ridges or for local ridges between 75 and 100 m distant and at least 8 m lower than major ridges. We related adjusted fatality rates to these categories of *ridge context* to identify disproportionate fatality rates.

Steps to identify saddles, notches, and benches

Because a large amount of evidence links 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 (Figure 12), a special effort was directed toward identifying ridge saddles, notches in ridges, and benches of slopes. Benches of slopes are where ridge features emerge from hill slopes that extend above the emerging ridge. These types of locations are where winds often compress by the landscape to create stronger force, and where raptors typically cross hilly terrain or spend more time to forage for prey. Compared to surrounding terrain, these types of features are often relatively flatter or shallower in slope and sometimes include lower elevations (e.g., saddles). Geoprocessing steps were used to provide some objectively to the identification of these features, but judgment was also required because conditions varied widely in how such features were formed and situated (Figure 12).

The same procedures were used as used in the ridge/valley selection. 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. 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 *hazard sites* representing saddles, notches, or benches. Maps depicting contours of the variable *percent up slope* were also examined, because these contours readily revealed sudden breaks in slope typical of saddles, notches, and benches, which were then also represented with polygons.

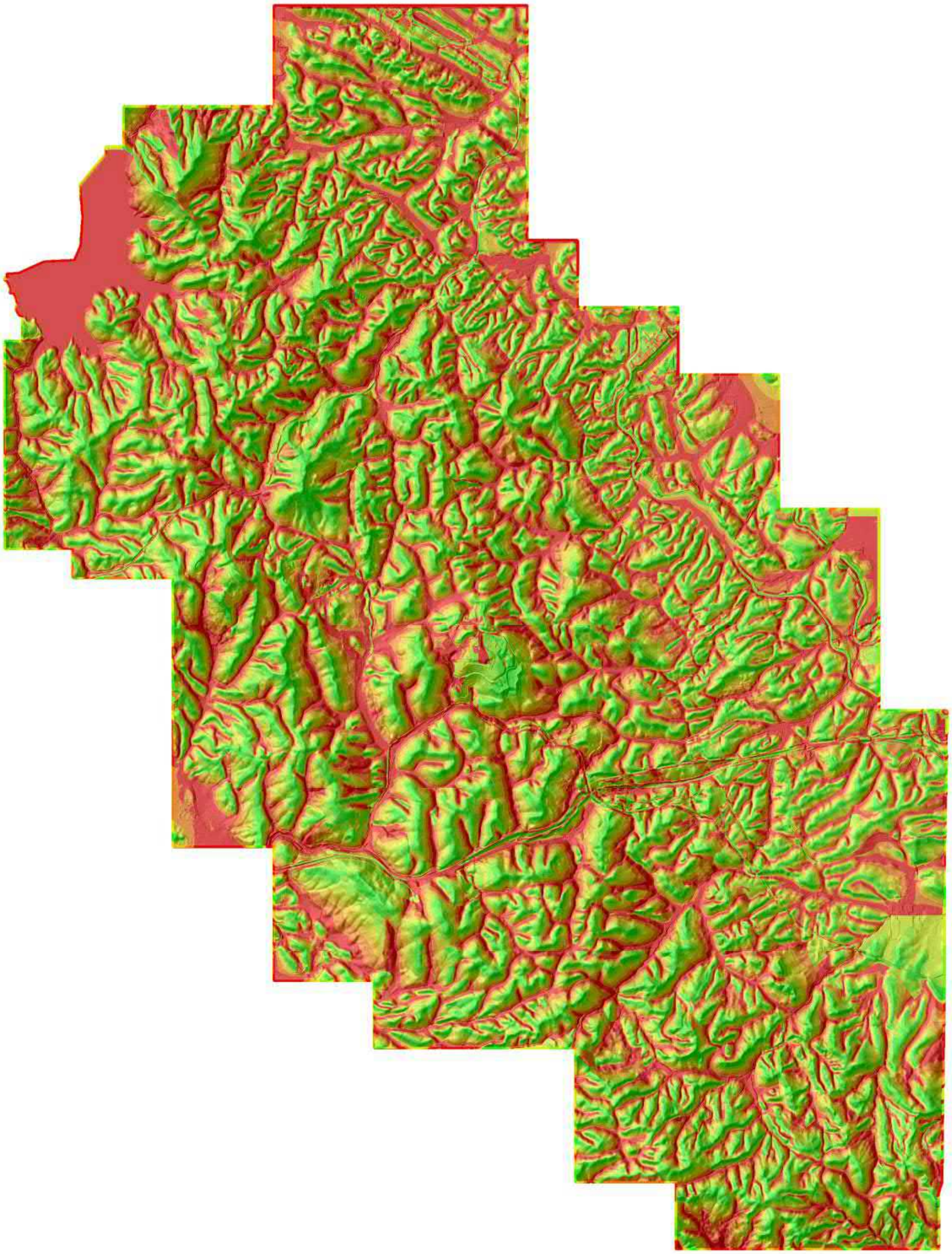


Figure 11. *Percent up slope across the Altamont Pass Wind Resource Area was derived from multiple terrain measurements to express a grid cell's position on the slope regardless of the size of the slope, where red was at the valley bottoms and dark green at the ridge crests*.

Figure 12. *We delineated polygons where ridge saddles present opportunities for flying birds to conserve energy by flying through the relatively lower portions of ridge structures (yellow arrows denote popular flight routes).*

GPS/GSM Telemetry

Doug Bell (2015) caught 18 golden eagles using baited traps since 18 December 2012. To each eagle he affixed 70 g GPS/GSM units manufactured by Cellular Tracking Technologies, LLC (CTT; http://celltracktech.com/) via backpack harness. CTT units measure 100 mm x 40 mm x 23 mm and run on solar powered batteries during daylight hours (Figure 13). All units recorded positions at 15 min intervals, and a subset recorded positions at 30 sec intervals during 3 days of every month. Actual times between position intervals vary, but are supposed to average 15 min or 30 sec. CTT Transmitters download data to cell towers daily during prescribed 1 hour windows, but if a transmitter is beyond cell tower coverage, it will store location data until it returns to an area with cell coverage. Eagle location data are down-loaded from the CTT website, and are password protected.

***Figure 13**. A golden eagle fitted with a GPS/GSM telemetry unit as seen during a visual scan survey to record behavior patterns.*

GPS/GSM telemetry positions were collected from all telemetered golden eagles intersecting the boundary of the APWRA from the inception of telemetry monitoring through November 2015. Lines representing flight paths were derived by connecting sequential positions, so each line was associated with a distance and time interval summed among all line segments, where a line segment was the line connecting two sequential positions. New flight lines were initiated each day, as well as when time intervals between sequential positions exceeded 60 sec in the case of data collected at 30 sec intervals and 1,020 sec in the case of data collected at 15 min (900 sec) intervals. We also subsampled 15 min interval data from 30 sec data was when the accumulated time among sequential positions surpassed 900 sec. We included the subsampled 15 min data with the 15 min interval data.

To assess error in the GPS/GSM telemetry units we placed these units on the ground for long periods next to a Trimble GeoXT with sub-meter accuracy. We also mounted telemetry units in the back of Smallwood’s truck (1.2 m above ground) and next to a Trimble GeoXT unit while driving throughout the APWRA on various dates from 22 October 2014 through 10 September 2015. Our visual examination of the GPS/GSM data indicated high lateral position accuracy relative to the Trimble GeoXT unit. However, we noticed high vertical error and a large vertical bias in the GPS/GSM data when examining simple statistics and histograms. Whereas the Trimble GeoXT unit generated positions that averaged about a meter above the 10-foot DEM surface – where the average was supposed to be – the GPS/GSM data averaged 9 m below the 10-foot DEM surface. We therefore adjusted upward the vertical positions of the telemetered golden eagles by 9 m. We also generated a cumulative distribution curve of the vertical error in the truck-mounted telemetry data, and found that 95% of the recorded positions were within 27 m of their true positions above the 10-foot DEM surface (Figure 14). We therefore used 27 m as a threshold value for determining whether flight lines of golden eagles were above ground. Flight lines were assigned to the following height domains above our 10-foot DEM: **0 (ground)** was <0 m above the DEM surface, **1 (near ground)** = 0 to 27 m above the DEM, **2 (medium)** was >27 m and <200 m above the DEM, and **3 (high)** was >=200 m above the DEM.

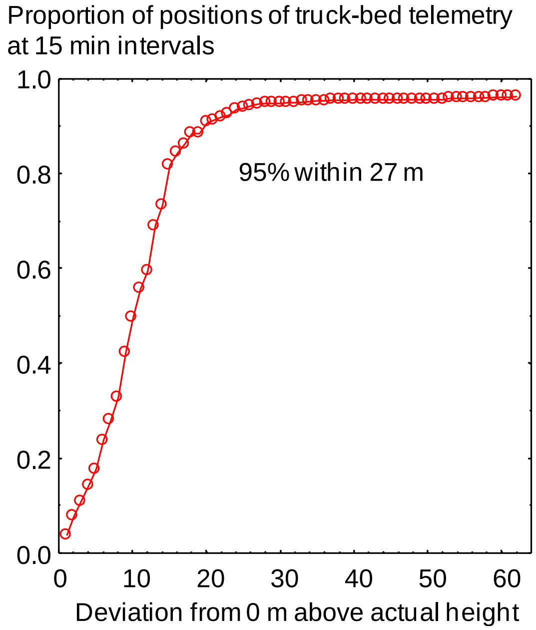


Figure 14. *Cumulative distribution of vertical error measured from 767 GPS/GSM telemetry positions between two units mounted in the back of Smallwood's truck at 1.2 m above ground while driving throughout the APWRA on various dates from 22 October 2014 through 10 September 2015.*

Examining data from GPS/GSM transmitters that we maintained at known locations (not affixed to eagles), we averaged false flight speeds caused by position scatter as 0.3 m/s (1.08 km/hr) for 30 second interval data, and 0.007 m/s (0.026 km/hr) for 15 min interval data. However, relying on speed alone was often insufficient for determining whether an eagle was flying because hovering or kiting golden eagles could have remained in the same locations over 30 sec intervals, and flying golden eagles could have returned to the same positions after flying out and back to another location or in a circle (these behaviors have been seen during visual surveys many times).

Whether an eagle was flying was determined as **possible (0)** if the flight line averaged slower than the speed of position scatter and ≤0 m above the DEM and intersected 1 subwatershed polygon, or it averaged slower than the speed of position scatter and <200 m above the DEM and intersected 1 subwatershed polygon. Whether an eagle was flying was determined as **probable**

(1) it the flight line averaged faster than position scatter and ≤27 m above the DEM and intersected ≥2 subwatershed polygons, or it averaged ≥3 km/hr and 0-27 m above the DEM and intersected ≥1 subwatershed polygon, or it averaged ≥1.08 km/hr and 27-200 m above the DEM and intersected ≥1 subwatershed polygon. Whether an eagle was flying was determined as **certain (2)** if the flight line averaged ≥2.5 km/hr or ≥100 m above the 10-foot DEM and intersected ≥4 subwatershed polygons, or it averaged ≥27 m above the DEM and intersected ≥3subwatershed polygons, or it averaged ≥2.3 km/hr and ≥27 m above the DEM and intersected ≥1subwatershed polygon. To prevent flight lines used in our association analysis from being falsely generated from position scatter around perched birds, we included lines determined to have been within height domains 1 or 2 and determined to have been certainly flying (2).

Associations between bird behaviors and terrain attributes

The location of each raptor was characterized by aspect, slope, 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 *aspect*), and the other expressing whether the landscape feature was tending toward convex versus concave orientation (expressed in a variable named *curve*). These features were defined using geoprocessing.

Fuzzy logic (FL) modeling (Tanaka 1997) was used to predict the likelihood each grid cell would be used by golden eagle, red-tailed hawk, American kestrel, and burrowing owl. FL likelihood surfaces were first created by each selected predictor variable. The mean, standard deviation, and standard error were calculated for each predictor variable among the grid cells where each targeted bird species was observed during standard observation sessions. These statistics formed the basis from which FL membership was assigned to grid cells. Depending on the pattern in the data, FL membership was assigned values of 1 whenever the value of the predictor variable was within a certain prescribed distance in value from the mean, oftentimes within 1 SD, but sometimes within 1 or 2 SE. FL membership values of 1 expressed confidence that grid cells with the corresponding value range for the predictor variable are likely to be visited by the target species. FL membership values of 0 were assigned to grid cells that were far from the mean value, usually defined by prescribed distances from the mean such as >2 SD from the mean. FL membership values of 0 expressed confidence that grid cells with the corresponding value range for the predictor variable are unlikely to be visited by the target species. All other grid cells were assigned FL membership values according to the following formulae, assuming that the likelihood of occurrence of each species will grade gradually rather than abruptly across grid cells that vary in value of the predictor variable (Y):

$$0.5 \text{ x } (1 - \cos(\pi \text{ x } (Y - V_c) \div (V_f - V_c))) \text{ below the mean}$$
$$0.5 \text{ x } (1 + \cos(\pi \text{ x } (Y - V_c) \div (V_f - V_c))) \text{ above the mean,}$$

where V_c represented the variance term (SD or SE) closer to the mean and V_f represented the variance term farther from the mean.

FL likelihood values were then summed across predictor variables contributing to a species-specific model. In earlier efforts to develop FL models for golden eagle, red-tailed hawk, American kestrel and burrowing owl in other parts of the APWRA, natural breaks were used to divide the summed values into 4 classes, but the percentages of study area composing these classes remained fairly consistent despite use of natural breaks. Therefore, this time the class divides were established at 63.5%, 83.5%, and 95.5% when natural breaks were not evident; otherwise, we used natural breaks. Class 1, including FL likelihood values <63.5% (i.e., 63.5% of the study area), represented the suite of grid cells including fewer bird observations other than expected. Class 2, including FL likelihood values between 63.5% and 83.5% (i.e., 20% of the study area), represented the suite of grid cells including about equal or slightly greater than equal bird observations other than expected. Class 3, including FL likelihood values between 83.5% and 95.5% (i.e., 12% of the study area), represented the suite of grid cells including more bird observations other than expected. And class 4, including the upper 4.5% of FL likelihood values, represented the suite of grid cells including substantially more bird observations other than expected.

The performance of each model was assessed by the magnitude of the ratio of the observed number to the expected number of observations representing a dependent variable and occurring within the suite of conditions specified by each FL surface class. Dependent variables included fatality rates (except for American kestrel), flights <180 m above ground, flights across ridge features and <180 m above ground (Figure 15), social interactions while flying (Figure 16), wind turbine interaction events (Figures 17 and 18), and hovering or kiting or surfing behaviors (Figure 19). FL surface models were later projected across wind project areas.

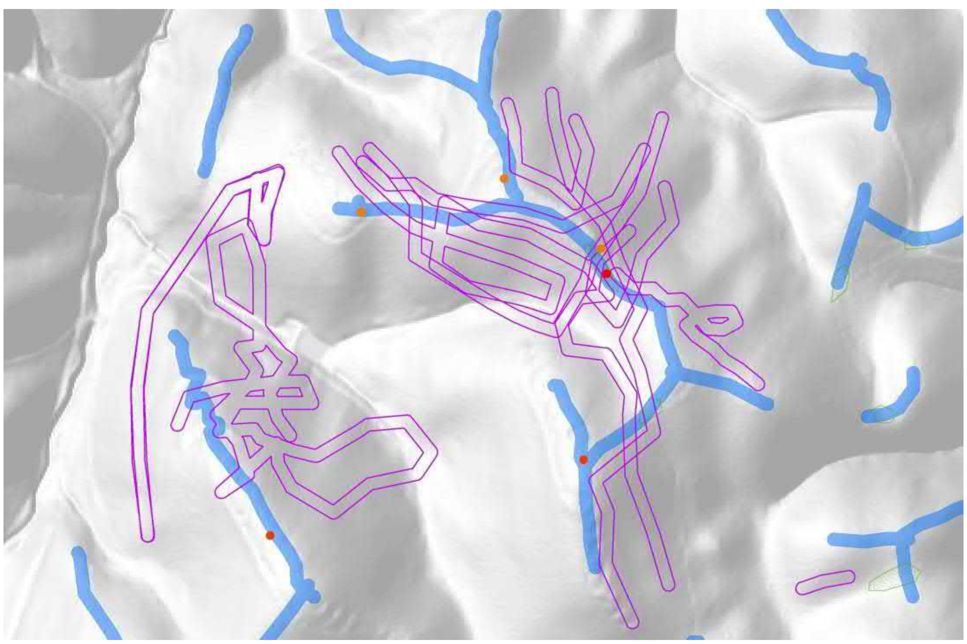


***Figure 15**. Example of how golden eagle ridge crossings were quantified. WE buffered flights within 180 m of the ground by 10 m (purple polygons) and their overlap with 10-m buffered ridge crests (blue polygons) were counted for each ridge orientation: N-S, NNE-SSW, NE-SW, ENE-WSW, E-W, ESE-WNW, SE-NW, and SSE-NNW. Colored circles depict golden eagle fatality rates adjusted for monitoring duration, were red was the highest fatality rates.*

***Figure 16**. Social or competitive interactions between flying birds served as a dependent variable for collision hazard modeling, so associations were sought between interacting birds and terrain measurements and terrain features.*

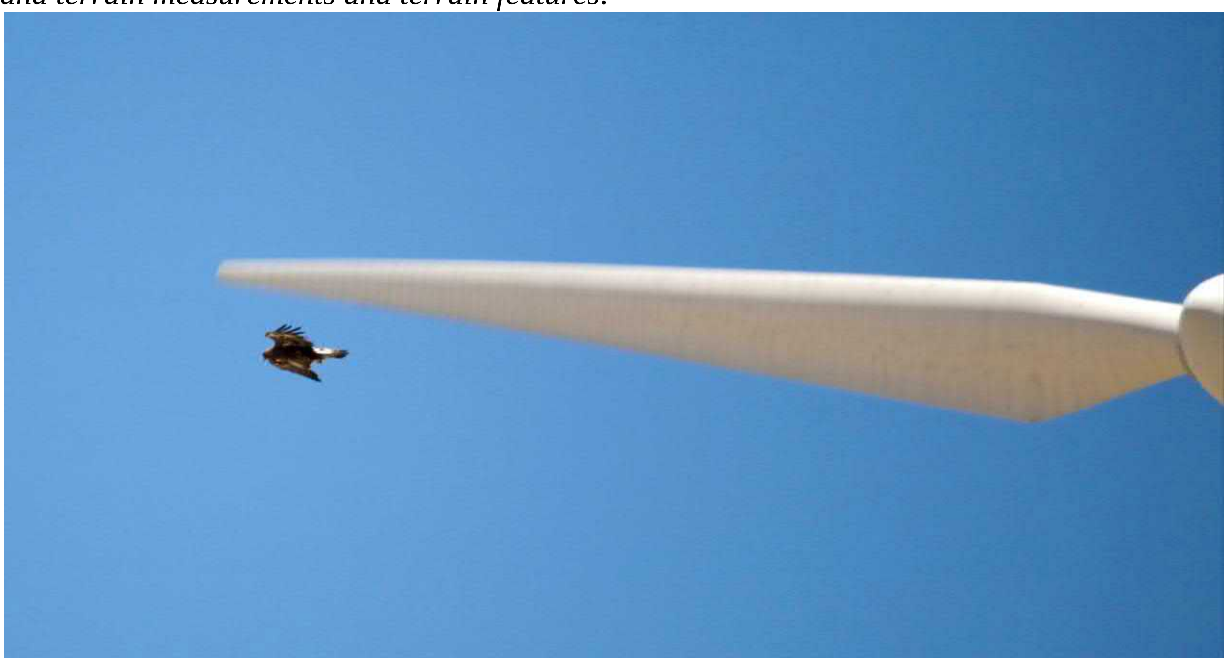


***Figure 17**. Wind turbine events of birds adjudged by observers to have flown dangerously close to wind turbine blades were recorded and used for collision hazard modeling, so associations were sought between wind turbine events and terrain measurements and terrain features. In this case a golden eagle narrowly avoided a collision with a moving wind turbine blade.*

***Figure 18**. Example of a social interaction between flying golden eagles that also happen to be near wind turbines. Where and under what conditions these combined social interactions and wind turbine events occur can assist with predicting collision hazard, but many hours of directed behavior surveys are needed to accumulate a sufficient number of these events to reliably associate them with environmental and terrain factors.*

***Figure 19**. Red-tailed hawks kiting near the top of a slope. Red-tailed hawks, American kestrels and burrowing owls (at night) often perform this behavior just upwind of wind turbines. It is a known dangerous behavior, having preceded multiple eye-witness accounts of birds drifting with the wind or being pushed back by wind into operating wind turbine rotors. The behavior is also dangerous because kiting or hovering birds often break off from these behaviors to glide quickly with the wind before turning back into the wind to repeat the behaviors over another portion of the slope, but the glide with the wind often places them in sudden jeopardy of colliding with turbine blades.*

Burrowing owl model

Because burrowing owls tend to nest low on the slope, it would be rare for a predictive model of burrowing owl burrow locations to correspond with terrain where burrowing owls are killed by wind turbines. Therefore, we developed a burrowing owl fatality model and relied on hazard classes 3 and 4 of this model wherever the cell centroids were located within 60 m of classes 3 or 4 predicted by the burrow model. Otherwise, all class values of the burrow model remained unchanged.

RESULTS

GPS/GSM Telemetry of Golden Eagles

All 18 of the golden eagles fitted with GPS/GSM telemetry units intersected the APWRA at some point during the study (Figure 20). Two of the eagles barely overlapped the APWRA with 3 positions each, so they did not contribute anything to the analysis. Another two eagles recorded only 15 and 16 positions within the APWRA, so they, too, contributed little if anything to the analysis. The other 14 eagles contributed hundreds or thousands of positions within the APWRA.

Our examination of associations between eagle positions and terrain variables indicated no difference between eagles tracked at 30 sec intervals and those tracked at 15 min intervals. Therefore, we combined the data from the two position intervals for quantifying associations with terrain variables. We found high variation in terrain associations between gender and age classes of eagles, but none of this variation appeared meaningful. However, we noticed strong differences in terrain associations between the 3 eagles that collided with wind turbines versus those that have not yet collided with wind turbines. Therefore, we relied mostly on terrain associations of the 3 eagles that collided with wind turbines to develop a collision hazard model.

After combining data sets based on 30 sec and 15 min intervals, golden eagle telemetry positions adjusted for vertical bias and intersecting the APWRA numbered 17,025 (14%) at or below ground (of course, these birds were not truly below ground, but recorded below ground due to position errors), 79,757 (66%) near ground, 18,396 (15%) within the hazardous height zone of 27 m to 200 m above ground, and 6,079 (5%) high above ground. Of the golden eagle positions intersecting the APWRA, 1.39% were possibly of flying eagles, 12.88% were probably of flying eagles, and 85.73% were certainly of flying eagles.

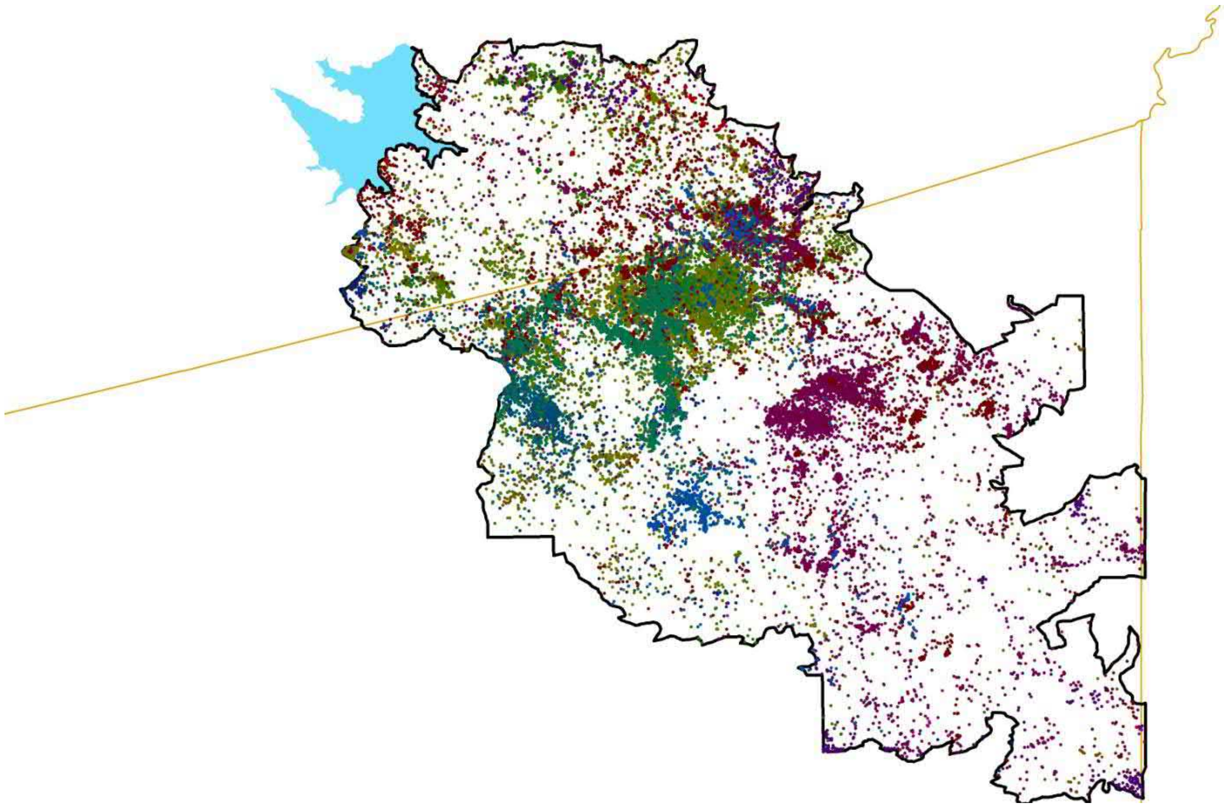


Figure 20. *GPS/GSM telemetry positions of golden eagles (each color represents a different eagle) within the boundary of the Altamont Pass Wind Resource Area, December 2012 through September 2015. Orange lines represent County boundaries, and the blue polygon at the upper left is Los Vaqueros Reservoir*.

Visual Surveys

Behavior surveys performed at Sand Hill through 5 April 2015 numbered 2,002 30-min surveys and across the rest of the APWRA through 29 October 2015 numbered 1,095 1-hr surveys elsewhere in the APWRA for a combined 2,096 hours. APWRA-wide observation rates were 0.6115 golden eagles/hour, 1.3597 red-tailed hawks/hour, and 0.4054 American kestrels/hour. We recorded wind turbine interaction events, including 86 golden eagle events, 156 red-tailed hawk events, and 98 American kestrel events.

Hazard Models

The FL models of golden eagle were composed of 7 predictor variables based on telemetry data (Table 1), 3 predictor variables based on behavior data (Table 2), and 9 predictor variables based on fatality rates (Table 3). The FL models of red-tailed hawk were composed of 3 predictor variables based on behavior data (Table 4), and 6 predictor variables based on fatality rates (Table 5). The FL models of American kestrel were composed of 5 predictor variables based on behavior data (Table 6), and 7 predictor variables based on fatality rates (Table 7). The FL models of burrowing owl were composed of 2 predictor variables based on burrow location data

(Table 8), and 4 predictor variables based on fatality rates (Table 9). How the models were weighted and combined for each species is summarized in Table 10.

Telemetered golden eagles were recorded flying disproportionately over the upper portions of slopes, even more so for the colliders (Figure 21). Colliders were also disproportionately recorded flying higher up the slopes of major terrain features, as well as over ridges oriented east to west and east-southeast to west-northwest and over slopes facing north-northwest, south-southwest and south (Figure 22). Colliders were disproportionately recorded flying farther from the major valley bottoms and over steeper-than-average slopes.

Golden eagle flights and wind turbine interactions occurred disproportionately over ridges oriented generally west-east. Associations were also strong with subwatershed slopes facing westerly directions, especially west and northwest. Golden eagles flew and interacted with wind turbines disproportionately at 91% to 100% up the slope (Figure 23).

Red-tailed hawks hovered and kited disproportionately over slopes oriented north-northeast, west, and northwest. Red-tailed hawks hovered and kited disproportionately over ground that was between 85% and 100% to the top of the slope (Figure 24). Red-tailed hawk kiting and hovering was broader across major terrain features, with peak activity ranging between 53% and 83% to the top of the feature (Figure 24).

American kestrels flew most disproportionately over slopes oriented west and southwest, ranging mostly between three-quarters to the peak of the slope and midway to just below the peaks of major terrain features. American kestrel wind turbine interaction events were observed disproportionately on relatively small hills.

Burrowing owl burrows were located disproportionately between 5% and 30% of the way up south-facing slopes (Figure 25). Burrowing owl fatality rates were disproportionately higher at low to moderate elevations and between 35% and 42% of the way up the slopes of major terrain features and in hazard sites (Figure 25).

Map-based collision hazard models were used to recommend shifts in the initially proposed wind turbine layout at Summit Winds (Figures 26-29). These models were combined from other models as described in the Methods section and Table 10. The numbering of proposed wind turbine sites is provided in the last figure of the Appendix.

Table 1. *Golden eagle fuzzy logic membership functions of DEM grid cells based on GPS telemetry positions primarily of 3 study birds that collided with wind turbines.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Ridge orientation	
Y = W-E	3
Y = WNW-ESE	2
Y = NW-SE,	1
Y = Other orientation	0
Subwatershed orientation	
Y = S, SSW, NNW	2
Y = N, NE, SW, WNW	1
Y = Other orientation	0
Percent up slope	
$85.70 < Y \leq 100$	1
$71.56 \leq Y \leq 85.70$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 71.56) / (85.70 - 71.56)))$
$Y < 71.56$	0
Percent up major terrain slope	
$59.0 < Y \leq 98.0$	1
$39.5 \leq Y \leq 59.0$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 39.5) / (59.0 - 39.5)))$
$98.0 < Y \leq 100.0$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 98.0) / (100.0 - 98.0)))$
$Y < 39.5$	0
Distance to major valley	
$168.81 < Y \leq 538.34$	1
$117.25 \leq Y \leq 168.81$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 117.25) / (168.81 - 117.25)))$
$538.34 < Y < 684.44$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 538.34) / (684.44 - 538.34)))$
$Y < 117.25$ or $Y > 684.44$	0
Gross slope	
$19.56 < Y \leq 33.10$	1
$15.04 \leq Y \leq 19.56$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 15.04) / (19.56 - 15.04)))$
$33.10 < Y < 42.13$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 33.10) / (42.13 - 33.10)))$
$Y < 15.04$ or $Y > 42.13$	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 2. *Golden eagle fuzzy logic membership functions of DEM grid cells based on flights involving ridge crossings, interactions with other birds, and wind turbine interaction events.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Ridge orientation (ridge crossings, social interactions, turbine events, behavior)	
Y = W-E	2
Y = N-S, NE-SW, WNW-ESE, NNW-SSE	1
Y = Other orientation	0
Subwatershed orientation (social interactions, turbine events, behavior)	
Y = WSW, W, NW	3
Y = SSE, WNW, SSW, NNW	2
Y = N, NNE, NE, SW	1
Y = Other orientation	0
Percent up slope (turbine events, social interactions)	
$91 < Y \leq 100$	1
$15 \leq Y \leq 91$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 15) / (91 - 15)))$
$Y < 15$	0

Table 3. *Golden eagle fuzzy logic membership functions of DEM grid cells based on fatality rates at wind turbine locations.*

Value of variable Y for *i*th grid cell (type of event)	Membership function of grid cell (Values >1 include weightings)
Ridge orientation	
Y = WNW-ESE	2
Y = WSW-ENE, W-E	1
Slope orientation (for percent upslope <90)	
Y = WNW	3
Y = WSW, NW	2
Y = SSW, SW	1
Ridge context (relative to major ridges)	
Y = 2 (low & far), 6 (low & very near)	2
Y = 5 (low & near)	1
Ridge elevation	
$207.70 < Y \leq 251.48$	1
$69.09 \leq Y \leq 207.70$	$0.5 \times (1 - \text{COS}(\pi \times (Y - 69.09) / (207.70 - 69.09)))$
$251.48 < Y \leq 360.91$	$0.5 \times (1 + \text{COS}(\pi \times (Y - 251.48) / (360.91 - 251.48)))$
$Y < 69.09$ or $Y > 360.91$	0
Hill size (for percent upslope <90)	
$66.76 < Y < 75.24$	1
$49.80 \leq Y \leq 66.76$	$0.5 \times (1 - \text{COS}(\pi \times (Y - 49.80) / (66.76 - 49.80)))$
$75.24 < Y \leq 92.20$	$0.5 \times (1 + \text{COS}(\pi \times (Y - 75.24) / (92.20 - 75.24)))$
$Y < 49.80$ or $Y > 92.20$	0
Ridgeline slope	
$Y > 10$	1
$Y \leq 10$	0
Percent upslope	
$30.65 < Y \leq 51.35$	1
$15.13 \leq Y \leq 30.65$	$0.5 \times (1 - \text{COS}(\pi \times (Y - 15.13) / (30.65 - 15.13)))$
$51.35 < Y \leq 66.87$	$0.5 \times (1 + \text{COS}(\pi \times (Y - 51.35) / (66.87 - 51.35)))$
$Y < 15.13$ or $Y > 66.87$	0
Percent up major terrain slope	
$15.29 < Y \leq 36.71$	1
$9.30 \leq Y \leq 15.29$	$0.5 \times (1 - \text{COS}(\pi \times (Y - 9.30) / (15.29 - 9.30)))$
$36.71 < Y < 42.07$	$0.5 \times (1 + \text{COS}(\pi \times (Y - 36.71) / (42.07 - 36.71)))$
$Y < 9.30$ or $Y > 42.07$	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 4. *Red-tailed hawk fuzzy logic membership functions of DEM grid cells based on flights involving ridge crossings, interactions with other birds, behavior, and wind turbine interaction events.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Subwatershed orientation (ridge crossings, social interactions, turbine events, hovering/kiting)	
Y = NNE, W, NW	3
Y = SW, N	2
Y = WSW, WNW, NNW	1
Y = Other orientation	0
Percent up slope (hovering/kiting)	
$85.43 < Y \leq 100$	1
$43.84 \leq Y \leq 85.43$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 43.84) / (85.43 - 43.84)))$
$Y < 43.84$	0
Percent up major terrain slope (hovering/kiting)	
$52.98 < Y \leq 82.66$	1
$29.24 \leq Y \leq 52.98$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 29.24) / (52.98 - 29.24)))$
$82.66 < Y \leq 100$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 82.66) / (100 - 82.66)))$
$Y < 29.24$	0

Table 5. *Red-tailed hawk fuzzy logic membership functions of DEM grid cells based on fatality rates at wind turbine locations.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Ridge orientation	
Y = N-S, NW-SE, WNW-ESE, W-E, WSW-ENE	1
Y = NNW-SSE, SW-NE, SSW-NNE	0
Subwatershed orientation (percent upslope <90)	
Y = SSW, NW	1.5
Y = SW, WNW, NNW	1
Ridge context (relative to major ridges)	
Y = 6 (low & very near)	1
Ridge elevation	
$195.68 < Y \leq 222.32$	1
$80.24 \leq Y \leq 195.68$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 80.24) / (195.68 - 80.24)))$
$222.32 < Y \leq 320$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 222.32) / (320 - 222.32)))$
$Y < 80.24$ or $Y > 320$	0
Percent up major terrain slope	
$22.18 < Y \leq 27.82$	1
$13.71 \leq Y \leq 22.18$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 13.71) / (22.18 - 13.71)))$
$27.82 < Y < 36.29$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 27.82) / (36.29 - 27.82)))$
$Y < 13.71$ or $Y > 36.29$	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 6. *American kestrel fuzzy logic membership functions of DEM grid cells based on flights involving ridge crossings, interactions with other birds, behavior, and wind turbine interaction events.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Subwatershed orientation (ridge crossings, social interactions, turbine events, hovering/kiting)	
Y = SE, SSW, SW, W, NNW	3
Y = WSW, NW	2
Y = N, NNE, SSE, S	1
Y = Other orientation	0
Percent up slope (hovering/kiting)	
$85.43 < Y \leq 100$	1
$43.84 \leq Y \leq 85.43$	$0.5 \times (1 - \cos(\pi \times (Y - 43.84) / (85.43 - 43.84)))$
$Y < 43.84$	0
Percent up major terrain slope (hovering/kiting)	
$66.36 < Y \leq 92.55$	1
$40.15 \leq Y \leq 66.36$	$0.5 \times (1 - \cos(\pi \times (Y - 40.15) / (66.36 - 40.15)))$
$92.55 < Y \leq 100$	$0.5 \times (1 + \cos(\pi \times (Y - 92.55) / (100 - 92.55)))$
$Y < 40.15$	
Hill size (turbine events)	
$20.73 < Y \leq 25.03$	1
$9.98 \leq Y \leq 20.73$	$0.5 \times (1 - \cos(\pi \times (Y - 9.98) / (20.73 - 9.98)))$
$25.03 < Y \leq 44.38$	$0.5 \times (1 + \cos(\pi \times (Y - 25.03) / (44.38 - 25.03)))$
$Y < 9.98$ or $Y > 44.38$	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 7. *American kestrel fuzzy logic membership functions of DEM grid cells based on fatality rates at wind turbine locations.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Subwatershed orientation	
Y = NNE, SW	2
Y = SE, SSW	1
Y = Other orientation	0
Ridge orientation	
Y = WSW-ENE	2
Y = NW-SE, NNW-SSE	1
Ridge context (relative to major ridges)	
Y = 4 (low & close), 5 (low & near)	1
Valley elevation (percent upslope < 90)	
66.75 < Y < 91.25 or 135.88 < Y < 148.12	1
$54.50 \leq Y \leq 66.75$ or $129.75 \leq Y \leq 135.88$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 54.50) / (66.75 - 54.50)))$ $0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 129.75) / (135.88 - 129.75)))$
$91.25 < Y \leq 103.5$ or $148.12 < Y < 154.25$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 91.25) / (103.5 - 91.25)))$ $0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 148.12) / (154.25 - 148.12)))$
54.5 < Y > 154.25	0
Slope to gross slope ratio (percent upslope < 90)	
$0.79 < Y \leq 1.20$	1
$0.69 \leq Y \leq 0.79$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 0.69) / (0.79 - 0.69)))$
$1.20 < Y \leq 1.31$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 1.2) / (1.31 - 1.2)))$
Y < 0.69 or Y > 1.31	0
Distance to major ridge (percent upslope ≥90)	
$155 < Y \leq 195$	1
$75 \leq Y \leq 155$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 75) / (155 - 75)))$
$195 < Y \leq 275$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 195) / (275 - 195)))$
Y < 75 or Y > 275	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 8. *Burrowing owl fuzzy logic membership functions of DEM grid cells based on burrow locations.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Subwatershed orientation	
Y = S	2.5
Y = ESE, SE, SSE	1.5
Y = ENE, E	1
Y = Other orientation	0
Percent up slope	
$5.56 < Y \leq 20.83$	1
$0.47 \leq Y \leq 5.56$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 0.47) / (5.56 - 0.47)))$
$20.83 \leq Y \leq 51.37$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 20.83) / (51.37 - 20.83)))$
Y < 0.47 or Y > 51.37	0

Table 9. *Burrowing owl fuzzy logic membership functions of DEM grid cells based on fatality rates at wind turbine locations.*

Value of variable Y for *i*th grid cell (type of event)	**Membership function of grid cell (Values >1 include weightings)**
Valley elevation	
$138.42 < Y \leq 155.09$	1
$91.18 \leq Y \leq 138.42$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 91.18) / (138.42 - 91.18)))$
$155.09 < Y \leq 202.32$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 155.09) / (202.32 - 155.09)))$
Y < 91.18 or Y > 202.32	0
Elevation	
$168.78 < Y \leq 193.00$	1
$60.00 \leq Y \leq 168.78$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 60) / (168.78 - 60)))$
$193.00 < Y \leq 440.19$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 193) / (440.19 - 193)))$
Y < 60.00 and Y > 440.19	0
Percent up major terrain slope	
$35.51 < Y \leq 42.85$	1
$25.05 \leq Y \leq 35.51$	$0.5 \times (1 - \mathrm{COS}(\pi \times (Y - 25.05) / (35.51 - 25.05)))$
$42.85 < Y < 52.95$	$0.5 \times (1 + \mathrm{COS}(\pi \times (Y - 42.85) / (52.95 - 42.85)))$
Y < 25.05 or Y > 52.95	0
Hazard site	
Y = Within polygon	1
Y = Outside polygon	0

Table 10. Fuzzy logic models developed for Summit Winds.

Dependent variable	Model	Max score possible
Golden eagle telemetry	Distance to major valley + 2×Percent up slope + 2× Percent up major terrain slope + Gross slope + 2×Subwatershed orientation + 3×Ridge orientation + 10×Hazard site	29
Golden eagle flights	Ridge orientation + 2×Subwatershed orientation + 2×Percent up slope +	10
Golden eagle fatalities	10×Hazard site + Ridge orientation + 2×Subwatershed orientation + 2×Ridge context + Ridge elevation + 2×Hill size + Ridgeline slope + Percent upslope + Major terrain upslope	28
Golden eagle combined	((Telemetry score/29)×2 + Behavior score/10 + (Fatality score/28)×3)/6	1
Red-tailed hawk kiting	2×(Percent up slope + Percent up major terrain slope) + Subwatershed orientation	7
Red-tailed hawk fatalities	6×Hazard site + Ridge orientation + 3×Subwatershed orientation + Ridge context + Ridge elevation + Percent up major terrain slope	14.5
Red-tailed hawk combined	((Behavior score/7) + (Fatality score/14.5))/2	1
American kestrel kiting	7×Hazard site + Ridge orientation + 3×Subwatershed orientation + 3×Percent up slope + Percent up major terrain slope + Hill size	21
American kestrel fatalities	8×Hazard site + 2×Ridge orientation + 2×Subwatershed orientation + 2×Ridge context + Valley elevation + Slope to grosslope ratio + Major ridge distance	21
American kestrel combined	((Behavior score/21)×3 + (Fatality score/21))/4	1
Burrowing owl burrows	2.5×Percent up slope + Subwatershed orientation	3.5
Burrowing owl fatalities	2×Hazard site + Elevation + 2×Valley elevation + Percent up major terrain slope	6

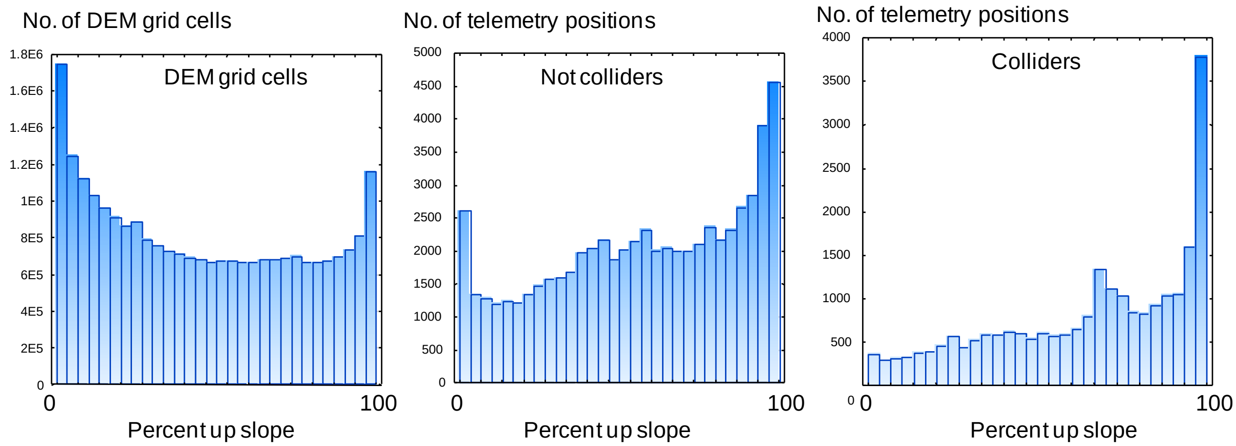


Figure 21. The distributions of telemetered eagle positions were shifted up the slopes (middle and right graphs) compared to the distribution of DEM grid cells in the APWRA (left graph).

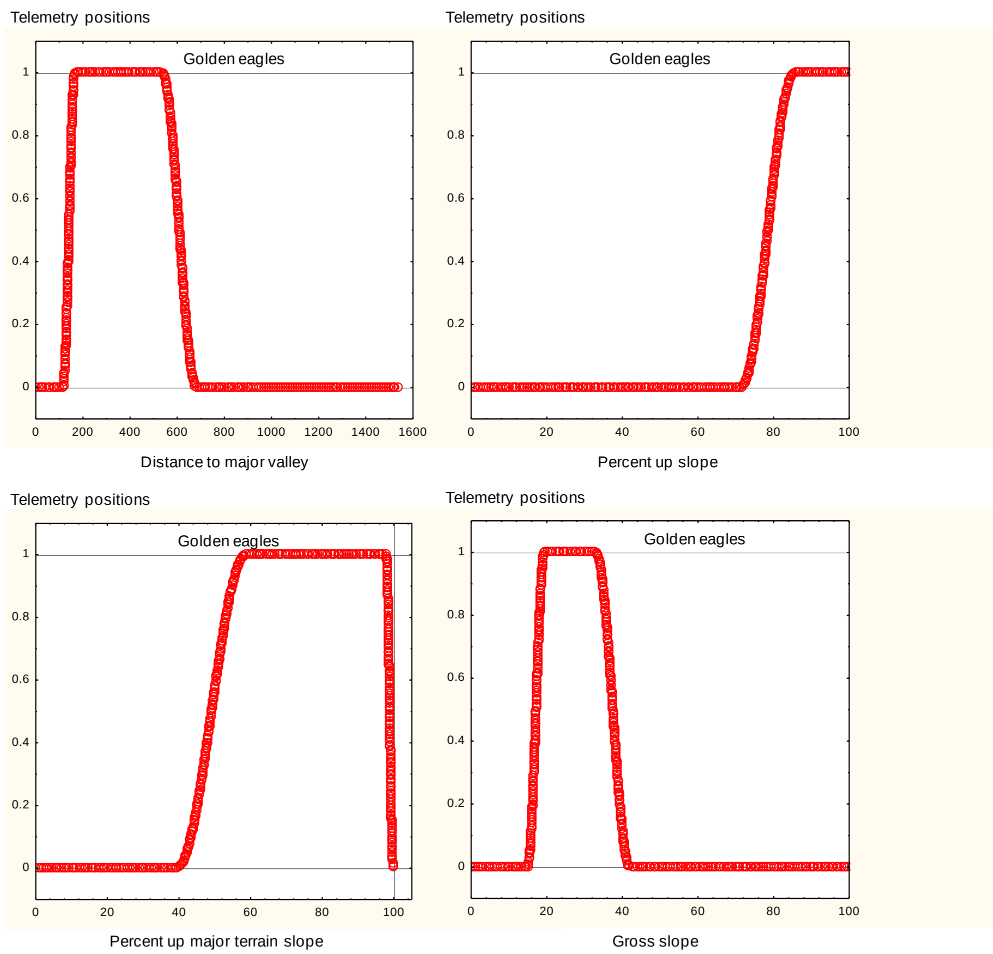


Figure 22. *Examples of grid cell membership values in respective fuzzy logic sets for telemetry positions related to four predictor variables.*

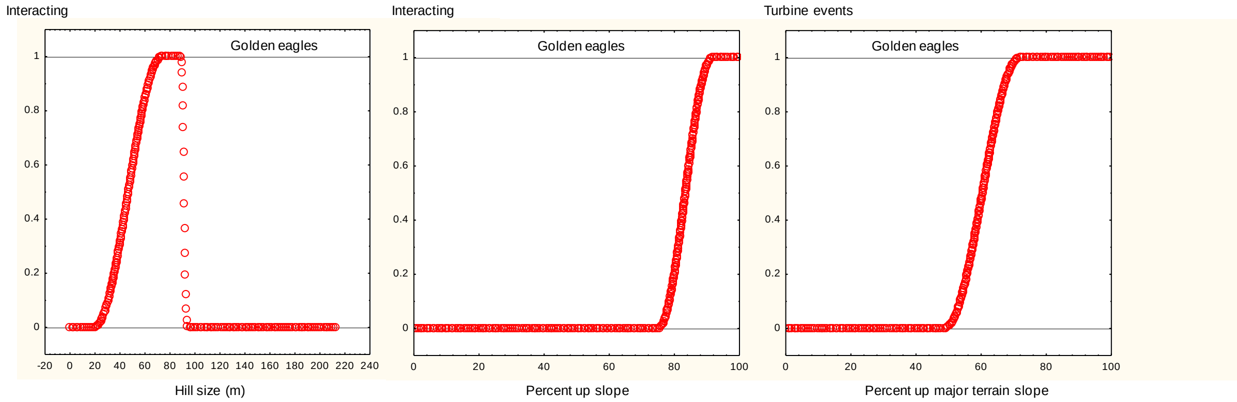


Figure 23. *Examples of grid cell membership values in respective fuzzy logic sets for three predictor variables, including of golden eagle interactions with other birds (left and middle) and wind turbine events (right).*

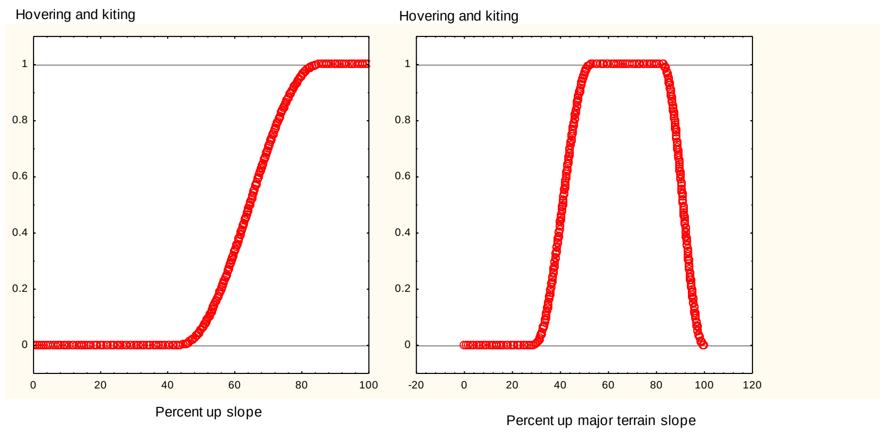


Figure 24. *Examples of grid cell membership values of red-tailed hawk hovering and kiting in respective fuzzy logic sets for percent upslope (left) and percent upslope of major terrain (right).*

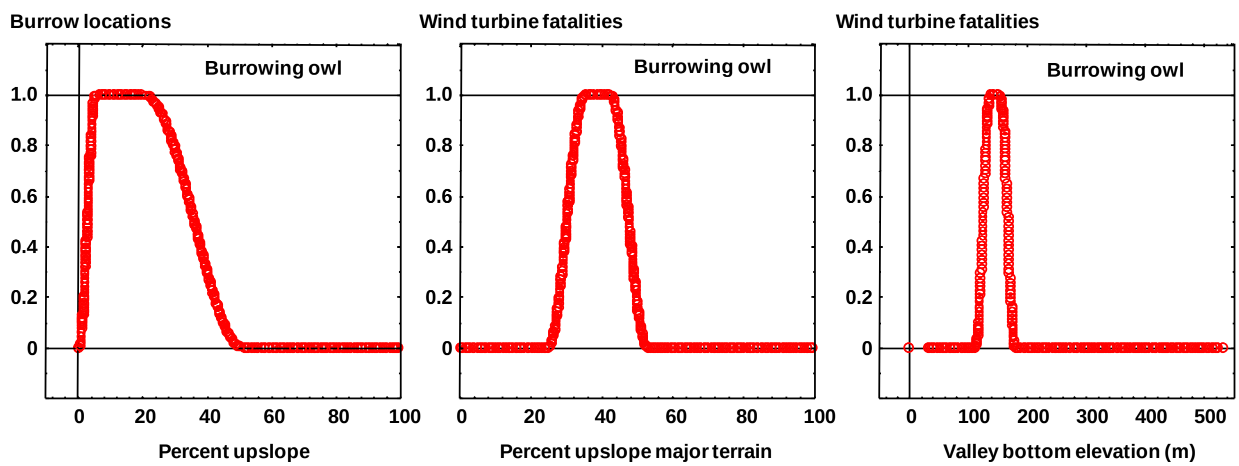


Figure 25. *Examples of grid cell membership values in respective fuzzy logic sets for three predictor variables, including of burrowing owl burrow locations (left) and burrowing owl fatalities at wind turbines (middle and right) in the study area.*

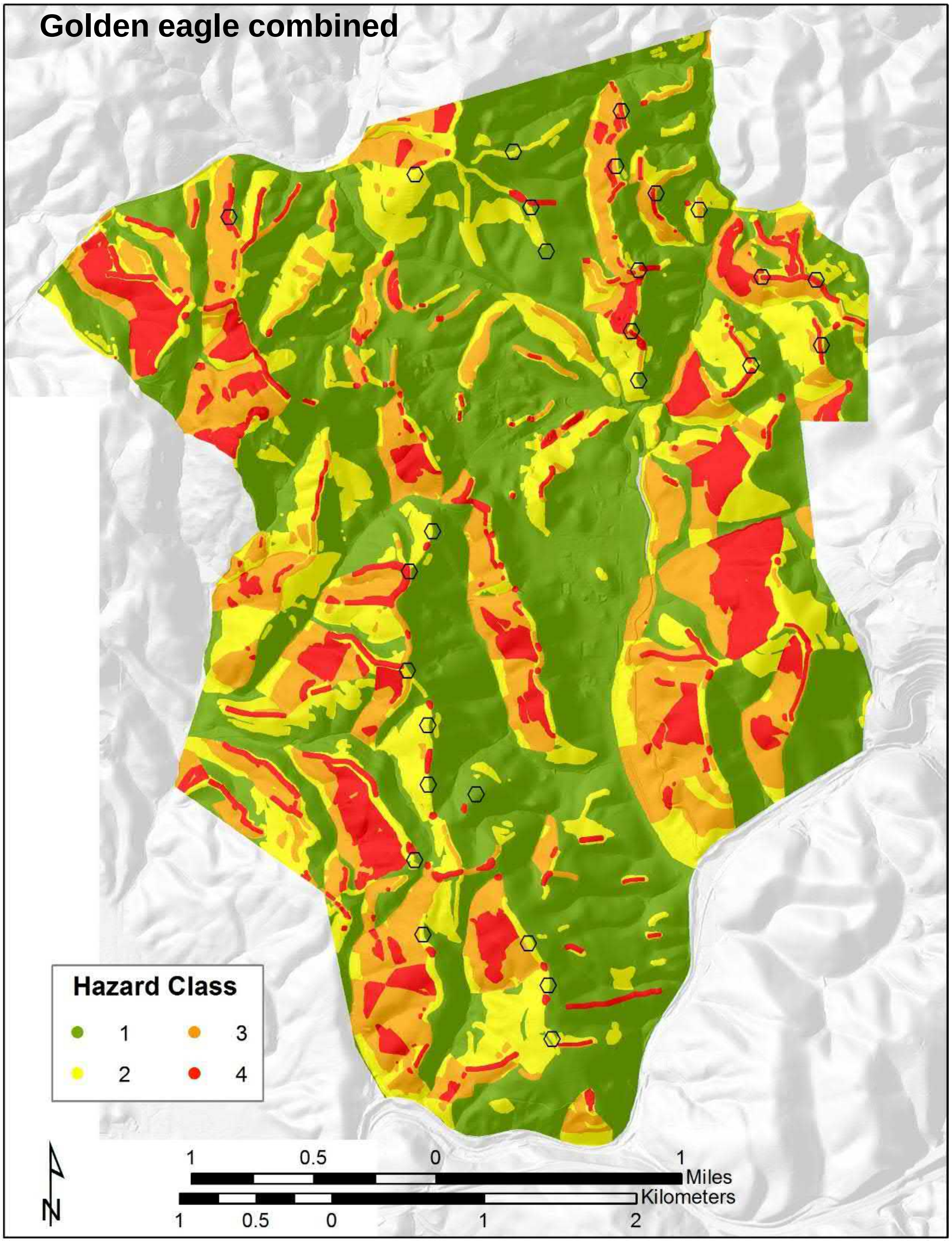


Figure 26. *Fuzzy Logic likelihood surface classes of golden eagle telemetry, flight behavior and fatality locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of golden eagle collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

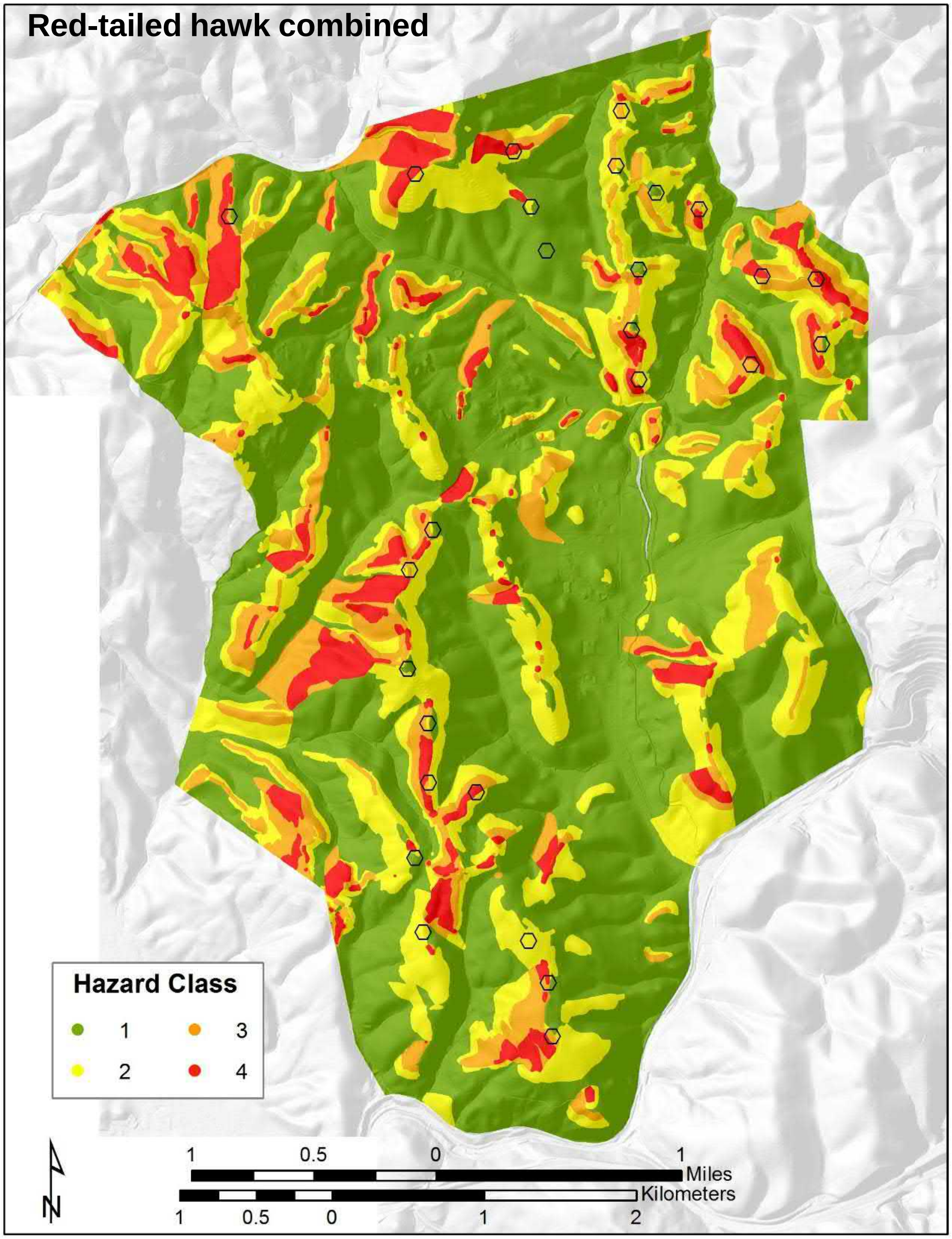


Figure 27. *Fuzzy Logic likelihood surface classes of red-tailed hawk flight behavior and fatality locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of golden eagle collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

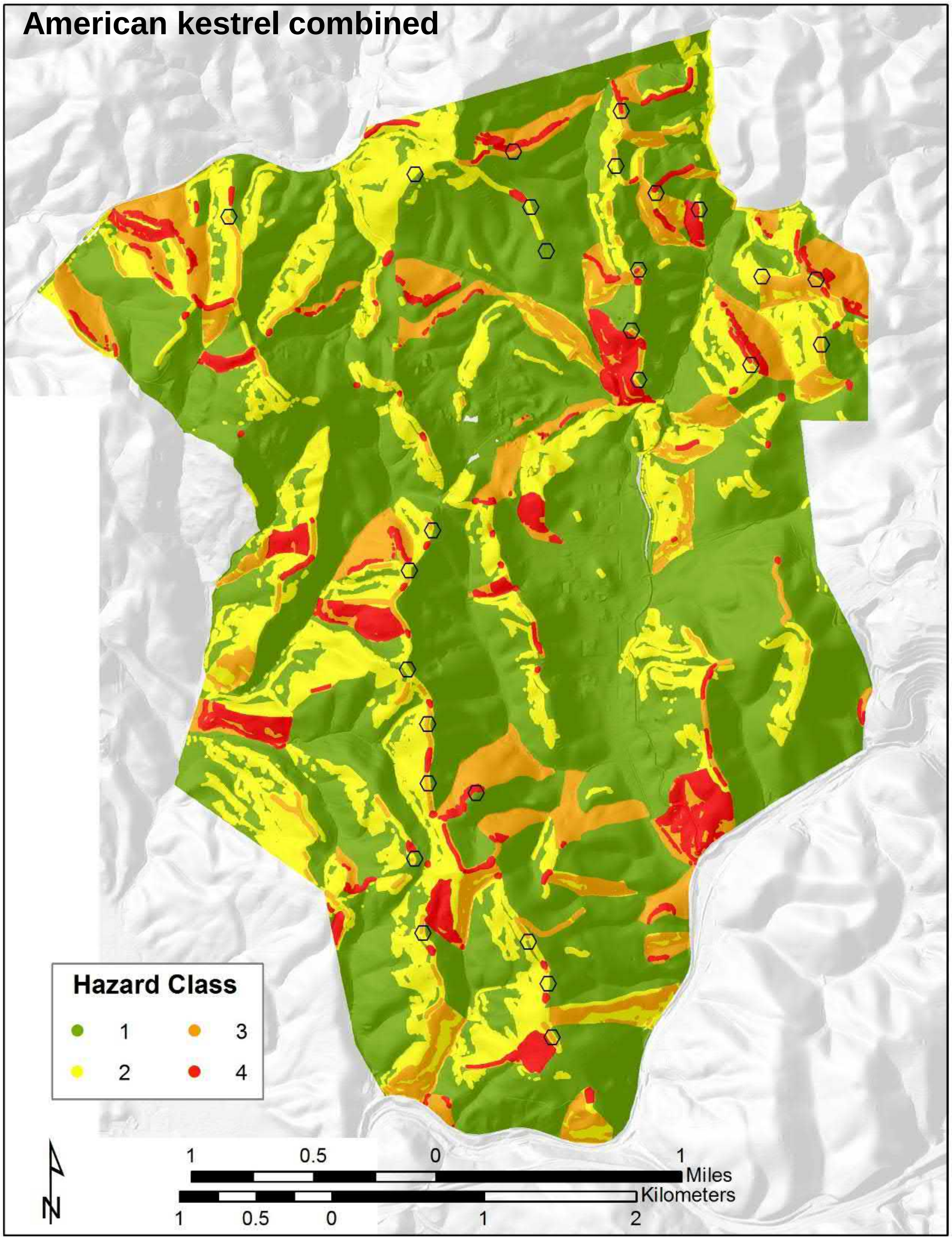


Figure 28. *Fuzzy Logic likelihood surface classes of American kestrel flight behavior and fatality locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of golden eagle collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

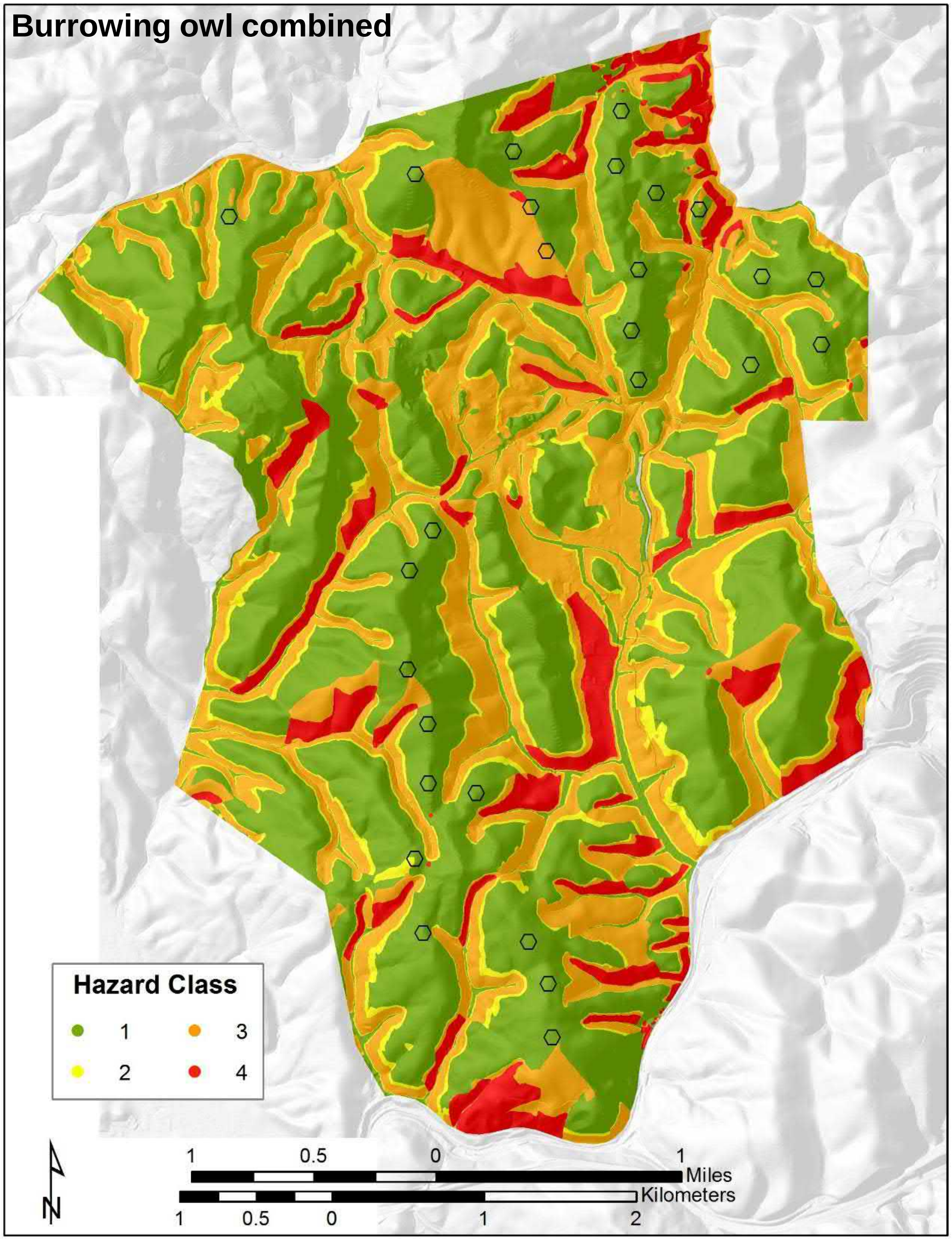


Figure 29. *Fuzzy Logic likelihood surface classes of Burrowing owl burrow and fatality locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

DISCUSSION

We produced simple map-based collision hazard models of golden eagle telemetry positions, ridge crossing flights, wind turbine events, and wind turbine fatalities, as well as of red-tailed hawk and American kestrel flight behaviors and fatalities in the Altamont Pass Wind Resource Area. We also produced simple collision hazard models of burrowing owls based on burrow locations and fatalities at wind turbines. We extended these models to the Summit Winds project area, which included areas where flight behavior data and burrowing owl burrow data were collected for developing the collision hazard models. Micro-siting according to these models and expert opinion should generally achieve the levels of fatality reductions observed at the repowered Vasco Winds project. After three years of operations at Vasco Winds, and compared to the old-generation wind project that preceded it, Brown et al. (2016) estimated fatality rate reductions of 75% to 82% for golden eagle, 34% to 47% for red-tailed hawk, and 48% to 57% for American kestrel, and 45% to 59% for burrowing owl. However, golden eagle fatality reductions might be less at Summit Winds due to the constraints of terrain. Some of the proposed turbine sites are on small hills and ridge structures, leaving little to no room for shifting turbine locations locally. In these situations, micro-siting is infeasible unless the turbine is moved to another hill or ridge structure altogether.

Map-based collision hazard maps need to be interpreted carefully, meaning the hazards of specific terrain and wind situations – ridge saddles, apices of southwest and northwest-facing concave slopes, and breaks in slope – should always trump model predictions. A few of the turbine sites that pose little or no conflict with collision hazard classes for golden eagle nevertheless cause us some concern. For example, we know that golden eagle use is intense around sites proposed for turbines 5, 8, 9, 10, 11, 13, 17, 18, 19, 28, 31, 32 and 33. Site 17 is located on the edge of a major travel route used by golden eagles, and site 18 is next to a saddle and also located upwind of another saddle. Site 8 is atop a slope covered by California buckeyes, and is used intensively by golden eagles. Site 31 is lower than surrounding terrain and is often the place where eagles soar to gain lift as they move eastward and upward along the ridge structure towards site 32; these eagles often launch long-distance glides once they reach a sufficient altitude from above site 32.

The effects of grading for turbine access roads and tower pads also need to be considered, because they are not anticipated in the collision hazard models. Changes in the shape of the hills due to grading can transform the location to a more hazardous situation than was assessed herein. It would be safer to not enhance ridge saddles or breaks in slope due to grading. It would also be safer to not leave earthen berms upwind of turbine towers, because doing so decreases the effective vertical space between the low reach of turbine blades and the ground that birds need to clear.

Table 11 summarizes the coincidences of proposed wind turbine locations with collision hazard classes for golden eagle, red-tailed hawk, American kestrel and burrowing owl. Table 11 also includes some micro-siting recommendations and concerns about proposed sites. Most of the sites are relatively safe for golden eagles and American kestrels and nearly all sites are relatively safe for burrowing owls. Slightly less than half the sites are relatively safe for red-tailed hawks. However, even the relatively safe sites pose some collision risk to these species. Wind turbine sites 3, 11, 14, 19 and 20 are outside hazard classes 3 and 4 for all four focal species. Site 1 could also occur outside hazard classes 3 and 4 for all four species following a small move.

Whereas we focused on four target raptor species, Summit Winds could have adverse impacts on bats and small birds. We developed no collision hazard maps for bats or small birds. We predict that small bird fatalities will lessen as a result of the repowering project, because the project will result in fewer hazardous obstacles on the landscape and airspace will open up for small birds during migration and resident activities. As for bats, we have no way of predicting the project's impacts because we lack sufficient on-site data on fatality rates at old turbines and activity patterns. Whereas we have data on activity patterns of bats at Summit Winds, we lack enough data to predict risk or where the risk might be greatest.

In the Appendix we included additional collision hazard maps based on specific types of data. In response to a request from a member of Alameda County's Technical Advisory Committee, the first map depicts golden eagle collision hazard in the absence of fatality data (Figure 30). We also depict golden eagle collision hazard based on telemetry data (Figure 31), flight behavior data (Figure 32), fatality data (Figure 33), red-tailed hawk collision hazard based on flight behavior data (Figure 34) and fatality data (Figure 35), American kestrel collision hazard based on flight behavior data (Figure 36) and fatality data (Figure 37), and burrowing owl collision hazard based on burrow locations (Figure 38) and fatality data (Figure 39). All of these maps in the Appendix are intended as support material and should not be relied upon alone for micro-siting wind turbines. Figure 40 provides the proposed wind turbine site numbers.

Table 11. *Micro-siting recommendations directed to Summit Winds wind turbine layout, where GOEA = golden eagle, RTHA = red-tailed hawk, AMKE = American kestrel, and BUOW = burrowing owl.*

Site	Overlaps hazard class 3 or 4				Suggested move/Concern
	GOEA	RTHA	AMKE	BUOW	
1	No	Yes	No	No	Move 20 to 25 m south
2	No	Yes	Yes	No	None
3	Near	No	No	Near	None
4	No	No	No	Yes	None
5	Yes	Yes	Yes	No	No local move possible; Steep declining slope
6	Yes	Yes	No	No	Too close to saddle
7	Yes	No	Near	No	None
8	Yes	Yes	Yes	No	No local move possible; Depressed knoll near trees heavily used by eagles
9	Yes	No	Yes	No	Knoll between 3 saddles leaving no local moves
10	Yes	Near	Yes	No	Local move likely infeasible
11	No	No	No	No	None
12	No	Near	Near	No	None
13	Yes	Yes	No	No	Move NNW away from saddle
14	No	No	No	No	None
15	No	No	Yes	No	None
16	No	Yes	Yes	No	None
17	No	Yes	Near	No	Move NNW across small saddle; Too close to intensively traversed large saddle
18	No	No	Near	No	Met tower site would be safer, farther from saddle
19	No	No	Near	No	None, but should prevent upwind berm due to grading
20	No	No	No	No	None
21	No	Yes	No	No	None
22	No	Yes	Yes	No	None
27	Near	Yes	Near	No	None
28	Yes	Yes	Yes	No	No better local option; entire ridgeline risky for both eagles and red-tailed hawks
31	Yes	Yes	Yes	No	Intensively used low terrain with no safe local option
32	Yes	Yes	Yes	No	Move 40 m WNW away from saddle; intensively used ridge
33	Yes	Yes	Yes	No	None; Intensively used area
Yes:	11	15	12	1	

ACKOWLEDGEMENTS

We thank Salka LLC for the opportunity to develop map-based guidelines for raptor-safe wind turbine siting. We also thank East Bay Regional Park District, California Energy Commission's Public Interest Energy Research program, NextEra Renewables, Ogin Inc. and EDF Renewables for earlier funding of research that prepared us for this project. Directed behavior surveys were performed since 2012 by K. S. Smallwood, H. Wilson, E. Walther, B. Karas, J. Mount, S. Standish, and E. Leyvas. We thank D. Funderburg, S. Michehl, Leah Neher, and S. Neher for digitizing bird locations from hard-copy maps. We thank D. Bell for use of GPS/GSM telemetry data of golden eagles.

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APPENDIX

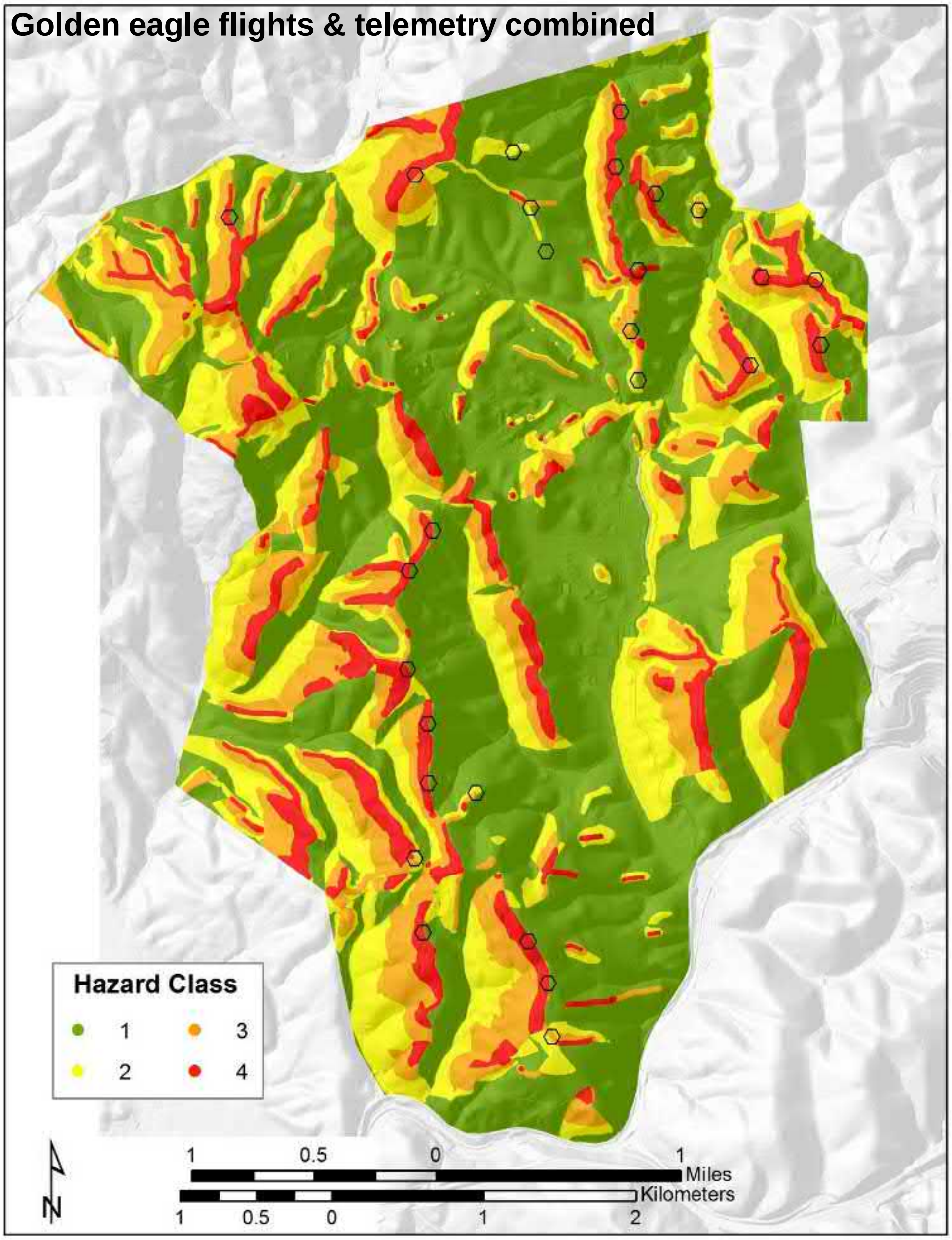


***Figure 30**. Fuzzy Logic likelihood surface classes of golden eagle flight behavior and telemetry data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

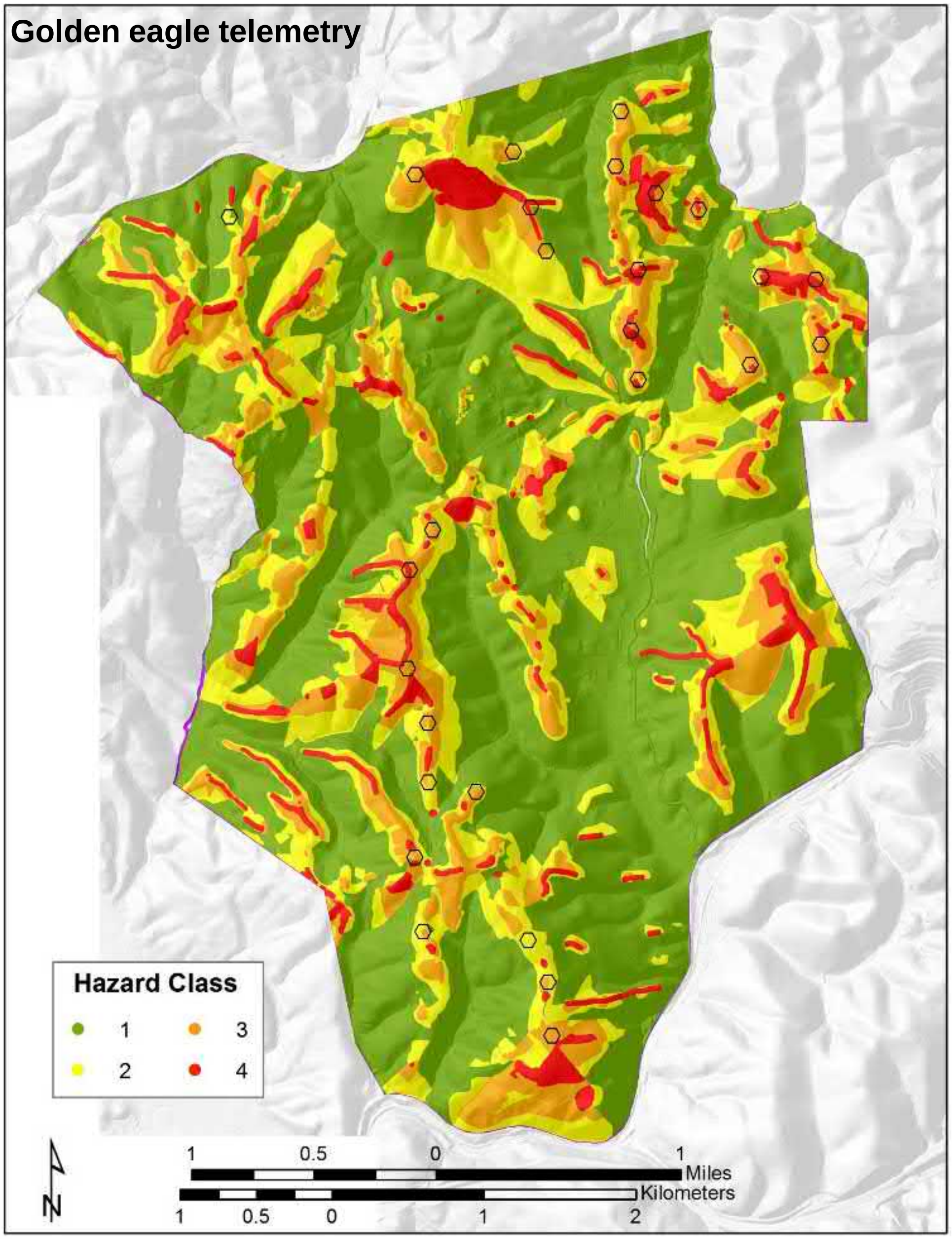


Figure 31. *Fuzzy Logic likelihood surface classes of golden eagle telemetry data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

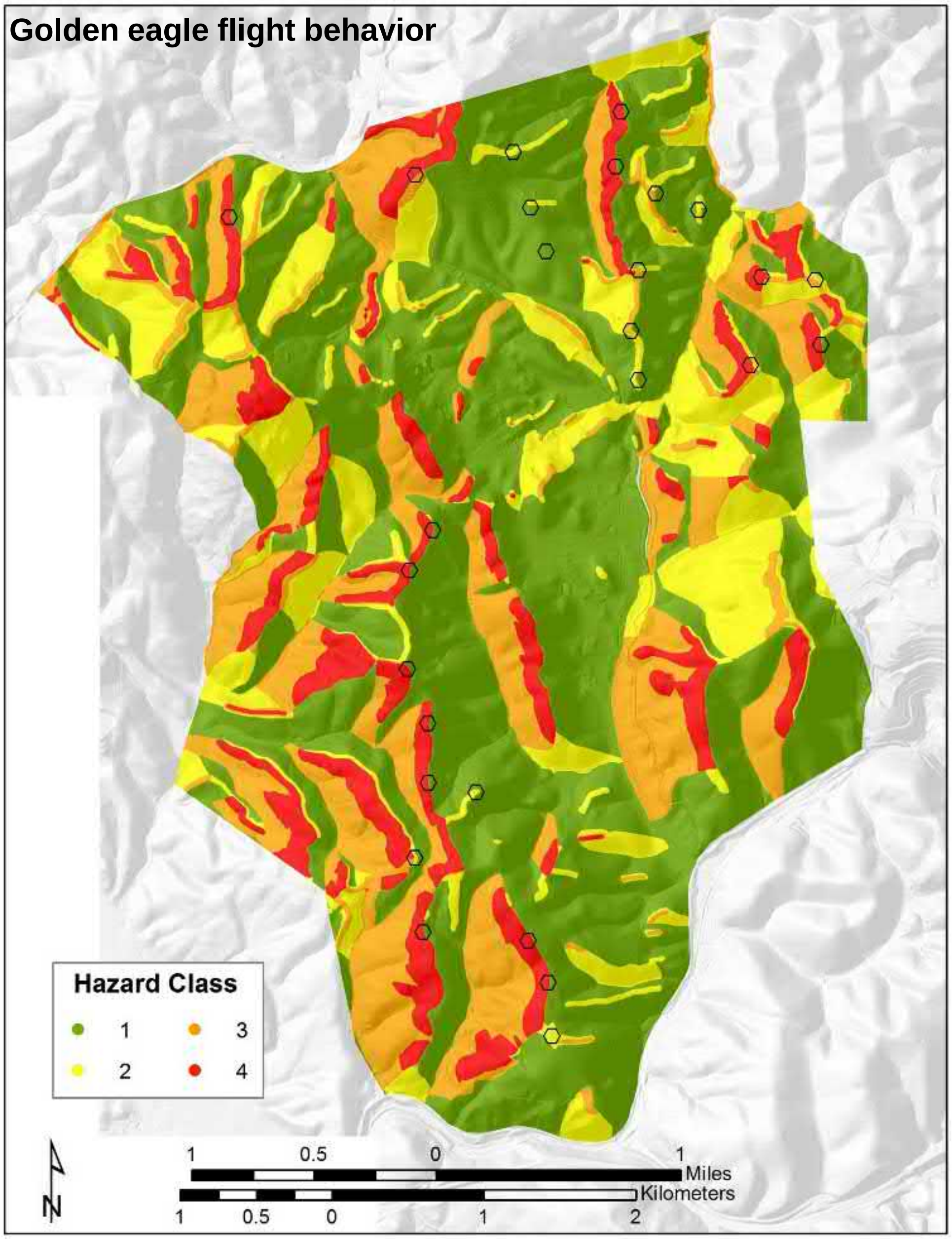


Figure 32. *Fuzzy Logic likelihood surface classes of golden eagle flight behavior data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

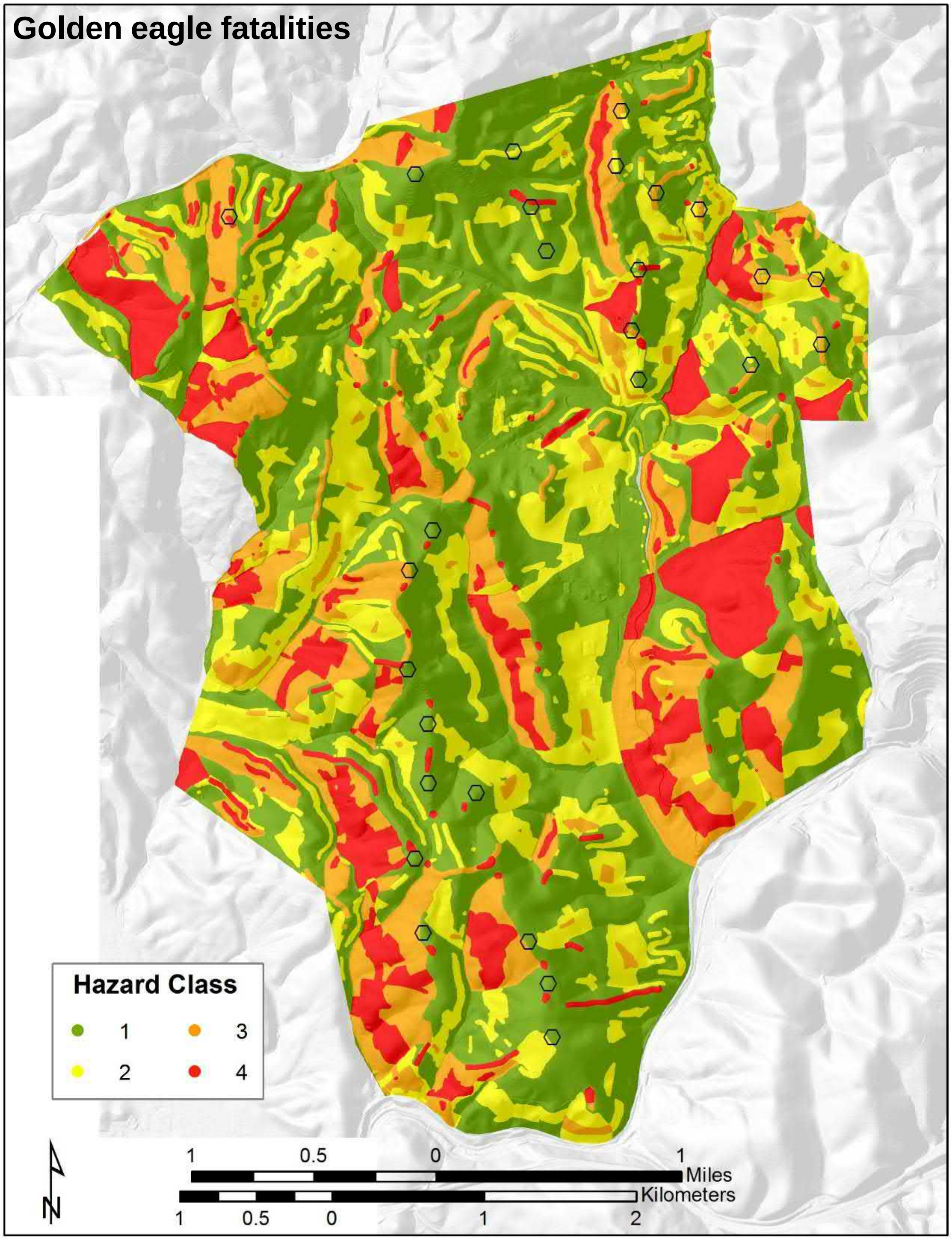


Figure 33. *Fuzzy Logic likelihood surface classes of golden eagle fatality data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

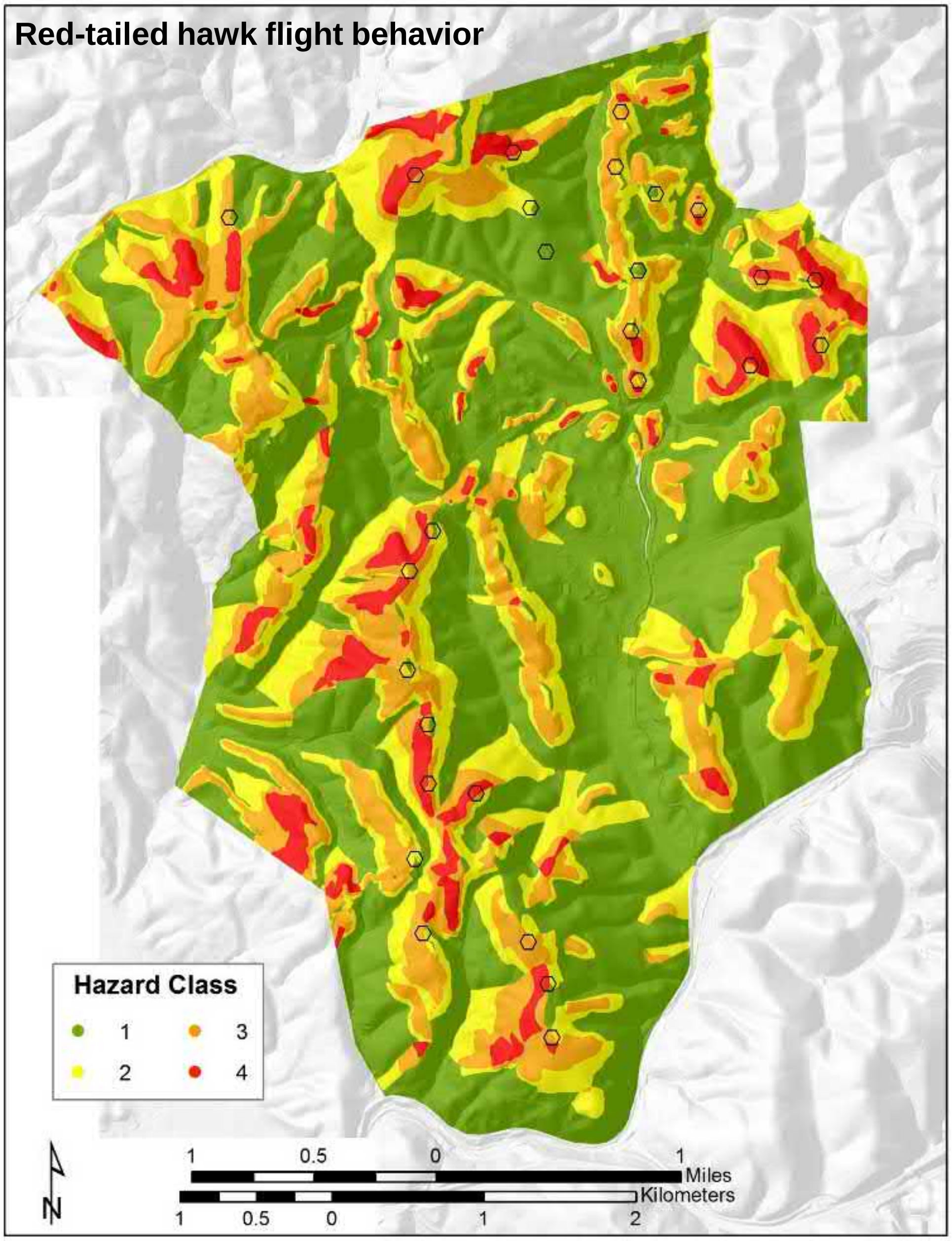


Figure 34. *Fuzzy Logic likelihood surface classes of red-tailed hawk flight behavior data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

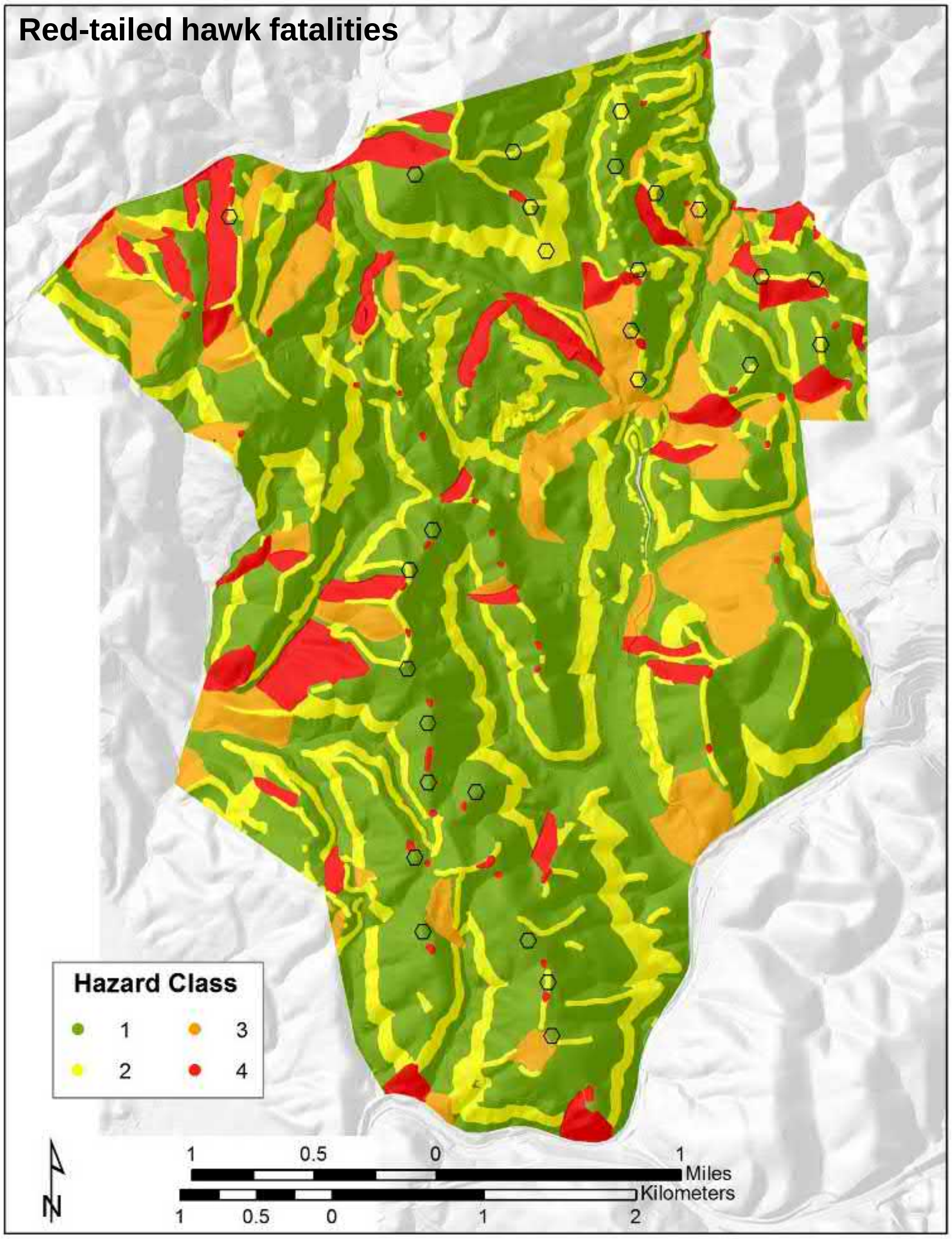


Figure 35. *Fuzzy Logic likelihood surface classes of red-tailed hawk fatality data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

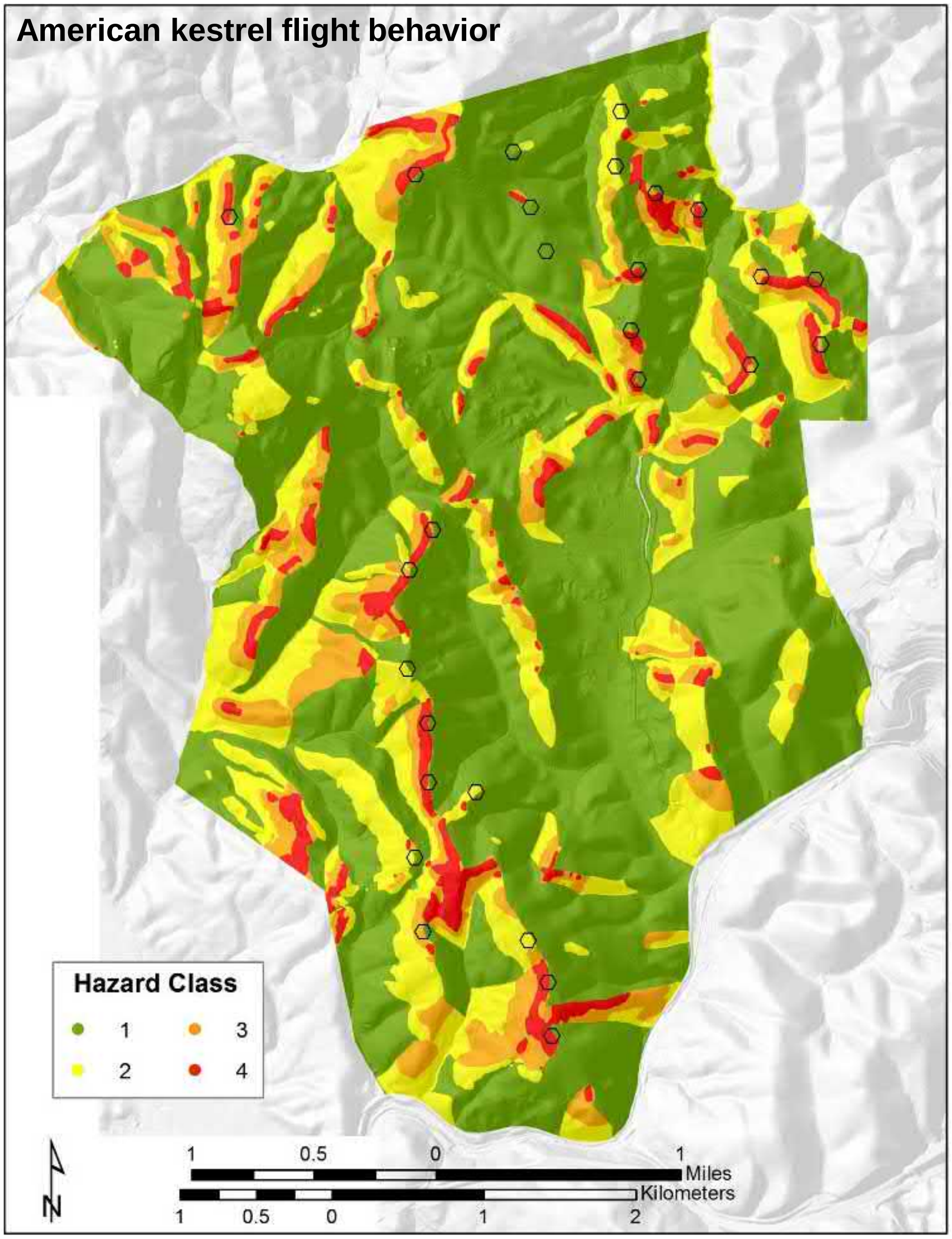


Figure 36. *Fuzzy Logic likelihood surface classes of American kestrel flight behavior data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

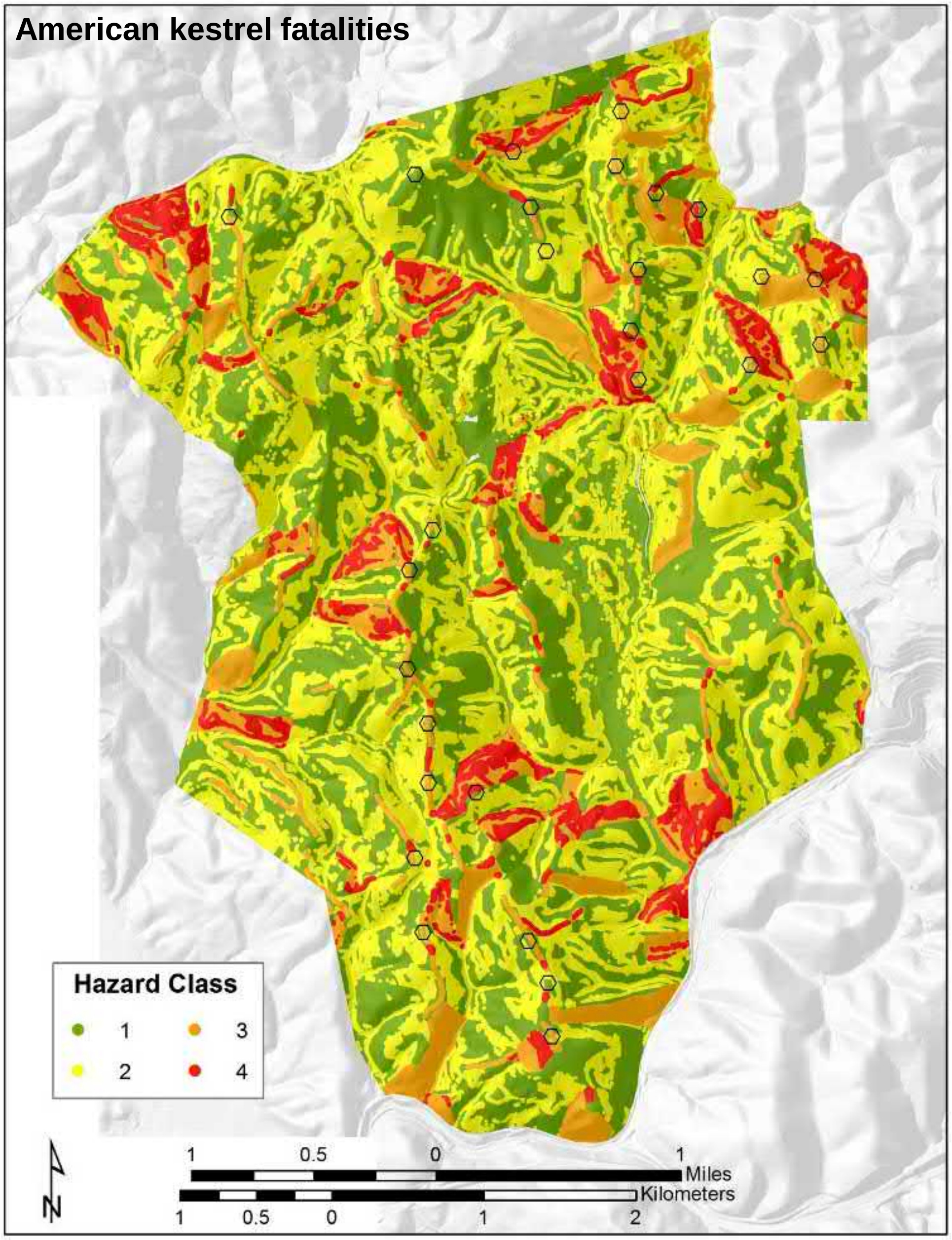


Figure 37. *Fuzzy Logic likelihood surface classes of American kestrel fatality data across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

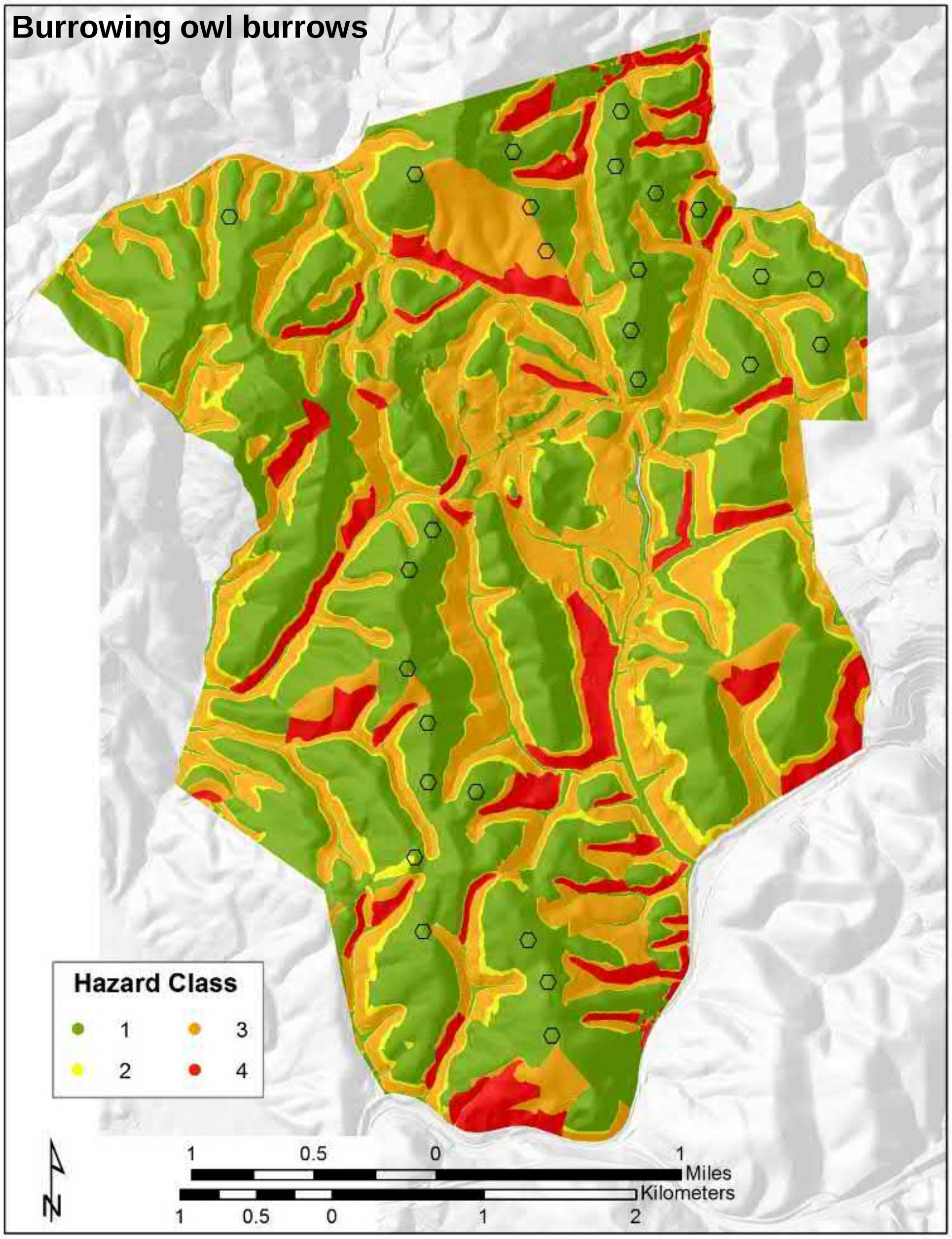


Figure 38. *Fuzzy Logic likelihood surface classes of burrowing owl burrow locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

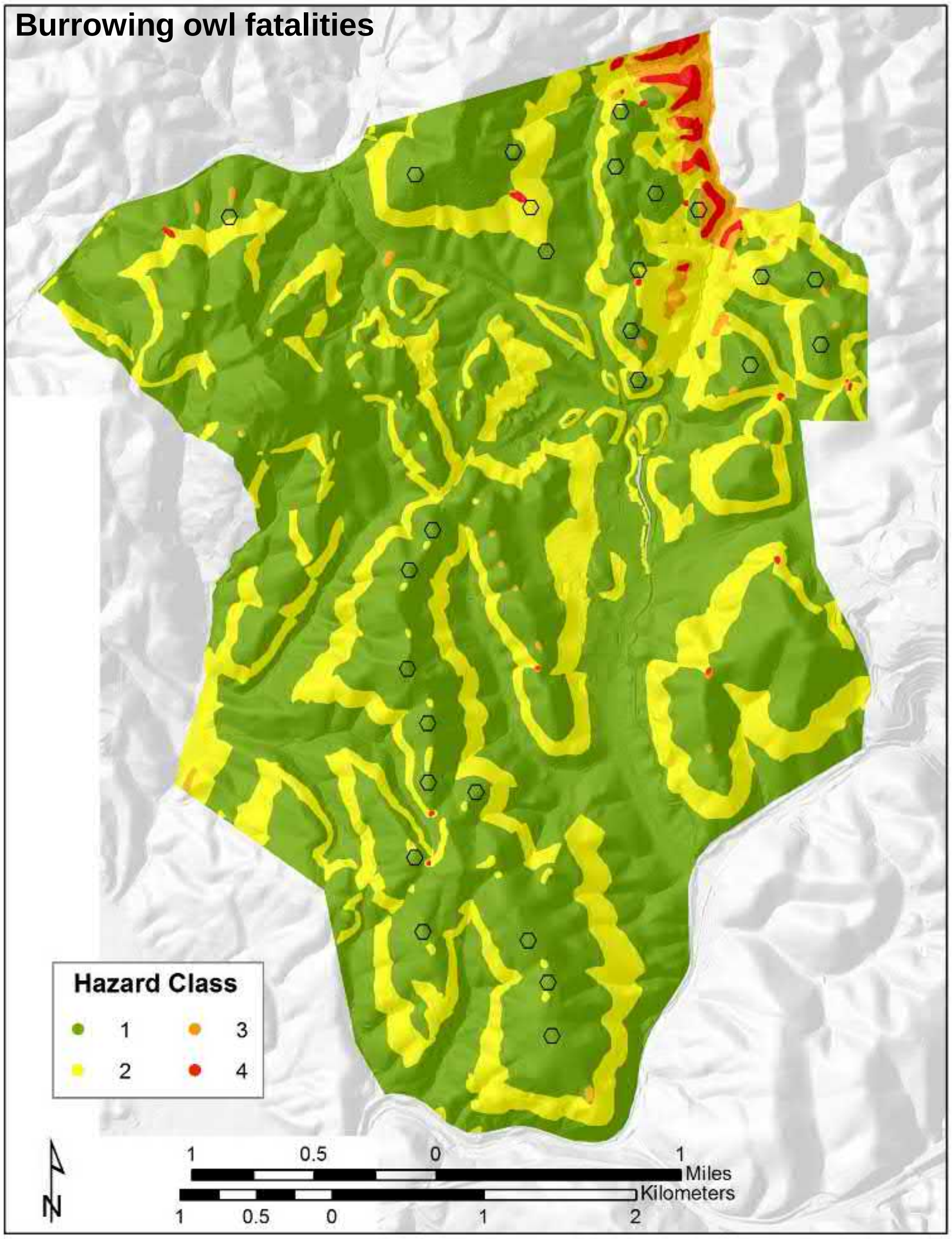


Figure 39. *Fuzzy Logic likelihood surface classes of burrowing owl fatality locations across the Summit Winds project area, Altamont Pass Wind Resources Area, California, where red corresponds with the highest likelihood of burrowing owl collision, orange corresponds with the second highest likelihood, yellow corresponds with the third highest likelihood, and dark green corresponds with the least likelihood.*

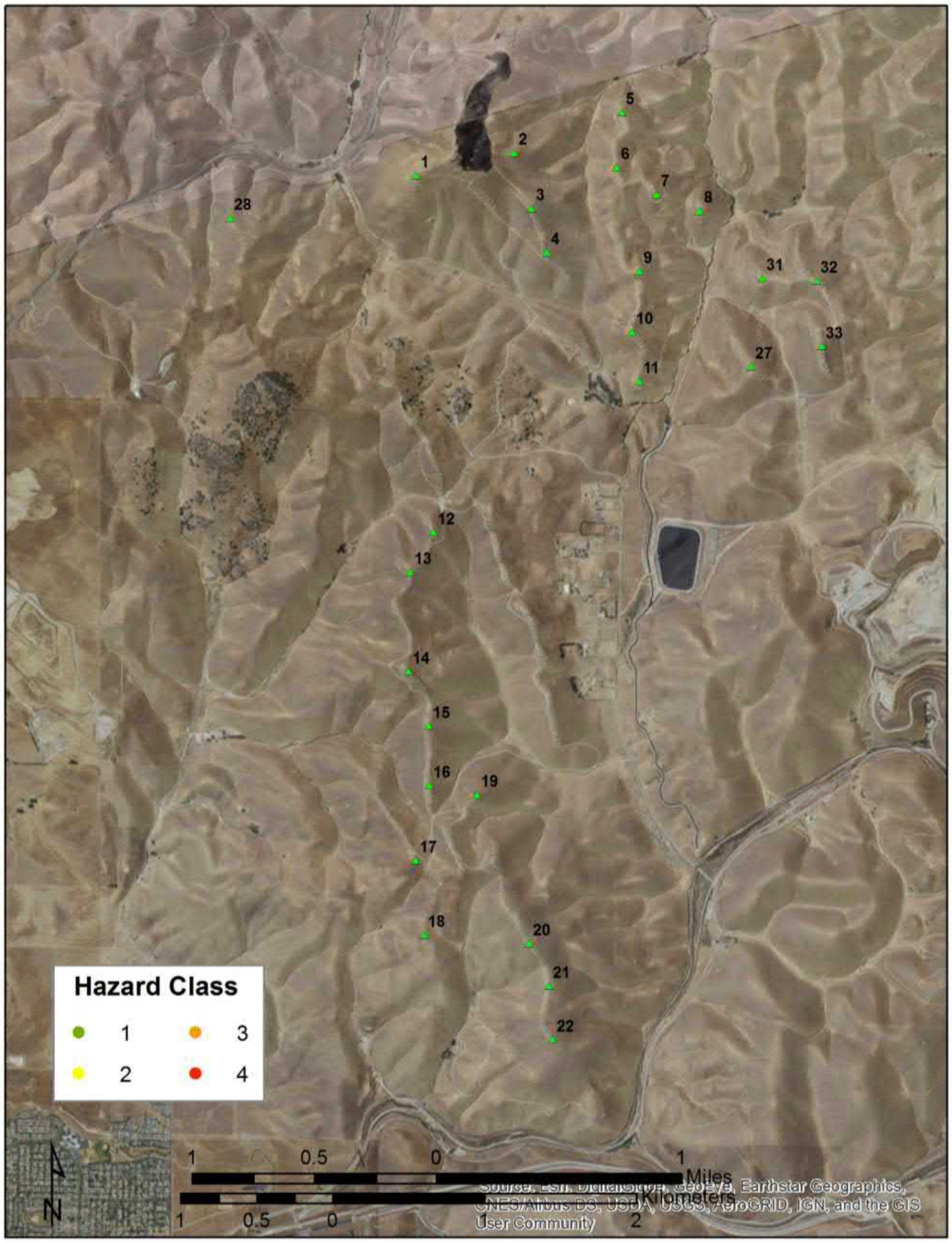
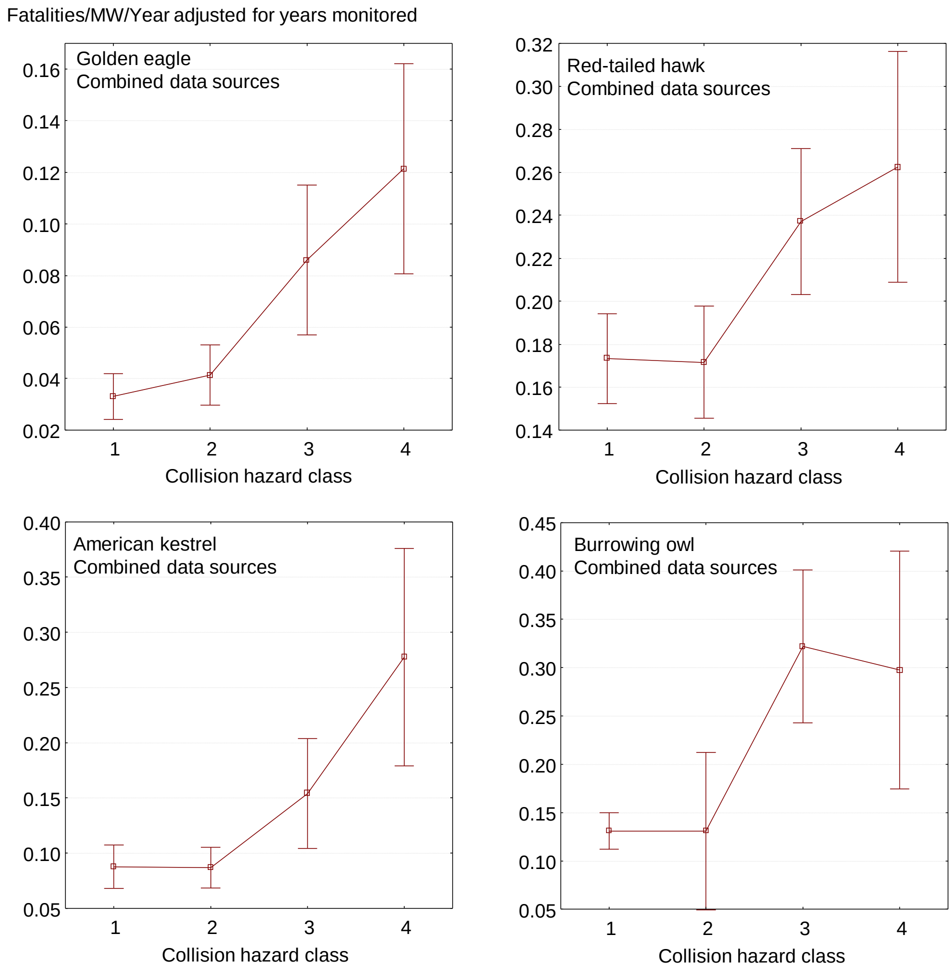


Figure 40. *Numbering of proposed wind turbine sites in the Summit Winds project as of 8 December 2016.*

REPORT ADDENDUM: COLLISION HAZARD MODEL PERFORMANCE

Shawn Smallwood and Lee Neher

12 December 2016



Collision hazard model performance assessed by comparing mean fatality rates by hazard class.

ASSESSMENT OF IMPACTS TO RAPTORS BY PROPOSED SHIFTS IN FIVE WIND TURBINE LOCATIONS AT SUMMIT WINDS REPOWERING PROJECT, ALTAMONT PASS WIND RESOURCE AREA

K. Shawn Smallwood

3 May 2018

I was asked to assess the potential impacts on raptors by shifting the address locations of 5 wind turbines in the Summit Winds project. The turbine addresses proposed for relocation included 3, 4, 6, 7, and 12. I asked Lee Neher to overlay the proposed new addresses onto our collision hazard maps for each of the focal raptor species, including Golden eagle (GOEA), red-tailed hawk (RTHA), American kestrel (AMKE), and burrowing owl (BUOW) (Smallwood and Neher 2016). From these overlays of the proposed new turbine sites I identified the underlying collision hazard class, 1 through 4, where 1 is the lowest and 4 the highest. I also visited each proposed new turbine site and rated it for collision hazard using the 0 to 10 point scale implemented by the Alameda County Scientific Review Committee. I assessed each site for likely grading impacts, where impacts are caused by berms or cut slopes remaining after grading for wind turbine pads and access roads. Finally, I reviewed the available historical data on raptor fatalities and how long each turbine was included in scientific fatality monitoring. Some fatalities had been reported from the non-scientific Wildlife Reporting and Response System maintained by the wind companies.

All of the proposed new wind turbine sites are located in areas used intensively by golden eagles. This said, all but one of the proposed new sites would be associated with micro-terrain conditions that are more hazardous that the original sites (Table 1). The exception would be site 6. The collision hazard model prepared for golden eagle predicts the same hazard level between the original and proposed new site 4 as well, but I predict greater hazard in the proposed new site due to its location within a slight break in slope, which would be used disproportionately by eagles and red-tailed hawks moving across the greater ridge structure (see SRC-style hazard ratings in Table 1). At sites 3, 7 and 12, the collision hazard model predicts substantial increase in risk to golden eagles because the new sites would be in the highest collision hazard class 4. Collision hazard is also predicted to increase at these sites for red-tailed hawk and American kestrel (Table 1).

The proposed new turbine site 7 is low on the ridgeline and would require significant grading of a notch into the slope to accommodate the pad and turbine tower. I rated the site the highest possible collision hazard of 10 out of 10. I believe this site would be the most dangerous to golden eagles among the five proposed sites, and it would be more dangerous than the original site.

In summary, all of the proposed new sites, except for site 6, would increase collision hazard to golden eagle. Most of the proposed site changes would also increase collision hazard for red-tailed hawks, American kestrels and burrowing owls. The sites proposed earlier, and which I assessed in Smallwood and Neher (2016), would generally be safer to raptors.

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Table 1. Summary of collision hazard assessments between the original (left of arrow) and proposed new (right of arrow) turbine sites, where GOEA = golden eagle, RTHA = red-tailed hawk, AMKE = American kestrel, BUOW = burrowing owl. There is also a new improved burrowing owl model (New BUOW), the performance of which was summarized in Smallwood and Neher (2018).

Site	Hazard Class					SRC-style Rating	Explanation
	GOEA	RTHA	AMKE	BUOW	New BUOW		
3	2→4	2→4	2→4	3→4	2→3	7→9	Newer site is further into the saddle and away from the bench
4	1→1	1→1	1→1	3→3	1→2	5→7.5	Low terrain either way, but new site is more hazardous on break in slope and would likely require grading that would leave a significant cut slope uphill of the turbine pad
6	3→3	3→3	2→3	1→1	2→3	7→7	High GOEA and RTHA traffic area either way, but same hazard levels
7	3→4	1→3	2→4	1→1	2→3	8→10	New site is low on steeply declining ridgeline, thus more hazardous
12*	2→4	2→3	2→4	1→1	2→2	8→7	High use area either way, but my SRC-style hazard rating differs from the collision hazard model prediction for GOEA. The new site would be farther from the intersection of saddles at the apices of ravines either side of the larger ridge structure, which should be safer for GOEA. However, I concur with the model predictions for RTHA and AMKE.

* This proposed site is near where site 13 had been proposed in Smallwood and Neher (2016).