Attachment 1

Final Environmental Assessment
Shiloh IV Wind Project Eagle Conservation Plan

U.S. Fish and Wildlife Service

Final
Environmental Assessment

Shiloh IV Wind Project Eagle Conservation Plan

California

Prepared by

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June 2014

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Abbreviations

AB	Assembly Bill
ABPP	Avian and Bat Protection Plan
ACPs	Advanced Conservation Practices/Advanced Conservation Measures
APP	Avian Protection Plan
BBCS	Bird and Bat Conservation Strategy
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BUC	bird use count
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQ	Council for Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CM	Conservation Measure
CPUC	California Public Utilities Commission
CO_2	carbon dioxide
CTS	California tiger salamander (*Ambystoma californiense)*
DEA	draft environmental assessment
Eagle Act	Bald and Golden Eagle Protection Act
EC	Environmental Commitment
ECP	Eagle Conservation Plan
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Federal Endangered Species Act
FEA	Final Environmental Assessment
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
LAP	local area population
MBPM-2	Migratory Bird Permit Memorandum
MBTA	Migratory Bird Treaty Act
MW	megawatt
NABCI	North American Bird Conservation Initiative
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
permit	programmatic eagle take permit
PG&E	Pacific Gas and Electric Company
REA	Resource Equivalency Analysis
RSA	rotor swept area
Service	U.S. Fish and Wildlife Service
Shiloh IV	Shiloh IV Wind Project, LLC
SR	State Route
SWPPP	stormwater pollution prevention plan
U.S.C.	United States Code
WRA	Wind Resource Area

Chapter 1

Purpose and Need

1.1 Introduction

We, the U.S. Fish and Wildlife Service (Service), have prepared this Final Environmental Assessment (FEA) pursuant to the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321 et seq.). This FEA evaluates the effects of issuing a programmatic eagle take permit (permit) for take that is incidental to otherwise lawful activities under the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668–668d and 50 Code of Federal Regulations [CFR] 22.26) for operational activities described in the Shiloh IV Wind Project Eagle Conservation Plan (ECP). Our *Eagle Conservation Plan Guidance Module 1: Land-based Wind Energy Version 2* (Service 2013) (ECP Guidance) recommends that eagle take permit applications include an ECP, or similar documentation, that details the impacts of the incidental take on affected eagle species and how these impacts will be avoided, minimized, and mitigated, and that provides for stable or increasing populations of eagles.

The applicant, Shiloh IV Wind Project, LLC (Shiloh IV), is requesting Eagle Act programmatic take coverage for operational activities associated with the Shiloh IV Wind Project. This company is an affiliate of EDF Renewable Development, Inc. Shiloh IV's ECP (Appendix A) is the foundation of their permit application. Our decision as to whether to issue an eagle take permit constitutes a discretionary Federal action that is subject to NEPA. The applicant requested a permit for the take of 3 eagles over the 5 year duration of a permit. In this FEA, we independently analyze Shiloh IV's risk of eagle take and evaluate the permit application for consistency with the Eagle Act permit regulations.

The project area is in the Montezuma Hills region of southeastern Solano County, about halfway between San Francisco and Sacramento, California (Figure 1-1). The Montezuma Hills region is a sparsely populated rural agricultural area in the Sacramento Valley, south of State Route (SR) 12, north of the Sacramento River, and east of Suisun Marsh. The easternmost point of the project area is about 6 miles west of Rio Vista, California, and about 7 miles southeast of Fairfield, California. Solano County has designated the Montezuma Hills as land suitable for wind energy development (Solano County 2008).

The Montezuma Hills Wind Resource Area (WRA) was established on the basis of wind energy monitoring and assessment studies conducted by the California Energy Commission (CEC), Pacific Gas and Electric Company (PG&E), and the Bureau of Reclamation during the late 1970s and 1980s. It is one of the largest operating WRAs in the state and includes more than 550 utility-grade wind turbines in a landscape of dryland farming and grazing. As of April 2013, there are 12 operating wind facilities in the Montezuma Hills (Figure 1-2):

- enXco V: 50 Kennetec 56-100 turbines, 90 feet tall
- enXco V Repowering: 6 General Electric 1.5MW turbines, 340 feet tall
- High Winds: 90 Vestas V-80 turbines, 330–350 feet tall
- Shiloh I: 100 General Electric 1.5MW turbines, 340 feet tall
- Shiloh II: 75 REpower MM92 turbines, 372–415 feet tall
- Montezuma I: 16 Siemens 2.3 turbines, 415 feet tall.

- Solano Wind Phase 1: 23 V-47 turbines, up to 291 feet tall
- Solano Wind Phase 2A and 2B: 29 Vestas V-90 turbines, 410 feet tall
- Solano Wind Phase 3: 55 Vestas V-90 turbines, 410 feet tall
- Shiloh III: 50 REpower MM92 turbines, 377–409 feet tall
- Montezuma II: 34 Siemens 2.3 turbines, 415 or 428 feet tall
- Shiloh IV: 50 REpower MM92 turbines, 377–409 feet tall

This FEA evaluates potential impacts that could result from the issuance of the programmatic eagle take permit based on the Shiloh IV ECP or alternatives to the proposed ECP. It is intended to assist us in evaluating effects on the human environment and in assessing the significance of the impacts that could result from the alternatives. "Significance" under NEPA is defined by regulation at 40 CFR 1508.27, and requires short-term and long-term consideration of both the context of a proposal and its intensity. As required by NEPA, all alternatives must undergo an equal level of analysis, and the final proposal may include all or some components of a single alternative, or it may include a combination of components from more than one alternative. Alternative 3 is our Preferred Alternative because it provides mitigation consistent with our mortality estimate and ensures that eagle fatalities are detected.

Our analysis within this FEA shows that while the incremental effect of the project is small and the impact intensity is lower than that of other Wind Resource Areas in the local area, the project could contribute to local and possibly regional adverse effects on the species. We anticipate that, by issuing a permit, the Service would ensure that take of eagles would be offset through implementation of Advanced Conservation Practices (ACPs) and by providing compensatory mitigation.

1.2 Project Background

The permit applicant, Shiloh IV, is operating a 100 megawatt (MW) commercial wind energy facility, consisting of 50 wind turbines, each with a 2 MW generation capacity, in the Montezuma Hills WRA of Solano County, California. Shiloh IV currently collects and delivers renewable energy to the California Independent System Operator (CAISO) power grid. The project contributes to California's Renewable Energy Portfolio Standard goals and helps reduce greenhouse gas (GHG) emissions pursuant to California Assembly Bill (AB) AB32 and Solano County's General Plan. California has a goal of generating 33% of the energy it uses through renewable energy sources, such as wind and solar energy, by 2020. The project generates far less GHG emissions than traditional generation methods such as fossil fuel power plants. The project is consistent with policies in the Solano County General Plan that encourage local power production and allow the conditional development of wind projects in this area.

The Shiloh IV Wind Project was constructed adjacent to other existing wind energy producing facilities—the Shiloh I, Shiloh II, and Montezuma II projects—and close to the High Winds project (Figure 1-2). The Shiloh IV Wind Project was a repowering and infill project, the largest of its type in the nation, entailing the decommissioning and removal of approximately 230 Kennetech wind turbines (each with a generation capacity of 100 kW), that were part of the enXco V Wind project constructed in the late 1980s.

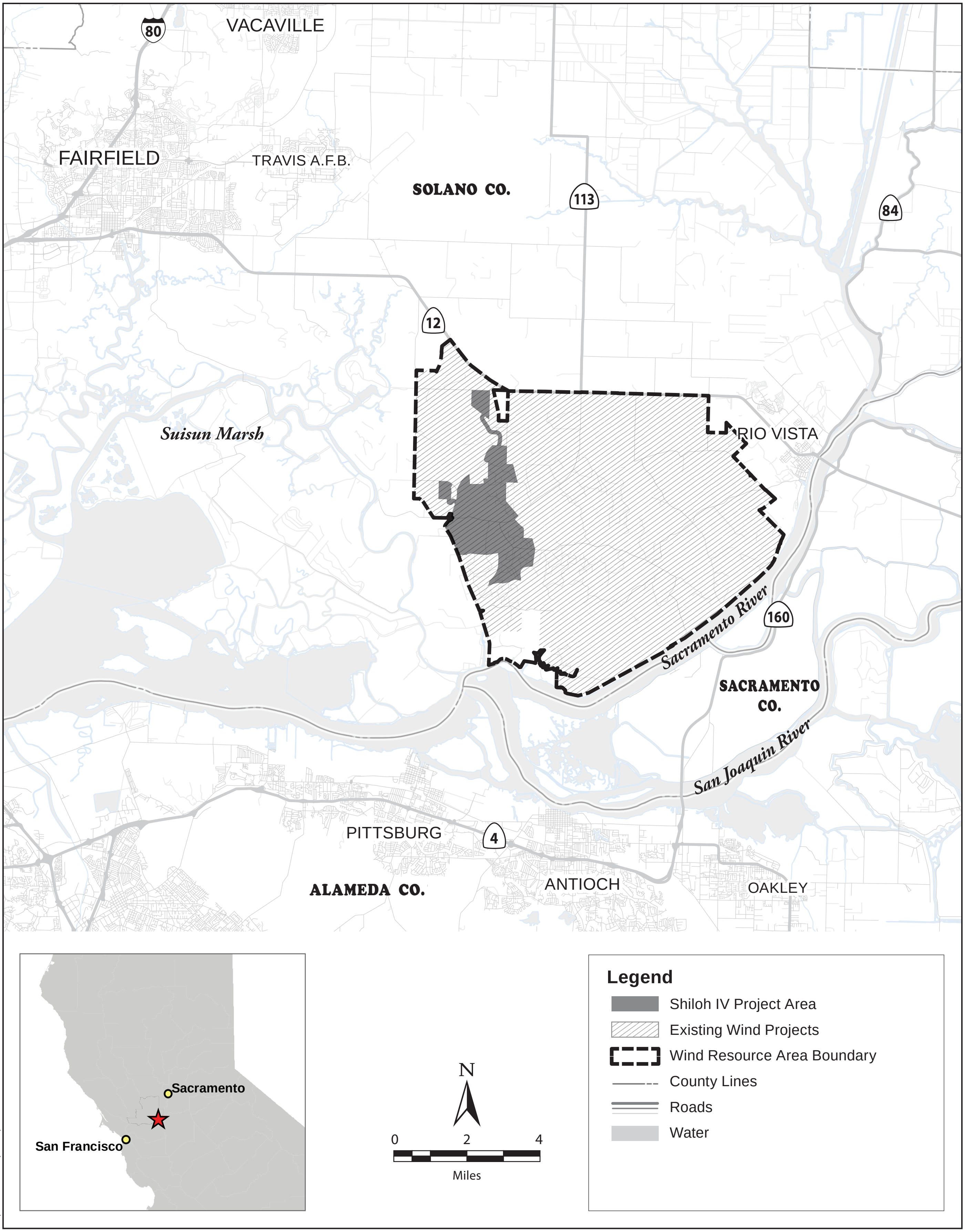

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Figure 1-1
Shiloh IV Project Location

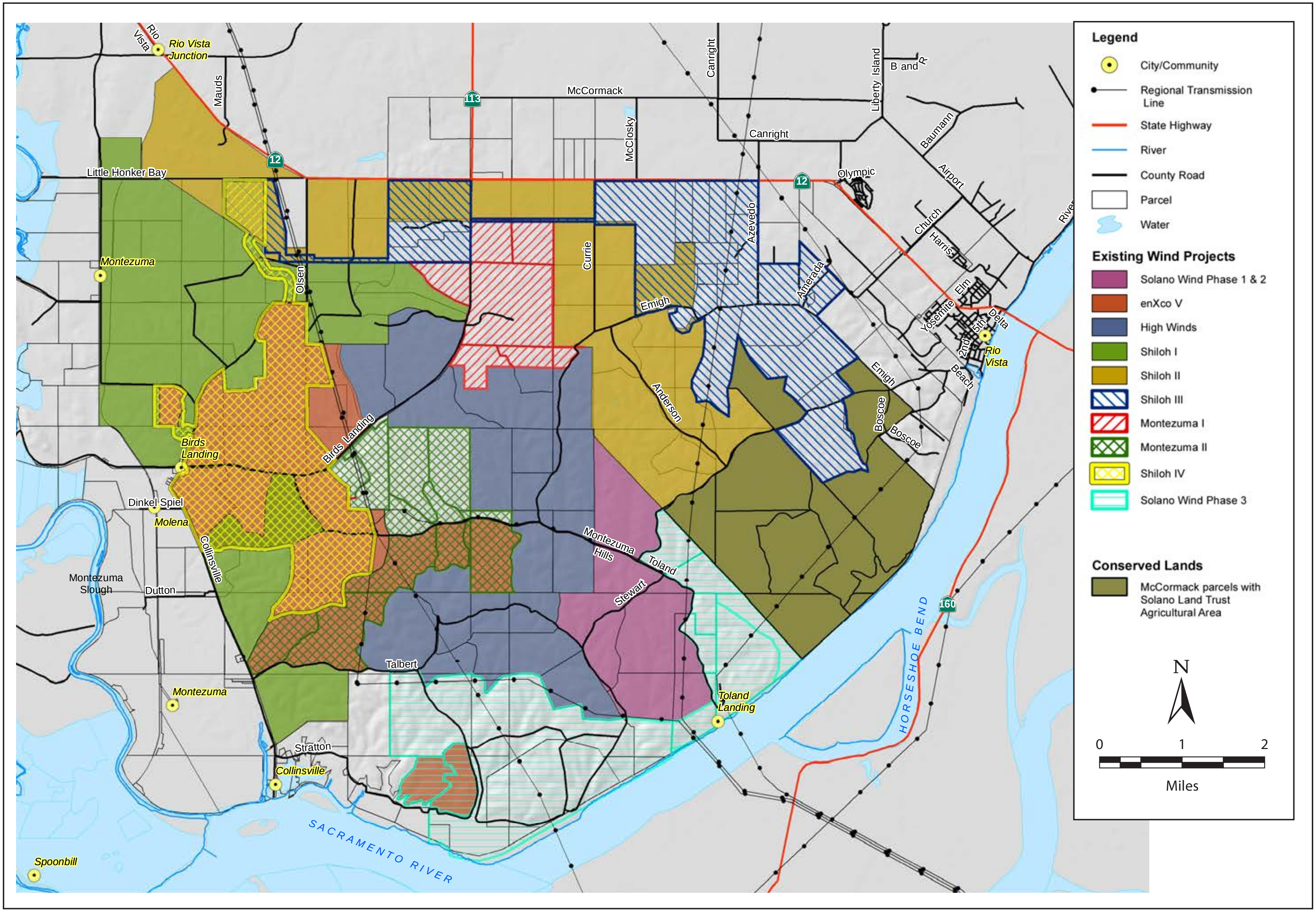

Figure 1-2
Wind Projects in the Montezuma Hills WRA

The project, located entirely on private lands, was subject to local land use approvals. Wind projects are allowed as conditional uses under Solano County Zoning Regulations and under the County's General Plan, but are subject to review under the California Environmental Quality Act (CEQA). In this case, Solano County was the CEQA lead agency. An Environmental Impact Report (EIR), pursuant to CEQA, was prepared by Solano County and was certified by the County's Planning Commission on December 15, 2011 (Solano County Department of Resource Management 2011a, 2011b).

We issued an Incidental Take Permit (ITP) to Shiloh IV pursuant to Section 10(a)(1)(B) of the Federal Endangered Species Act (ESA) for potential effects on California tiger salamander (*Ambystoma californiense*) (CTS). A Habitat Conservation Plan (HCP) was developed by the applicant to ensure that impacts on California tiger salamander would be avoided, minimized, and mitigated pursuant to ESA Section 10. We prepared a Draft Environmental Assessment (DEA) for the HCP; the DEA was noticed in the Federal Register for a 60-day public comment period in December 2011. We received no comments. A FEA and Finding of No Significant Impact (FONSI) were prepared, and an ITP was issued in April 2012.

A list of permits obtained and in process by Shiloh IV are listed in Table 1-1.

Table 1-1. Shiloh IV Permits

Permitting Agency	*Permit*	*Status*
Federal		
U.S. Fish and Wildlife Service	Incidental Take Permit—California tiger salamander (CTS)	Complete
U.S. Fish and Wildlife Service	Programmatic Incidental Take Permit—Golden Eagle	Pending
State		
California Department of Fish and Wildlife	Incidental Take Permit—CTS	Complete
California Department of Fish and Wildlife	Streambed Alteration Agreement	Complete
California State Water Resources Control Board	General Construction Permit	Complete
Local		
Solano County Department of Resource Management	Conditional Use Permit (U-10-10)	Complete

Our Division of Migratory Bird Management has been meeting with the applicant since early 2011 regarding the potential for the Shiloh IV Wind Project to affect migratory birds, eagles, and bats. Shiloh IV initially submitted an Avian and Bat Protection Plan (ABPP) for the Shiloh IV Wind Project in July 2011. However, we recommended that Shiloh IV prepare an ECP and a Bird and Bat Conservation Strategy (BBCS) in late 2011 in keeping with evolving policy and management guidance (see section 1.4 below). We received a draft ECP in February 2012.

Under the 2011 version of the ECP Guidance, our review of the February 2012 ECP resulted in our designation of the project as Category 2: "high to moderate risk to eagles but there are opportunities to mitigate the impacts." We continued to provide technical assistance to the applicant on the ECP management strategy. Subsequently, Shiloh IV revised the ECP and submitted it on August 3, 2012 (Appendix A), as part of their permit application package.

1.3 Purpose of and Need for the Federal Action

The purpose of the Federal action is to consider issuing a permit to the operational Shiloh IV Wind Project under the Eagle Act for programmatic take of eagles. This is driven by a need for the Service to make a permitting decision that may enable Shiloh IV to continue to generate renewable energy in a manner that is in consistent with our Eagle Act regulations. In responding to the request for a permit, we, the Service, must ensure compliance with the Eagle Act and our goal to maintain stable or increasing breeding populations of bald and golden eagles. We may consider issuance of programmatic eagle take permits if 1) the incidental take is necessary to protect legitimate interests, 2) the take is compatible with the preservation standard of the Eagle Act, 3) the take has been avoided and minimized to the degree achievable though implementation of ACPs and the remaining take is unavoidable, and 4) compensatory mitigation will be provided for any remaining take.

This purpose and need establishes the basis for determining if other viable alternatives to the applicant's Proposed Action, as described in the ECP (Appendix A), may meet the project's intended purpose and reduce potential effects. Alternatives considered in this analysis are the No-Action Alternative and three action alternatives, including the Proposed Action.

1.4 Regulatory Setting, Authorities, and Guidance

Two primary Federal statutes, the Eagle Act and the Migratory Bird Treaty Act (MBTA), as well as regulations and guidance under those statutes, provide the basis for our review of the Proposed Action.

1.4.1 Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668–668d) makes it illegal to import, export, take (which includes molest or disturb), sell, purchase, or barter any bald eagle or golden eagle or parts thereof. The Service oversees enforcement of this act. Under the Eagle Act (72 FR 31132, June 5, 2007), "take" is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest or disturb." "Disturb" is defined as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

"Disturb" was defined in 2007 (72 FR 31132) as "to agitate or bother a bald or golden eagle to a degree that causes…injury to an eagle, reduced productivity, or nest abandonment…"

With the removal in 2007 of bald eagle from the ESA list of threatened and endangered species, we issued new regulations to authorize the limited take of bald and golden eagles under the Eagle Act, where the take that may be authorized is associated with otherwise lawful activities. A final Eagle Permit Rule was published on September 11, 2009 (74 FR 46836–46879; 50 CFR 22.26 and 22.27).

Under these new rules the Service can issue permits that authorize individual instances of take of bald and golden eagles when the take is associated with, but not the purpose of, an otherwise lawful activity and cannot practicably be avoided. The regulations also authorize permits for "programmatic" take, which means that instances of "take" may not be isolated, but may recur. The programmatic take permits are the most germane permits for wind energy facilities. However, under these regulations, any ongoing or programmatic take must be unavoidable even after the implementation of ACPs. We developed the ECP Guidance to provide recommendations for the development of ECPs in support of issuance of programmatic eagle take permits for wind facilities. The Draft Guidance was published in the Federal Register on February 18, 2011 (76 FR 9529), and a revised version was published in May 2013 (78 FR 25758, May 2, 2013).

Although eagles are protected by both the MBTA and the Eagle Act, MBTA take authorization is not required because the Eagle Permit Rule exempts those who hold Eagle Act permits from the requirement to obtain an MBTA permit (50 CFR 22.11[a]).

1.4.2 Migratory Bird Treaty Act

The MBTA protects migratory birds and prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the Service (16 U.S.C. 703; 50 CFR 21; 50 CFR 10). Under the MBTA, "take" is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture or collect." Most actions that result in taking or the permanent or temporary possession of a protected species or nests containing eggs or young constitute violations of the MBTA. We are responsible for overseeing compliance with the MBTA. Most bird species and their occupied nests that occur in the project area are protected under the MBTA. The bird species protected by MBTA are listed in 50 CFR 10.13.

The Service's *Migratory Bird Permit Memorandum* (MBPM-2) (Service 2003) dated April 15, 2003, clarifies that the destruction of most unoccupied bird nests (containing no birds or eggs) is permissible under MBTA. However, unoccupied nests of federally listed threatened or endangered bird species and eagles are protected under ESA (16 U.S.C. 1531, 1543) and the Eagle Act (16 U.S.C. 668).

Shiloh IV has prepared a BBCS (Appendix B) as outlined in the Service's Land Based Wind Energy Guidelines (Service 2012a), in coordination with the Service, which addresses bats and migratory birds and sets forth measures to avoid, minimize, and implement voluntary conservation measures to offset effects of the project on those species. It must be noted that the MBTA has no provision for allowing unauthorized take, and issuance of an Eagle Act permit shall not be construed to authorize take of migratory birds.

1.4.3 National Environmental Policy Act

Federal agencies must complete environmental documents pursuant to NEPA (42 USC 4321 et seq.) before implementing Federal actions. Such documents help ensure that the underlying objectives of NEPA are achieved: to disclose environmental information, assist in resolving environmental problems, foster intergovernmental cooperation, and enhance public participation. NEPA requires evaluation of the potential effects on the human environment related to the proposed action, alternatives to the proposed action, and a "No-Action Alternative."

An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a FONSI. If we determine that this project has "significant" impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a FONSI would be signed for the EA approving the alternative selected, and a Set of Findings may be prepared.

We have prepared this FEA pursuant to NEPA (42 U.S.C. 4321 et seq.), its implementing regulations (40 CFR 1500–1508), Department of Interior NEPA regulations (73 FR 61292–61323), and Department of Interior and Service NEPA policy and NEPA guidance. This FEA evaluates the environmental effects of issuing a programmatic eagle take permit under the Eagle Act (50 CFR 22.26).

1.4.4 Consultation and Coordination with Tribal Governments

Tribal participation is an integral part of the NEPA process, as well as a key component of determining whether to issue an eagle take permit. In accordance with Executive Order 13175 and our Native American Policy, we consult with Native American tribal governments whenever our actions taken under authority of the Eagle Act may affect tribal lands, resources, or the ability to self-govern. This consultation process is also intended to ensure compliance with the National Historic Preservation Act and American Indian Religious Freedom Act.

1.4.5 Department of Interior Adaptive Management Implementation Policy

This policy from the Department of the Interior states that Interior agencies should incorporate the operational components identified in *Adaptive Management: The U.S. Department of the Interior Technical Guide* (U.S. Department of the Interior 2009). These operational components include the definition of adaptive management, the conditions under which adaptive management should be considered, and the process for implementing and evaluating adaptive management effectiveness. Adaptive management is a decision process promoting flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. It is not a “trial and error” process, but rather one that emphasizes learning while doing. Adaptive management is considered here because of the challenges associated with avoiding, minimizing, and mitigating the take of eagles. Adaptive management is not an end in itself, but rather a means to more effective decisions and enhanced benefits. Accordingly, we have proposed an adaptive management framework for which ACPs can be applied to this project to address long-term effects. ACPs are defined as scientifically supportable measures that we approve and that represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level at which the remaining take is unavoidable (Service 2009).

1.5 Scope of Analysis

This FEA considers alternatives for issuance of a permit to take golden eagles at the Shiloh IV Wind Project. It analyzes the effects of our proposed issuance of a 5-year programmatic eagle take permit on the human environment and evaluates impacts over the 30-year duration of the project. The analysis primarily focuses on bald and golden eagles, but also addresses other elements of the human environment, including other potential avian, noise, visual, and cultural effects.

As referenced in the Council for Environmental Quality (CEQ) NEPA regulations regarding the contents of an EA (40 CFR 1508.9[b]), NEPA Section 102(2)(E) requires Federal agencies to develop, study, and briefly describe alternatives to any proposed action with the potential to result in unresolved resource conflicts. This FEA evaluates the effects of four alternatives:

- Alternative 1: No Action
- Alternative 2: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan
- Alternative 3: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Additional Mitigation and Monitoring Measures **(Service Preferred Alternative)**
- Alternative 4: Issue 5-Year Permit Based on Eagle Conservation Plan with Seasonal Restrictions

Each alternative's viability is evaluated for its ability to meet the Eagle Act permit issuance criteria as described in section 1.5.2.

1.5.1 Geographic Extent

The geographic scope of the analysis of all alternatives considers the local project level—the footprint of the Shiloh IV Wind Project and a 10-mile radius around it—and the local eagle population level. The local area population for both species is defined by the dispersal distance of young—43 miles for bald eagles and 140 miles for golden eagles (Service 2013). The Shiloh IV local area population for bald eagles is within the Service's Region 8, which includes all of California and Nevada and the Klamath Basin in Oregon. The local area population for golden eagles includes parts of four Federal Bird Conservation Regions (BCRs): BCR 32 (Coastal California), BCR 15 (Sierra Nevada), BCR 9 (Great Basin), and BCR 5 (Northern Pacific Rainforest) as shown in Figure 1-3 and summarized in Table 4-1.

1.5.2 Permit Issuance Criteria

In the analysis of alternatives, we consider the degree to which each alternative will conform to the permit issuance criteria for programmatic take permits under the Eagle Act. We may not issue a take permit under the Eagle Act unless the following issuance criteria are met as required in 50 CFR 22.26(f)(1–6):

1. The direct and indirect effects of the take and required mitigation, together with the cumulative effects of other permitted take and additional factors affecting eagle populations, are compatible with the preservation of bald eagles and golden eagles;
2. The taking is necessary to protect a legitimate interest in a particular locality;
3. The taking is associated with, but not the purpose of, the activity;
4. The taking cannot practicably be avoided; or for programmatic authorizations, the take is unavoidable;
5. The applicant has avoided and minimized impacts to eagles to the extent practicable, and for programmatic authorizations, the taking will occur despite application of advanced conservation practices; and
6. Issuance of the permit will not preclude issuance of another permit necessary to protect an interest of higher priority as set forth in paragraph (e)(4) of 50 CFR 22.26.

1.5.3 Previous Environmental Analysis

Previous environmental analysis was conducted for the project; these analyses are available in *Final Environmental Impact Report—Shiloh IV Wind Energy Project* (Solano County Department of Resource Management 2011b) and *Final Environmental Assessment for the Shiloh IV Wind Project Habitat Conservation Plan* (Service 2012b). These documents provide a foundation for the analysis of most other elements of the project related to the human environment, and consequently allow the current analysis to focus primarily on eagles and sensitive bird species. The analysis in the HCP FEA is hereby incorporated by reference into this FEA, as described in greater detail in chapter 4, *Environmental Consequences*.

1.6 Scoping and Public Participation

1.6.1 Internal Scoping

The Service engaged in an internal scoping process in the Pacific Southwest Region in November 2011. We worked with regional program leaders to determine the appropriate level of NEPA analysis for the Shiloh IV programmatic eagle permit application.

1.6.2 Public Scoping

The DEA was made available to the public for a 45-day comment period, allowing the public opportunity to provide comments on the content and scope of the document. No public comments were received during the HCP FEA process. Concern may be limited because Shiloh IV was a partial repowering project in an established wind resource area rather than an altogether new wind energy development.

1.7 Tribal Trust Coordination

As a first step in the consultation process, we requested a list of potentially affected tribes from the California Native American Heritage Commission (NAHC) on July 13, 2012. The NAHC responded on August 17, 2012, with a list of potentially affected tribes. We then contacted in writing each of the seven representatives of the Wintun Nation to solicit comments on the Proposed Action. This list was updated in May 2013 by contacting the Bureau of Indian Affairs to include all tribes within 140 miles of the project area. In July 2013, we sent letters to all 55 tribes within 140 miles of the project area soliciting comments and initiating a government-to-government consultation. In November and December 2013, we conducted follow-up phone calls to all 55 tribes, and in January 2014, we conducted a workshop with the tribes at EPA's Regional Tribal Operations Committee meeting. Comments were also encouraged and welcomed during the 45-day comment period on the DEA.

Previous tribal outreach was conducted as part of Solano County's approvals; no comments were received. Similarly, we conducted tribal outreach on the DEA for the project's HCP, attempting to contact the tribes by telephone, and no comments were received.

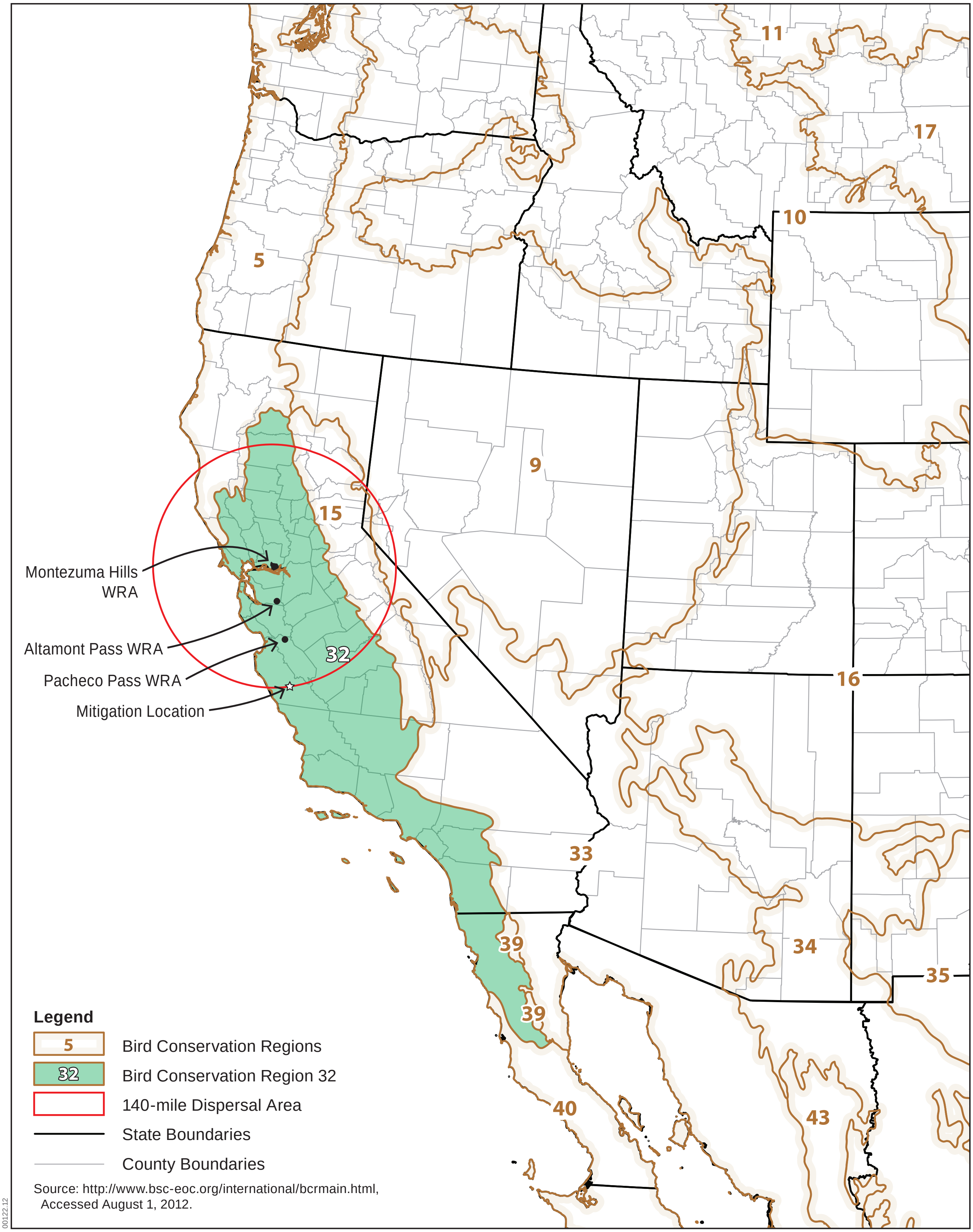

Figure 1-3
Bird Conservation Region Planning Area

Chapter 2

Alternatives

2.1 Introduction

As referenced in the CEQ's NEPA regulations regarding the contents of an EA (40 CFR 1508.9[b]), NEPA requires federal agencies to develop, study, and briefly describe alternatives to a proposed action and evaluate how those alternatives can resolve resource conflicts. This chapter describes the alternatives we considered during preparation of this FEA and alternatives that were considered but eliminated from further consideration. Alternative 3 is our Preferred Alternative.

2.2 Alternatives Analyzed in this FEA

2.2.1 Alternative 1: No Action

Under the No-Action Alternative, we would take no action or would deny the permit application and would not issue an eagle take permit. The wind project would continue to operate without a take permit being issued. We consider this alternative because NEPA requires evaluation of a No-Action Alternative, and either issuing or not issuing the permit are the potential responses to the permit application. Under the No-Action Alternative, we would deny the permit application because it fails to meet one or more of several issuing criteria under 50 CFR 22.26 as described in section 1.5.2, or because we have determined that the risk to eagles is so low that a take permit is unnecessary.

2.2.2 Alternative 2: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan

Under this alternative, we would issue a 5-year permit to take up to five golden eagles with associated conditions, as allowed by regulation. The permit would incorporate all conservation commitments described in the ECP (Appendix A) and the BBCS (Appendix B). The project would entail the operation of 50 turbines for 30 years and the implementation of ACPs outlined in the ECP. In addition, the applicant would provide compensatory mitigation by retrofitting 75 power poles in year 1 of permit issuance, and would provide for additional power pole retrofits as eagle take occurs.

2.2.3 Alternative 3: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Additional Mitigation and Monitoring Measures (Service Preferred Alternative)

Under this alternative, we would issue a 5-year permit to take up to five golden eagles with associated conditions, as allowed by regulation. The permit would incorporate all conservation commitments described in the ECP (Appendix A) and the BBCS (Appendix B) as well as additional mitigation and fatality monitoring. The additional mitigation involves retrofitting a total of 133 power poles in year 1 of permit issuance. The additional mortality monitoring consists of monitoring all turbines monthly for at least the first year to provide assurances that any potential eagle take is detected; subsequent annual monitoring will be determined in coordination between the Service and the applicant based on the results of the first year's intensive mortality monitoring.

2.2.4 Alternative 4: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Seasonal Restrictions

Under this alternative, we would issue a 5-year permit to take up to four golden eagles with associated conditions, as allowed by regulation. The permit would incorporate all conservation commitments described in the ECP (Appendix A) and the BBCS (Appendix B), but would also stipulate that operational restrictions be implemented to curtail individual turbines to further avoid and minimize potential take of eagles. Under this alternative, turbines would be curtailed during daylight hours for 2 months (June and July). Mitigation involves retrofitting a total of 101 power poles in year 1 of permit issuance.

2.2.5 Key Elements of Alternatives

A summary of the key components of the alternatives is provided in Table 2-1. The primary elements of each alternative are predicted take, mortality monitoring, compensatory mitigation, population effects, and ACP implementation. Each component is described following the table.

Table 2-1. Summary of Key Components of Alternatives

	Alternative 1 – No Action	*Alternative 2 – Issue 5-Year Permit based on Applicant's ECP*	*Alternative 3 – Issue 5-Year Permit based on Applicant's ECP with Additional Mitigation and Monitoring*	*Alternative 4 – Issue 5-Year Permit based on ECP with Reduced Operations*
Predicted Take:				
Annual	0.89	0.89	0.89	0.68
5 Years	5	5	5	4
30 Years	27	6–15[a]	6–15[a]	5–15[a]
Mortality Monitoring:				
# of Years	3	3+	3+	3+
Turbines Searched	50%	50%	100%	100%
Compensatory Mitigation	None	75 poles[b]	133 poles[c]	101 poles[c]
Population Effects	Yes	No	No	No
ACP Implementation	No	Yes	Yes	Yes

[a] ACPs will be implemented to reduce risk and fatality estimates; this range represents potential fatalities for the remainder of the operational duration.
[b] Additional poles would be completed as necessary as take occurs.
[c] If take is higher than predicted additional pole retrofits may be needed.

2.2.5.1 Predicted Take

In the ECP Guidance (Service 2013), we provided a mathematical model that estimates fatality risk at wind project sites. The model relies on a logical assumption that there is a positive relationship between the number of minutes eagles are present in the air near turbines, the number of turbines, and the risk of collisions by eagles. The results of the model estimate the possible number of fatalities per year at the project site for each of the alternatives. There have been few bald eagle observations and no fatalities in the Montezuma Hills WRA since wind facility development began during the late 1980s, and no bald eagle observations were made during preconstruction bird use surveys conducted by the applicant for the project.

Consequently, we did not run for bald eagles because we consider risk of take to be very low. If a bald eagle injury or fatality were to occur, the stepwise approach to ACPs would be applied, and we would work with Shiloh IV to determine if there is a need to amend the eagle take permit to include bald eagles.

Our model predicts eagle fatalities using Bayesian estimation based on golden eagle use data, risk area, and daylight operational hours (Service 2013). The technical details of our Shiloh IV golden eagle risk analysis is provided in Appendix C of this FEA and the results are summarized here. We evaluated both a low and a high level of daylight operational hours (3,600 and 3,850 hours/year) based on cut-in speeds of 3 meters/second. We used the more conservative, higher level (3,850 hours/year) to develop our fatality estimate. The resulting take prediction for golden eagles is 0.89 eagle annually or 4.46 eagles—rounded to 5 eagles—over a 5-year period. This is based on the 80th percent quantile assessment, indicating that there is an 80% chance that the impact would be less than or equal to the prediction. Thus, under the no-action alternative, in the absence of ACPs, 27 eagles could be taken over the 30-year life of the project compared to a predicted maximum of 15 eagles taken under the action alternatives (Table 2-1). Predicted take under Alternative 4 is lower because the alternative represents 900 fewer hours/year of operation.

The predicted take of golden eagles represents a worst-case assessment that conservatively estimates impacts on eagles. We have purposefully used these estimates to be protective of eagles and ensure that take authorization is not overallocated across the population.

2.2.5.2 Mortality Monitoring

Under all alternatives, the monitoring protocols for the project include annual postconstruction monitoring for 3 years from the initiation of power delivery, with the possibility of extending the monitoring period if results warrant. The monitoring program comprises three major field components:

- Avian use surveys to determine the seasonal and annual variations in relative abundance and species use patterns,
- Carcass surveys to search for the bodies of birds and bats killed by turbines or power transmission structures, and
- Carcass detection probability and removal monitoring for bias correction.

Results will be used to determine the effectiveness of mitigation measures and to determine which, if any, turbines produce disproportionately high levels of mortality.

As illustrated in Table 2-1, more than 3 years of monitoring may be required under the action alternatives, with additional monitoring being triggered by an eagle fatality. Fifty percent of the turbines are proposed to be monitored under Alternatives 1 and 2, but 100% of the turbines are proposed to be monitored for at least 1 year under Alternatives 3 and 4. The intent of the additional monitoring is to ensure that no dead eagles remain undetected.

2.2.5.3 Compensatory Mitigation

2.2.5.3.1 Introduction

Under all action alternatives, the applicant will provide compensatory mitigation for eagles by retrofitting electric distribution poles. The intent is to minimize the potential for electrocutions in this area and ensure that the effects of take caused by Shiloh IV are offset. As shown in Table 2-1, 75 poles are proposed to be retrofitted under Alternative 2, 133 poles under Alternative 3, and 101 poles under Alternative 4. The number of retrofits was derived using our Resource Equivalency Analysis (REA) (Service 2013, Appendix D), based on the anticipated annual eagle fatalities. The lower number of pole retrofits under Alternative 2 was based on the applicant's estimate of annual mortality of 0.5 eagle per year.

We worked with a utility company to identify high-risk utility poles appropriate for eagle compensatory mitigation. We selected the Shiloh IV mitigation site based on an area identified as having higher than average electrocution rates and high densities of wintering and breeding eagles. The retrofits are not duplicative of the utility company's other obligations to retrofit poles within its system.

2.2.5.3.2 Utility Company's Avian Protection and Pole Retrofitting Policy

Eagle take is a known problem on utility power lines, and utility companies have their own responsibilities to rectify eagle take caused by electrocution and line collision. Therefore, prior to proposing a mitigation package for Shiloh IV, we evaluated multiple candidate utility companies' avian protection policies. We found PG&E to be the best candidate to receive Shiloh IV mitigation funds to retrofit lines for the proposed permit because of its current avian policy and the concentration of utility lines within the same BCR as Shiloh IV.

PG&E followed the Avian Power Line Interaction Committee model to develop its companywide Avian Protection Plan (APP). The primary focus of PG&E's APP is to reduce raptor mortality while also improving system reliability. It incorporates construction techniques that follow the suggested practices in a PG&E engineering document. Key elements of PG&E's APP include using avian-safe construction methods and materials for new and reconstructed facilities in designated areas, retrofitting over 4,000 poles annually, and retrofitting within 90 days all poles associated with a raptor electrocution incident (i.e., both incident and adjacent poles).

PG&E's APP aims to minimize risk to raptor species in general with an emphasis on reducing golden eagle incidents. At our request, PG&E worked with us to develop a methodology within its system for selecting candidate power poles for retrofit with the intent of reducing golden eagle mortality on the highest risk poles on the landscape. To inform the approach, PG&E used a 10-year data set that included 90 historical records of golden eagle incidents.

2.2.5.3.3 High Risk Pole Identification

We worked with PG&E to identify high electrocution risk utility poles for appropriate eagle compensatory mitigation. PG&E collects information about golden eagle incidents to support its reporting commitments and requirements of its APP and Federal permits. In addition, the Federal Special Purpose Utility Permit requires reporting to the Service whenever an eagle electrocution or collision incident is discovered. PG&E used the golden eagle incident data to identify candidate poles for retrofit with the primary objective of reducing golden eagle mortality.

A thorough evaluation of the incident data collected for over 10 years found no single common or leading risk factor when comparing the incidents on a pole-by-pole basis. Historical and recent incidents of golden eagle mortality varied widely in circumstance. However, when the evaluation was conducted on a circuit-by-circuit basis, a trend did emerge in frequency of golden eagle incidents by circuit. Certain circuits within the PG&E system have incurred higher frequencies of golden eagle mortality. PG&E's data indicated a need to identify and prioritize circuits with the highest incidents of eagle mortality and to identify candidate poles within those circuits for retrofit.

2.2.5.3.4 Shiloh IV Mitigation Site

The Oilfields 1103 circuit was identified as a high priority area for retrofits. The mitigation area is located near the U.S. Army Garrison Fort Hunter Liggett property and directly adjacent to Monterey County's San Antonio Reservoir. The Oilfields 1103 circuit has experienced four known golden eagle mortalities since 2002. Three of these incidents occurred in recent years (i.e., one incident each in December 2009, January 2010, and January 2011). All three of these incidents occurred within 5 miles of one another. It should be noted that PG&E discovers eagle electrocutions after investigating a power outage, incidentally by personnel working on utility lines, or—less frequently—from reports from the public. We believe the rate of eagle electrocution events are higher than what is discovered and reported on an annual basis, and this variation is accounted for in our REA (Appendix D). As described in the following paragraphs, additional data validates that this area supports a high density of eagles.

2.2.5.3.5 Mitigation Area Eagle Population Data

Winter bald eagle surveys were conducted at San Antonio Reservoir in Monterey County between 1979 and 2012 as part of U.S. Geological Survey's Midwinter Bald Eagle Survey program. These surveys documented an average of 26 wintering bald eagles per year. Incidental golden eagle sightings were also recorded during the surveys. The surveys documented an average of 11 wintering golden eagles per year and a total of 192 golden eagle observations between 1988 and 2010, the highest total observations of any midwinter survey location in California (USGS 2014).

U.S. Army Garrison Fort Hunter Liggett is a military installation encompassing 162,000 acres within the Santa Lucia Mountains in southern Monterey County. In 1996, biologists at Fort Hunter Liggett documented the first occupied bald eagle nest in Monterey County since the 1930s (U.S. Army 2012). Since then, the installation has annually surveyed for and monitored bald eagle nests in accordance with its Integrated Natural Resources Management Plan. The bald eagle pairs had fledged at least 26 eaglets, collectively, between 1996 and 2011. Golden eagle nest monitoring began in 2010. During the Fort Hunter Liggett surveys for both wintering bald and resident golden eagles, five total golden eagles were observed on January 12, 2011. During bald and golden eagle nesting surveys at Fort Hunter Liggett in 2010 and 2011, seven of eight known nests were monitored (Guilliam 2012). Four of the eight nests were identified as golden eagle nests (U.S. Army 2012).

Therefore, because of the high eagle use data in this area, we believe this is an appropriate mitigation area where retrofitting will benefit eagle populations.

2.2.5.3.6 Retrofit Effectiveness Monitoring

As required by the California Public Utilities Commission (CPUC), PG&E established inspection cycles and record-keeping protocols for its utility distribution equipment. These requirements are set forth in General Order 165 (CPUC 1997). In general, utilities must patrol (walk, drive, or fly by) their systems once per year (in urban areas) or once every 2 years (in rural areas). PG&E must conduct detailed inspections every 3–5 years, depending on the type of equipment. For detailed inspections, utilities' records must specify the condition of inspected equipment, any problems found, and a scheduled date for corrective action. PG&E submits an annual report summarizing inspections made, equipment condition observed, and repairs made. The Service finds this inspection schedule to be acceptable for the purposes of the project's compensatory mitigation effectiveness monitoring. Once the retrofits are made for Shiloh IV's mitigation, PG&E has agreed to maintain them.

2.2.5.3.7 Conclusion

Based on the available data sets, we have determined that retrofitting poles within PG&E's Oilfields 1103 circuit will satisfy the compensatory mitigation requirement for the Shiloh IV programmatic eagle take permit.

2.2.5.4 Advanced Conservation Practices

Permits for eagle take at wind-energy facilities are programmatic in nature as they will authorize recurring take rather than isolated incidences of take. For programmatic take permits, the regulations require that any authorized take must be unavoidable after the implementation of advanced conservation practices (ACPs). ACPs are defined as "scientifically supportable measures that are approved by the Service and represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable" (50 CFR 22.3).

Because the best information currently available indicates there are no conservation measures that have been scientifically shown to reduce eagle disturbance and blade-strike mortality at wind projects, the Service has not currently approved any ACPs for wind energy projects.

The process of developing ACPs for wind energy facilities has been hampered by the lack of standardized scientific study of potential ACPs. The Service has determined that the best way to obtain the needed scientific information is to work with industry to develop ACPs for wind projects as part of an adaptive-management regime and comprehensive research program tied to the programmatic-take-permit process. In this scenario, ACPs will be implemented at operating wind facilities with an eagle take permit on an "experimental" basis (the ACPs are considered experimental because they would not currently meet the definition of an ACP in the eagle permit regulation). The experimental ACPs would be scientifically evaluated for their effectiveness, as described in detail in this document, and based on the results of these studies, could be modified in an adaptive management regime. This approach will provide the needed scientific information for the future establishment of formal ACPs, while enabling wind energy facilities to move forward in the interim.

Under all action alternatives, the applicant will implement experimental ACPs as appropriate. Table 2-2 shows an adaptive management framework involving implementation of experimental ACPs if golden eagle take occurs. ACPs are defined in 50 CFR 22.3 as "scientifically supportable measures that are approved by the Service and represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable." The stepwise approach provides a framework in the event that additional conservation measures or compensatory mitigation prove necessary. The stepwise approach outlines the thresholds at which Shiloh IV will implement experimental ACPs and relies on technical assistance and decisions to be made by the Service. Table 2-2 provides graduated adaptive management steps to be taken as eagle mortality occurs. The table elaborates the management actions that are to be taken when specific take thresholds are reached; it is not intended to limit or preclude other equivalent experimental ACPs that are identified in coordination with the Service, or that may be developed as a result of new information, techniques, or science. After a take threshold is reached, the Service will evaluate the corresponding step on Table 2-2 and determine the approaches necessary to maintain the "no net loss" standard for eagle populations. Under Step V, an example of operational modifications would be seasonal turbine shutdowns. Examples of other appropriate actions for Service consideration under Step VI are nighttime only operations and removal of hazardous turbines.

Table 2-2. Summary of Advanced Conservation Practices Using a Stepwise Approach: to be Implemented when Eagle Take Occurs on Shiloh IV

Step	*Advanced Conservation Practices (ACPs)*	*Threshold or Trigger*
Step I	Initiate consultation with the Service to illuminate appropriate conservation measures to minimize likelihood of further take. Mortality monitoring for eagles using approved protocol for 1–3 years based on Service requirements.	One eagle taken.
Step II	Initiate ACPs involving visual and/or auditory deterrence procedures and consultation with Service to design a protocol to evaluate effectiveness of these methods (e.g., painting a statistically meaningful subset of blades or installing auditory deterrence measures on a subset of blades). Intensify eagle monitoring studies to define seasonal and diurnal flight patterns within the project area to inform development/ implementation of future ACPs (e.g., monitoring flight patterns in the wind resource area). Conduct 3 years mortality monitoring to evaluate effectiveness of deterrence methods.	Two eagles taken within any 12-month period or three eagles taken within a 5-year period.
Step III	Employ qualified biological monitors (i.e., with suitable eagle experience) onsite during daylight hours with the ability to temporarily modify the operation of particular turbine(s) (i.e., feathering turbines) when an eagle/large raptor approaches the rotor swept area (RSA). Alternatively, the latest proven avoidance techniques or experimental techniques such as radar systems will be selected and implemented in consultation with the Service. Initiate consultation with Service to refine and evaluate the operations modification protocol utilizing data from monitoring efforts undertaken in Step II. Extend or reinitiate eagle movement studies if such are demonstrated to generate useful information. Conduct 3 years mortality monitoring to evaluate effectiveness of deterrence methods.	Three eagles taken within any 12-month period or four eagles taken within any 5-year period.
Step IV	Deploy radar system(s) designed to allow real-time temporary operational modifications to turbine blade rotation as eagle(s)/large raptors approach particular turbines or the latest proven avoidance technique or experimental techniques that would provide an equivalent level of potential protection for eagles. In consultation with the Service, design and implement a protocol for determining the effectiveness of the radar system(s) or other techniques. Conduct 3 years mortality monitoring to evaluate effectiveness of radar system at reducing eagle take.	Four eagles taken within any 12-month period or five eagles taken within any 5-year period.
Step V	Initiate consultation with the Service to determine operational modification schedules based on evaluation of data collected in previous phases. Options may include operational modification at appropriate season and time of day or at identified problem turbines/strings. Eagle movement monitoring and mortality monitoring will be extended for a 3-year period.	Five eagles taken within any 24-month period or six eagles taken within the first 5 years of operations.
Step VI	In consultation with the Service, determine other appropriate actions necessary to minimize and compensate for additional impacts on eagle populations.	Seven eagles taken within a 5-year period.

2.3 Alternatives Considered but Eliminated from Further Consideration

The project has been through two major environmental reviews and a variety of alternatives have been considered. These alternatives and the rationale for their elimination are presented in Table 2-3.

Table 2-3. Shiloh IV Alternatives Considered and Eliminated During Previous Environmental Reviews

Alternative	*Description*	*Rationale for Rejection*
Considered in the EIR		
No Project: enXco V Removed	Decommissioning.	Does not achieve project objectives.
No Project: enXco V Continues	No decommissioning.	Raptor impacts 1.1 times higher on a per-MW basis. Does not produce as much energy.
Offsite Alternative: Cordelia Hills	Same project in another part of Solano Co.	More sensitive noise and visual receptors for adjacent residents. Resource impacts on wildlife and other resources likely to be equal at offsite location.
Reduced Project/Alternative Layout	50% fewer turbines.	Does not achieve project objectives or maximize use of wind resource area.
Considered in the EA for the CTS HCP		
Alternative Sites	Same project in other locations.	Resource impacts likely to be equal. Does not achieve project objectives.
Alternative Setbacks for CTS	Move turbine locations.	Not expected to reduce potential for take of CTS.

Other alternatives focused on reducing eagle take considered in this FEA, but these were rejected from further consideration as described in Table 2-4.

Table 2-4. Shiloh IV Alternatives Considered and Eliminated as Part of this FEA

Alternative	*Description*	*Rationale for Rejection*
Range management/prey enhancement	Improve range management for eagles	Productivity increases hard to quantify
Lead abatement	Reduce sources of lead	Productivity increases hard to quantify
Lead rehabilitation	Treat eagles with lead poisoning	Difficult to find and capture ill birds
Other collision sources	Reduce other collision sources	Difficult to identify consistent and cost-effective sources
Education and outreach	Produce educational materials	No direct benefit to offset eagle mortality
Contribution to research	Support research	No direct benefit to offset eagle mortality
Nesting platform construction	Install additional nesting platform	Uncertainty around location and existing territories
Turbine removal	Remove a portion of turbines	Risk level does not demonstrate this is currently necessary
Alternative ACPs	Implement a different set of ACPs	ACPs are by definition flexible and will be under the Service's direction and guidance; operational alternative helps bracket potential restrictions

Additionally, an alternative to issue a 30-year permit, coinciding with the expected life of the project, was considered but was also rejected from further consideration. Under regulations in place when the draft EA was made available for public review, the programmatic eagle take permit was available for 5-year term and is renewable. The expected life of the project is approximately 30 years. A permit option for a term longer than 5 years was not yet an option at the time the draft EA was made available for public comment. Accordingly, this alternative was dismissed from further consideration. However, it should be noted that the effects analysis in this FEA is for the operational life of the project.

The Service recently amended regulations at 50 CFR 22.26 for permits authorizing take of eagles. The new Duration Rule extends the maximum term for programmatic permits from five to 30 years, provided that the permit incorporates specific measures that may be necessary to ensure the preservation of eagles (78 FR 73704, December 9, 2013). The rule changes also amend the schedule of permit fees set forth at 50 CFR 13.11 by substantially increasing the fees charged for such programmatic permits. Additionally, changes have been made to allow programmatic permits to be transferable to new owners of projects (50 CFR 13.25: transfer of permits and scope of permit authorization) and to ensure that any successors to the permittee are qualified and committed to carrying out the conditions of the permit (50 CFR 13.24: right of succession by certain persons).

We asked the applicant if they wanted to change their permit request prior to completing this FEA. Shiloh IV declined and chose to continue with the processing of their 5-year take permit request as submitted.

Chapter 3

Environmental Setting

3.1 Introduction

This chapter provides background on the environmental resources that are evaluated in the context of the Federal action and alternatives. Specifically, this chapter describes the physical environment, climate change, eagle use and demographics, and birds of conservation concern.

Multiple resource topics, including their associated environmental settings, were described in the *Final Environmental Impact Report—Shiloh IV Wind Energy Project* (Solano County Department of Resource Management 2011b) and the *Final Environmental Assessment for the Shiloh IV Wind Project Habitat Conservation Plan* (Service 2012b). Resource-specific setting information beyond that provided here and incorporated by reference is provided in greater detail in chapter 4, *Environmental Consequences*. The following resource topics previously considered in the EIR and the HCP FEA and summarized in chapter 4 are listed below.

- Aesthetics
- Agricultural Resources
- Air Quality and Climate Change (additional information provided)
- Biological Resources (additional information provided)
- Cultural Resources (additional information provided)
- Geology, Seismicity, Mineral Resources, and Paleontological Resources
- Growth-Inducing Effects
- Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Noise
- Public Health Hazards
- Recreation
- Traffic and Transportation
- Utilities and Public Service Systems

3.2 Setting Discussions

3.2.1 Physical Environment

The project area is zoned by Solano County for agricultural use. Land uses immediately adjacent to the project area include dryland farming, existing wind energy projects, and residential and commercial structures in Birds Landing. There are rural community centers in Collinsville (approximately 1.5 miles south of the nearest project area boundary) and Rio Vista (approximately 6.2 miles east of the nearest project area boundary). Rio Vista Airport and Travis Air Force Base are both approximately 8 miles from the nearest project area boundary (Figure 1-2).

Low-density residential housing is present in the Montezuma Hills agricultural region. Five residences are within the project area boundary and more than a dozen other residences are within approximately 1 mile of the project area, including those in the community of Birds Landing.

Low rolling hills separated by valleys and intermittent drainages characterize the project area's landscape. The hills are relatively constant in elevation, with ridge crests ranging from 100 to 272 feet above mean sea level. Dominant vegetation in the area consists of wheat and other grasses planted by landowners for agriculture and livestock grazing. Although there are very few trees and shrubs, eucalyptus and other trees grow adjacent to some drainages in lowland areas.

Agricultural uses—primarily dryland farming and livestock grazing—are the dominant land uses in the project area. As of July 2012, approximately 98% of the project area was in wheat production or in preparation for wheat production, with the remainder being utilized as grazing lands. Farmers in the Montezuma Hills typically use a 1- to 3-year crop rotation cycle in which grazing and fallow years follow planting and harvesting. Wheat, barley, and oats are the main crops in the Montezuma Hills, and sheep are the primary livestock.

The project area climate is characterized by the transition between the San Francisco Bay Area and the Sacramento Valley. Cool air flows from the Pacific Ocean and San Francisco Bay through the Carquinez Strait, where it mixes with warm air in the Sacramento Valley. This difference in temperature and atmospheric surface pressure circulation results in strong winds, dry summers, and rainy winters. From November through March, average temperatures recorded at Rio Vista range from lows of 37–44°F to highs of 53–65°F. From April through October, average temperatures range from lows of 47–58°F to highs of 71–91°F. When temperatures are highest, precipitation is lowest, averaging 0.3 inch in July and August. In winter, average monthly precipitation ranges from 1.7 inches in November to 2.72 inches in January. Area rainfall averages 16–20 inches per year.

3.2.2 Climate Change

This section addresses the possible impact of the project on climate change and the impact of climate change on eagles in the region. The HCP FEA (Section 3.3, Service 2012b) provides a thorough review of the wind energy project's greenhouse gas (GHG) emissions and climate change effects and is incorporated by reference. As a wind energy project, Shiloh IV itself would have no primary direct carbon dioxide (CO_2) emissions from electricity production during operation; however, there are other minor sources of GHG emissions that result from site operations, including the use of off-road equipment as well as on-road vehicles used for inspection and maintenance and personnel commuting. During its operation, Shiloh IV is likely to result in a large indirect reduction in GHG emissions due to the displacement of electricity generated by fossil fuel–fired power plants, offset by a small increase in GHG emissions due to the loss of carbon uptake from the removal of vegetation and minor sources of GHG emissions. Our issuance of a programmatic eagle take permit will contribute minor sources of GHG emissions that result from eagle monitoring operations, including the use of vehicles and equipment used for monitoring and commuting. The following analysis of climate change will focus on the effect of the Service's proposed action (issuing a programmatic eagle take permit) on climate change and the effects of climate change on the proposed action and the affected resource (golden eagle).

According to the Intergovernmental Panel on Climate Change (IPCC), there is abundant evidence of global climate change based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC 2007). The IPCC predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20th century, and global warming of about 0.4°F per decade is projected for the next 2 decades.

According to the U.S. Global Change Research Program's draft National Climate Assessment, U.S. average temperature has increased by about 1.5°F since 1895; more than 80% of this increase has occurred since 1980 (USGCRP 2013). The most recent decade was the nation's hottest on record. The authors project that temperatures will continue to rise, with the next few decades projected to see another 2–4°F of warming in most areas. Though most regions of the U.S. are experiencing warming, the changes in temperature are not uniform.

In the Southwest U.S., scientists have shown that annual mean temperatures, the length of the freeze-free season, and the frequency of heat waves have all increased significantly over the last 100 years (Kunkel et al. 2013). Climate model projections for the next 50–100 years indicate there will be significant increases in annual mean temperatures of 1.8–9°F, increases in the number of hot days (maximum temperature of more than 95°F), and decreases in annual mean precipitation across the southern portions of the Southwest, with the California region exhibiting the greatest reduction in precipitation (Cayan et al. 2012; Kunkel et al. 2013). Extremes in high temperatures are anticipated to increase, whereas extreme cold events are expected to become less severe and shorter in duration. For the Mojave Desert ecoregion, there is general consensus across multiple models that by 2070, temperatures will increase by 3.4–4.7°F and precipitation will decrease by 0.28–2.6 inches (PRBO 2011). In addition, prolonged (7-day) hot spells are projected to increase as is the duration and mean temperature of such events.

The warming climate and its effects or potential effects on wildlife have been well documented (reviewed in Inkley et al. 2004). Birds in every habitat type will be affected by climate change, although individual species in each habitat are likely to respond differently. In a review of research evaluating the effects of recent climate change, McCarty (2001) noted that, while scientists have documented the response of species to interannual or geographic variations in climate, they lack sufficient information to understand or predict the responses to the kinds of long-term trends in climatic conditions that have occurred in recent decades. However, changes in the timing of avian breeding and migration and a northward expansion of the geographic range in North American birds have already been documented (McCarty 2001; Peterson 2003; LaSorte and Thompson 2007).

Recent analyses suggest migratory behavior of some North American raptors may be changing in response to climate change. Van Buskirk (2012) analyzed raptor migration data from Lake Superior for a period spanning over 30 years from the 1970s through the 2000s and found very strong shifts in golden eagle phenology with the interval between spring and autumn migration increasing by about 30 days.

Predicting impacts on eagles from the issuance of a programmatic eagle take permit and the local effects of climate change is subject to changes or fluctuations in such variables as land use, vegetation, predation dynamics, parasites, prey abundance or cycles of prey abundance, and changes in human behavior that lead to increased disturbance (Mustin et al. 2007). Raptors in general may be able to mitigate—through behavioral adaptations such as dispersal to areas with better conditions—some of the predicted impacts from climate change (Wichmann et al. 2005).

Although high temperatures and drought occur routinely in the Mojave Desert, extended periods of high temperatures and drought have the potential to affect golden eagles and their habitats through physiological effects on individuals (i.e., heat stress) and changes in prey availability. Beecham and Kochert (1975) found that heat stress was a significant mortality factor for nestling eagles in Idaho, and Steenhof et al. (1997) demonstrated that an increase in the number of extremely hot days during brood-rearing resulted in a lower percentage of successful laying pairs and smaller mean brood size at fledging. Long-term drought may cause die-off of desert trees, mature shrubs, and other organisms. In the western U.S., Ziska et al. (2005) found that increasing atmospheric CO_2 concentrations associated with climate change may have contributed to cheatgrass productivity and fuel load with subsequent effects on fire frequency and intensity. In the western U.S., cheatgrass has become a major invasive plant, and studies have shown that cheatgrass supports lower abundances of golden eagle prey species such as ground squirrels, black-tailed jackrabbits, and small mammals (Knick and Dyer 1997; Steenhof et al. 2006). Golden eagle reproductive rates fluctuate with prey densities, and failure of eagles to lay eggs during periods of low prey abundance has been documented in the western U.S. (Smith and Murphy 1979 in Steenhof et al. 1997).

The North American Bird Conservation Initiative's (NABCI's) State of the Birds 2010: Report on Climate Change (NABCI 2010), assessed the relative vulnerability of each U.S. bird species based on five biological aspects of sensitivity to climate change, as well as on the exposure of the habitat of each species to climate change in the near future. The results indicate that most bird species in aridlands show lower overall vulnerability, and golden eagle was not listed as a vulnerable species (http://www.stateofthebirds.org/2010/results-for-species). Nevertheless, the report notes that aridlands are predicted to become warmer and drier and that many aridland birds are at increased risk because of drought and the potential for summertime temperatures greater than they can tolerate.

A recent study by the California Department of Fish and Wildlife (CDFW) and Point Reyes Bird Observatory (Gardali et al. 2012) of California's at-risk bird species determined that golden eagle was not one of the state's most vulnerable species to climate change; the assessment evaluated the intrinsic characteristics of an organism that make it vulnerable and the magnitude of climate change expected for each species. No specific observations about golden eagles were made in the published study; however, the golden eagle climate change vulnerability score is available on the following website: http://data.prbo.org/apps/bssc/index.php?page=climate-change-vulnerability. Although golden eagle was not considered one of the most vulnerable species, the authors did note that, of all the ecoregions in California, the deserts, Central Valley, and low elevation Sierra Nevada are predicted to experience the most extreme hot weather events for extended periods and that habitat suitability is likely to decrease for the majority of taxa.

3.2.3 Eagle Use and Demographics

3.2.3.1 History and Summary of Avian and Eagle Monitoring in the Montezuma Hills WRA

Avian use of the Montezuma Hills WRA has been studied over a nearly 25-year period, and several studies are ongoing. Howell and DiDonato (1991) conducted the first avian use monitoring study related to wind turbine siting in the Montezuma Hills. During this study, which was conducted in 1987–1988, the researchers surveyed portions of the Montezuma Hills that were part of the U.S. Windpower Montezuma Hills Windfarm Project (since renamed enXco V). Data were collected on species diversity, species abundance, migratory use, nesting, and behavioral characteristics (e.g., flight patterns, altitudes, and perching). From 1990 to 1991, Howell and Noone (1992) conducted additional avian surveys as part of the postconstruction monitoring of the enXco V project.

Additional survey efforts have continued in the Montezuma Hills since the development of the enXco V project. Such efforts include several recent large-scale avian use/abundance surveys conducted in association with the development of the High Winds project (2000); the Shiloh I (2001), Shiloh II (2003), and Shiloh III (2005) projects; the Montezuma Wind project (2005); and the Shiloh IV project (2010). Each of these survey efforts employed a similar method of establishing fixed observation points across the landscape that incorporate as much of the project area as possible in accordance with guidance from the National Wind Coordinating Committee (Erickson et al. 2001) and California guidelines (California Energy Commission and California Department of Fish and Game 2007). The surveys were designed to assess avian abundance, diversity, distribution, habitat use, and behavior.

In addition to observational surveys, each survey effort also entailed a survey of breeding raptors in and around each project area. In 2007, nesting raptor surveys were conducted encompassing the entire Montezuma Hills WRA, including a 5-mile buffer zone, to the extent visible from aerial surveys and public roads (Hunt et al. 2007). In 2011, another survey for nesting eagles was conducted in the Montezuma Hills WRA, including a 10-mile buffer zone, consistent with Service survey guidance (GANDA 2011).

Through postconstruction monitoring, each new facility has also generated data regarding avian mortality in the Montezuma Hills WRA. All facilities in operation have conducted at least 1 year of postconstruction mortality surveys. Other mortality and injury data, derived from incidental observations during project operations, are also collected. Collectively, these surveys form a robust body of baseline biological data for the area. These studies have documented avian mortality, including occasional golden eagle mortalities, associated with turbine collisions.

3.2.3.2 Bald Eagle

3.2.3.2.1 Local Status

Bald eagle use of the area is intermittent. The site generally lacks suitable nesting and foraging habitat, though the Sacramento River to the south provides opportunities for foraging. During 2011, there were three observations of adult bald eagles within the Montezuma Hills WRA (GANDA 2011): one observation of a pair and another of a single individual. Although there are no documented nests within a 10-mile radius of the Montezuma Hills WRA, GANDA speculated, on the basis of flight direction, that the observed pair may have nested in the Grizzly Island area, which lies between Suisun Bay and the Montezuma Hills WRA. These are the first observations of this species recorded during a survey encompassing the Montezuma Hills WRA. No bald eagle fatalities have been documented in the WRA since wind facility development began during the late 1980s, despite multiyear pre- and postconstruction monitoring at several projects.

3.2.3.2.2 Demographics

Bald eagle is the largest raptor in North America next to California condor and is broadly distributed throughout North America and into northwestern Mexico (Buehler 2000).

California's resident breeding populations of bald eagle exhibit high fidelity to both breeding and wintering sites. Resident breeding pairs overwinter in California and do not disperse far from their nest sites, unless harsh weather drives them to lower elevations. Bald eagles that breed in northwestern Canada and the United States migrate south in large numbers to California to overwinter; these populations are most prevalent from September through March, with some remaining in California as late as April.

Bald eagle habitat use is largely correlated with proximity to substantial bodies of water, because fish constitute a large proportion of the species' diet. Breeding habitat is typically in forested areas adjacent to rivers, lakes, or wetlands (Buehler 2000). Breeding populations in California are predominantly concentrated in the northern counties of Shasta, Siskiyou, Modoc, Lassen, Plumas, Butte, Lake, and Trinity (California Department of Fish and Game 1999). However, nests have been observed in smaller numbers throughout counties farther south since the late 1980s. Nests have been documented during the 1990s and 2000s within 60 miles of the Montezuma Hills WRA at Lake Berryessa (Napa County) and near reservoirs in Alameda and Contra Costa Counties (California Department of Fish and Game 2011).

Bald eagles are opportunistic foragers that take both live prey and carrion. They are known to hunt for live fish in shallow water, but more frequently they scavenge dead or dying fish. They also forage on other aquatic and terrestrial animals, including waterfowl, muskrats, raccoons, and small mammals, which are taken alive or scavenged as carrion (Stalmaster 1987; Jackman et al. 1999). Bald eagles hunt in flight or detect prey from perches, and they frequently steal food from other animals. Favored foraging habitat usually includes water that is less than 1,600 feet from suitable perching trees (Buehler 2000), although bald eagles also forage in habitat that provides ample opportunities for scavenging carrion.

In California, the breeding season lasts from January through August. Bald eagles typically build stick nests in trees in mature and old-growth forests. More rarely, nests are built on cliff faces or on the ground (Buehler 2000). Nest sites are usually adjacent to large bodies of water or other suitable foraging habitat. Bald eagles build their nests in the upper canopy, generally selecting the tallest trees in the area. In California, ponderosa pine and sugar pine are the most frequently used tree species for nesting, and 87% of nest sites are within 1 mile of water (Lehman 1979; Anthony et al. 1982). Where no large conifers are present, bald eagles nest in deciduous trees such as oaks and cottonwoods (Anthony et al. 1982; Buehler 2000). Bald eagles construct from one to five additional nests within their breeding territories (Lehman 1979; Stalmaster 1987) and pairs alternate between these nests over multiple years. Bald eagles are sensitive to anthropogenic disturbance and typically do not nest if there is evidence of human activity (California Department of Fish and Game 1999).

Bald eagle home range size varies widely with age of the bird, season, and distance to available food resources (Buehler 2000). Home range size of breeding adults in Saskatchewan ranges from 2.3 to 47 square miles (Gerrard et al. 1992), and averages approximately 8.5 square miles for both breeding and nonbreeding pairs (Monte et al. 1993). Juvenile bald eagles have significantly larger home ranges than adults, likely because immature bald eagles are not tied to a breeding territory. Weeks after leaving the nest, juveniles from California's breeding populations migrate to post-nesting dispersal sites hundreds of miles north (Hunt et al. 1992). These sites, as far as northern Canada (Jenkins et al. 1999), provide rich foraging opportunities (e.g., high concentrations of salmon carcasses).

3.2.3.2.3 Population

We derived population estimates for bald eagle regional management areas during preparation of the EA for the 2009 Eagle Permit Rule. The methods and results of the population estimates were reported in Appendix C of the FEA (Service 2009). Estimates of bald eagle populations were derived on the basis of Service regions. The results indicated that approximately 111 nesting pairs and a total population of 888 individuals are present in Region 8. An estimate of the local area population (i.e., those birds within 43 miles of the project) is 21 eagles (Table 4-1).

3.2.3.3 Golden Eagle

3.2.3.3.1 Local Status

Eagle observation data, primarily height and behavior data, as well as incidental observations by Service biologists, indicate that golden eagles routinely forage in the Montezuma Hills, including within the project area. Avian abundance and use surveys (bird use counts [BUCs]) have been conducted in the project area (Kerlinger et al. 2011) and in the surrounding region for other wind projects. The point counts in the project area resulted in a total of 19,888 observations of 27 avian species recorded at the two observation points in the study area during a year-long study. The point counts included a total of 14 golden eagle observations. Table 3-1 summarizes the eagle observations in the project area.

Table 3-1. Summary of Golden Eagle Observations in the Shiloh IV Project Area

Observation Point	*Date*	*Total Viewing (minutes)*	*Height*	*Behavior*	*Number of Minutes in Rotor Swept Area (RSA)*
2	4/26/2007	2	High	Flapping	Above RSA
2	5/16/2007	2	Medium	Flapping	2
2	6/13/2007	2	Medium	Flapping	2
1	6/20/2007	5	High	Soaring	Above RSA
1	7/4/2007	6	High	Soaring	Above RSA
1	7/20/2007	2	High	Soaring	Above RSA
2	8/7/2007	5	High	Soaring	Above RSA
1	10/1/2007	4	High	Soaring	Above RSA
2	10/17/2007	1	High	Soaring	Above RSA
1	11/8/2007	2	High	Soaring	Above RSA
2	11/19/2007	2	Medium	Soaring	2
2	12/12/2007	5	High	Soaring	Above RSA
1	2/5/2008	4	Medium	Soaring	4
1	3/5/2008	6	High	Soaring	Above RSA

Source: Curry & Kerlinger 2012.

Raptor nesting habitat in the mostly treeless Montezuma Hills is generally limited to small groups of nonnative eucalyptus trees or lone oak trees. Raptor nest surveys were conducted sporadically between the late 1980s and late 1990s and more frequently during the 2000s, with the most current data provided in Kerlinger et al. (2006, 2009a) and GANDA (2011). Hunt et al. (2007) and Kerlinger et al. (2006, 2009a) found four nest sites within the Montezuma Hills WRA during raptor nesting surveys conducted in 2004–2005 and 2007. During April and May 2011, GANDA conducted additional bald eagle and golden eagle surveys in support of an adjacent project. The surveys documented four currently occupied nesting territories within a 10-mile radius of the project area (GANDA 2011). Nesting was confirmed at one site west of the Montezuma Hills WRA and suspected at one site northwest of the Montezuma Hills WRA. The other two territories are south of the Sacramento–San Joaquin River confluence and the Pittsburg-Antioch urban area. While nesting was not confirmed for either of these two territories, the GANDA biologists expressed confidence that they were active nesting territories on the basis of observed breeding behaviors. The GANDA surveys also detected a fifth territory south of the river confluence outside the 10-mile radius.

Shiloh IV's ECP discusses four nest sites within the Montezuma Hills WRA boundary (Figure 3-1). The Masson Property is approximately 0.25 mile north of Shiloh IV in a grove of eucalyptus trees within the Shiloh I Wind Project footprint. Nesting has not been documented here since 2001, although a deteriorating nest structure is still present in the tree. The Callahan Property is 0.75 mile east of Shiloh IV. Golden eagles have regularly bred at this site in the past. The last documented successful breeding was in 2007. The site was last visited in 2010 when a subadult was detected, but there were no signs of nesting activity. There were two nests in eucalyptus trees near the intersection of Currie and Emigh Roads (Currie nests). These two nests are more than 3 miles east of Shiloh IV. They were likely alternate nest sites in the same breeding territory. As of 2011, neither nest could be located; they may have been blown out of the trees during winter storms. No nesting or attempted nesting was observed in 2012. Together, these four nest sites probably represented three breeding territories that have likely been lost due to hazards presented by wind energy development in the Montezuma Hills over the past 10 years. While these territories may no longer be viable, because nesting sites are limited within the immediate area, eagles may attempt to breed at these locations again in the future.

The data reflect two recently active nests representing two eagle territories west and northwest of the Shiloh IV project area, and two others to the southwest (Figure 3-1). Consequently, the local project area currently supports four or possibly five pairs of breeding eagles. Historically, the Montezuma Hills area likely supported six or seven breeding territories.

3.2.3.3.2 Demographics

Golden eagle is a large, long-lived raptor whose range extends throughout western North America across a broad range of elevations in open and semi-open grassland, shrub-steppe, desert, tundra, and forested habitats (Kochert et al. 2002). Southern breeding populations are largely sedentary, while most birds from Canada and Alaska are migratory, wintering on the dry prairies and deserts of the western Great Plains, the central Rocky Mountains, the Colorado Plateau, and the desert southwest. Evidence collected to date suggests that relatively few northern migrants winter in California (e.g., Goodrich and Smith 2008; McIntyre et al. 2008), probably due in part to high densities of year-round residents in many areas of the state (Hunt 2002). In areas where established breeders are primarily sedentary, other eagles are present in the population as well. Young birds may wander extensively, especially subadults during summer. In addition, mature eagles of breeding age but without territories—called *floaters*—move through the area and may occupy territories that may become vacant as a result of breeders dying or otherwise abandoning their territory. Golden eagles show high breeding site fidelity. Data on natal dispersal distances are sparse, but the Service (74 FR 175:46836–46879) has established a radius of 140 miles as the scale required for inferring local population effects based on natal dispersal distances. Evidence collected to date suggests that migratory eagles, at least adults, also tend to show high site fidelity to wintering habitat (Kochert et al. 2002).

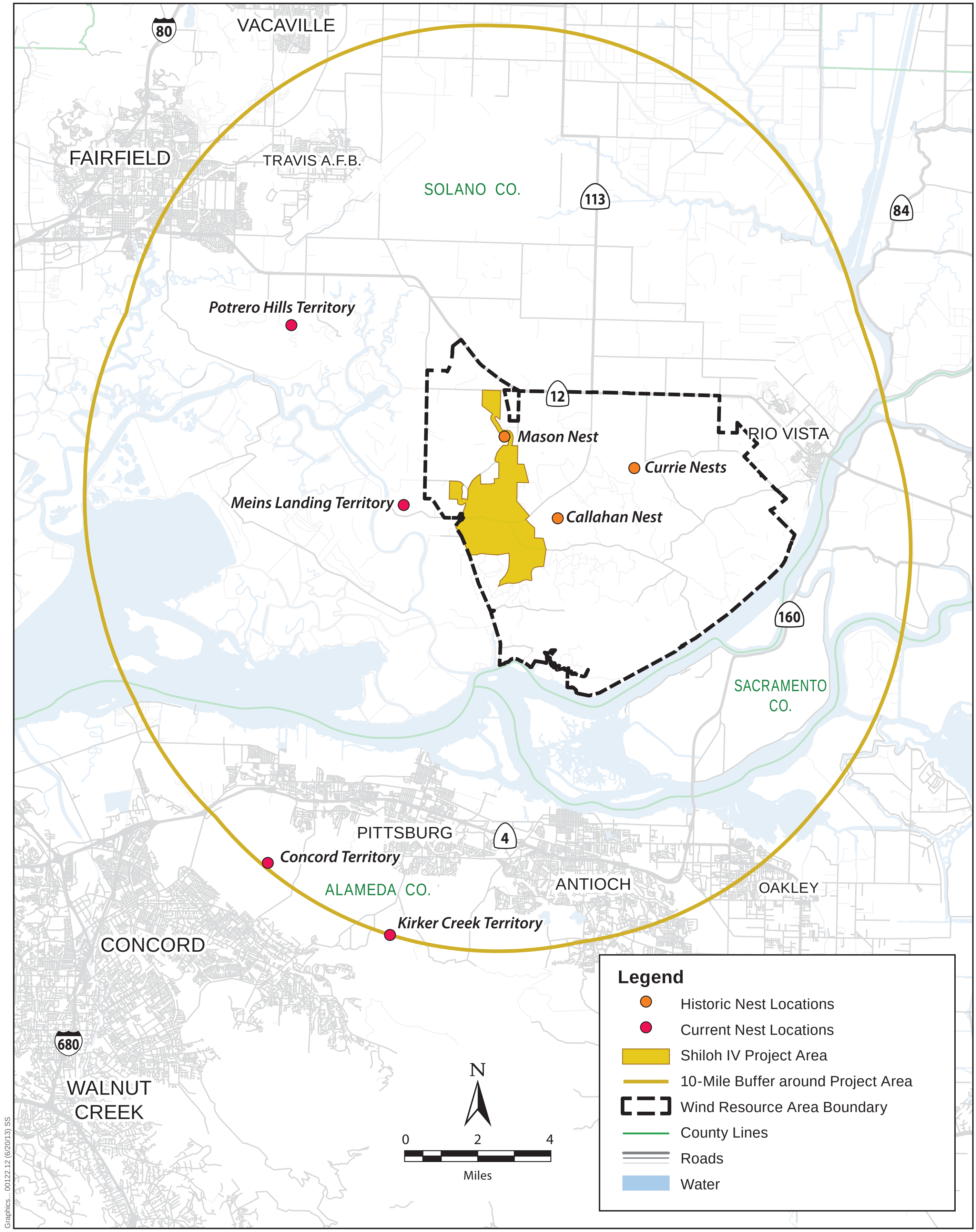

Figure 3-1
Current and Historic Nest Locations in the Montezuma Hills Vicinity

Golden eagles generally favor relatively open and undisturbed rangelands and native landscapes over densely populated and agricultural areas. Nevertheless, the highest known density of nesting golden eagles is in central California among the rolling hills of Alameda and Contra Costa Counties, where there is agricultural activity, nearby urban development, and wind facilities. Golden eagles are attracted by the area's wind-driven updrafts, which facilitate movement and hunting, and by mature oaks (*Quercus* spp.) interspersed with grassland, a land cover type that provides both ideal nest sites and abundant California ground squirrels (*Spermophilus beecheyi*) (Peeters and Peeters 2005:225–230). Due to the very high abundance of ground squirrels, the home ranges of breeding eagles in this area are much smaller than those throughout most of the species' range (Kochert et al. 2002).

Golden eagles are most likely to occur where there are dense populations of ground squirrels or hares. In many areas their breeding efforts are strongly correlated to the cyclical abundance patterns of species such as black-tailed jackrabbit (*Lepus californicus*) throughout much of the interior West, and snowshoe hare (*L. americanus*) across much of Alaska and northern Canada. Where ground squirrels predominate as favored prey, such as in central California, interannual cycling of breeding activity tends to be less pronounced. Besides hares and ground squirrels, golden eagles may take a wide variety of other food items, including large birds, reptiles, mammals, and carrion. They may hunt by diving from a high soar but often fly low, following the contours of the land to surprise their prey.

Throughout most of their range, golden eagles nest on cliffs and other elevated rocky substrates, building stick nests that often grow very large from continuous use and augmentation over many years (Kochert et al. 2002). In other areas, they nest in large, mature conifers, and in central California they frequently nest in large, mature oak and eucalyptus trees (Peeters and Peeters 2005). Nesting occurs in association with open-country grassland, prairie, savanna, shrub-steppe, desert, and tundra habitats where foraging occurs. Like many species of large raptors, golden eagles routinely construct and maintain multiple nests in their breeding territories, rotating use among them over the years. These alternate nest sites, which may number more than a dozen per territory, are often separated by distances of 0.5 mile or more depending on breeding densities. Pairs often tend and refurbish more than one nest each year, but reuse intervals for individual nests may extend to several years or more.

Where golden eagle home ranges have been documented, they have typically varied in extent from 8 to 13 square miles during the breeding season. The range for year-round residents may encompass much greater areas during the winter (Kochert et al. 2002). Where they have been quantified (e.g., in southwest Idaho), foraging distances have averaged around 0.6 mile during the breeding season and 1.9 miles during winter (Marzluff et al. 1997), but excursion distances of several miles are not uncommon.

Human-caused eagle mortality risk factors in the project vicinity include wind power, electrocutions, habitat loss and fragmentation, collision with motor vehicles, lead poisoning, and motorized recreational activities. There is limited data on the contribution of each of these to overall population conditions, though wind facilities are believed to be one of the current leading causes of mortality.

3.2.3.3.3 Population

We derived population estimates for golden eagle on a BCR basis during the preparation of the FEA on the 2009 Eagle Permit Rule. The methods and results of the population estimates were reported in Appendix C of the FEA (Service 2009). The local area population (i.e., those birds within 140 miles of the project area) is estimated at 527 individuals (Table 4-1).

3.2.4 Birds of Conservation Concern

The list of Birds of Conservation Concern (BCC) identifies migratory and nonmigratory birds of conservation concern within each BCR of the United States and its territories (Service 2008). The conservation concern may be the result of population declines, constrained distribution, anthropogenic threats to habitat, or other factors. Several BCC species in addition to golden eagle occur within 10 miles of the proposed project. The 1988 amendment to the Fish and Wildlife Conservation Act requires us to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." *Birds of Conservation Concern 2008* (Service 2008) reflects the most recent effort to carry out this mandate. As outlined in Table 3-2, 46 taxa are included on the 2008 BCC list for BCR 32. Our review of the available preconstruction and postconstruction survey reports for the WRA indicate that 15 species on this list have been documented in the WRA. Of these species, seven have had documented mortalities at wind projects near the Shiloh IV project. Several other species have been observed within the WRA but have not had documented fatalities to date. These species were not addressed in the HCP FEA but are considered in this FEA.

Table 3-2. Birds of Conservation Concern for BCR 32 (Coastal California)

Species	*Observed in the Montezuma Hills*[a]	*Potential Habitat in the Montezuma Hills*[b]	*Documented Fatalities in the Montezuma Hills*[c]
Black-footed Albatross	No	No	No
Pink-footed Shearwater	No	No	No
Black-vented Shearwater	No	No	No
Ashy Storm-Petrel	No	No	No
Bald Eagle	Yes (uncommon)	Yes	No
Peregrine Falcon	Yes (uncommon)	Yes	No
Yellow Rail	No	No	No
Black Rail	Yes (uncommon)	Yes	Yes
Snowy Plover	No	No	No
Mountain Plover	No	Yes	No
Black Oystercatcher	No	No	No
Whimbrel	Yes	Yes	No
Long-billed Curlew	Yes	Yes	Yes
Marbled Godwit	No	No	No
Red Knot (*roselaari* ssp.)	No	No	No
Short-billed Dowitcher	No	No	No
Gull-billed Tern	No	No	No
Black Skimmer	No	No	No
Xantus's Murrelet	No	No	No
Cassin's Auklet	No	No	No
Yellow-billed Cuckoo (w. US DPS)	No	No	No
Flammulated Owl	No	No	No
Burrowing Owl	Yes	Yes	No
Spotted Owl (*occidentalis* ssp.)	No	No	No
Black Swift	Yes	Yes	No
Costa's Hummingbird	No	No	No

Table 3-2. Birds of Conservation Concern for BCR 32 (Coastal California)

Species	*Observed in the Montezuma Hills*[a]	*Potential Habitat in the Montezuma Hills*[b]	*Documented Fatalities in the Montezuma Hills*[c]
Allen's Hummingbird	No	No	No
Lewis's Woodpecker	No	No	No
Nuttall's Woodpecker	Yes	Yes	No
White-headed Woodpecker	No	No	No
Loggerhead Shrike	Yes	Yes	No
Island Scrub-Jay	No	No	No
Yellow-billed Magpie	Yes	Yes	No
Oak Titmouse	No	No	No
Cactus Wren	No	No	No
LeConte's Thrasher	No	No	No
Yellow Warbler (*brewsteri* ssp.)	Yes	Yes	Yes
Common Yellowthroat (*sinuosa* ssp.)	Yes	Yes	Yes
Spotted Towhee (*clementae* ssp.)	No	No	No
Black-chinned Sparrow	No	No	No
Song Sparrow (*graminea* ssp.)	No	No	No
Song Sparrow (*maxillaris* ssp.)	Yes	Yes	No
Song Sparrow (*pusillula* ssp.)	Yes	Yes	No
Song Sparrow (*samuelis* ssp.)	No	No	No
Tricolored Blackbird	Yes	Yes	Yes
Lawrence's Goldfinch	No	No	No

[a] *Observed during preconstruction or post-construction surveys.*
[b] *For the purposes of this table, "potential habitat" includes breeding, foraging, roosting, and/or migration areas.*
[c] *Based on documented mortalities observed during post-construction monitoring.*

Chapter 4

Environmental Consequences

4.1 Introduction

This chapter describes the environmental consequences of the four permitting alternatives. The analysis considers four alternatives that provide a reasonable range of options for responding to the Shiloh IV application for an eagle permit, and evaluates the impacts of the Proposed Action on the human environment; most specifically, impacts on the local area and regional eagle populations and birds of conservation concern that occur in the area. The alternatives listed below are evaluated on the basis of the 30-year project lifespan.

- Alternative 1: No Action
- Alternative 2: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan
- Alternative 3: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Additional Mitigation and Monitoring Measures **(Service Preferred Alternative)**
- Alternative 4: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Seasonal Restrictions

4.2 Impact Analysis

4.2.1 Effects Related to Take of Golden eagles

4.2.1.1 Approach and Methods

In determining the significance of effects of each alternative on eagles, we screened each alternative against the Eagle Act's Permit Issuance Criteria (chapter 1, section 1.5.2) using recently developed tools such as Bayesian analysis (consistent with Appendix D, "Stage 3—Predicting Eagle Fatalities," of the ECP Guidance); Resource Equivalency Analysis (consistent with Appendix G, "Examples Using Resource Equivalency Analysis to Estimate the Compensatory Mitigation for the Take of Golden and Bald Eagles from Wind Energy Development," of the ECP Guidance); and Cumulative Effects Analysis (consistent with Appendix F, "Assessing Project-Level Take and Cumulative Effects Analyses," of the ECP Guidance). We have also used some qualitative analysis based on our knowledge of the wind resource area, attendance at local technical meetings, discussions with other local experts, and studies of local eagle populations.

To address the effects of golden eagle take on cultural practices, we assessed whether the Proposed Action or alternatives would substantially burden a Tribe's free exercise of its religion.

4.2.1.2 Effects Common to Alternatives

All alternatives have the potential to result in permitted or unpermitted take of eagles. The potential is substantially greater for golden eagles than bald eagles due to their frequency of occurrence in the WRA and different foraging and nesting requirements. Because bald eagles occur infrequently in the WRA, forage over water, and typically nest in mature conifer or hardwood forest, and because no bald eagles have been taken through operation of past projects in the WRA, we believe that effects on bald eagle will not occur and that therefore no permit for bald eagle is required. Accordingly, this analysis focuses on golden eagles, BCC, and red-tailed hawk and American kestrel, which have been identified as bird species of interest for the purpose of this analysis.

4.2.1.2.1 Direct and Indirect Effects

Multiple new-generation wind projects (i.e., using large, widely space turbines) currently operating in the WRA contribute to eagle fatalities, though such fatalities are found infrequently (approximately one eagle is found per year, with eight known eagle fatalities and one injury [currently in rehabilitation] in the past 7 years). Historically, the enXco V wind project (now mostly decommissioned or repowered) also contributed to eagle fatalities, accounting for 14 eagle fatalities (13 turbine-related fatalities and a single electrocution) reported between 1991 and 2010, and the Sacramento Municipal Utilities District wind project (now decommissioned) reported three eagle fatalities between 1999 and 2001. As indicated in our Bayesian analysis, we believe that the number of eagle fatalities in the WRA could be higher than the currently reported from post-construction monitoring or other incidental detections in view of limited search intervals, limited search areas, and existing land use / cropping patterns.

Mortality and Demographics

The effect of turbine-related golden eagle fatalities on the local population is dependent on the age, status, and origin of the individual eagle. Direct mortality of golden eagles could adversely affect local survival and fecundity, and could thereby affect local and possibly regional populations. The biological impact of killing an eagle within the WRA on the overall population depends on the type of eagle killed: a breeding adult, a juvenile, or a floater.

Losing a breeding adult has the most immediate and significant effect because it has survived to breeding age—studies show that less than half the population reaches breeding age—and because it helps maintain the population by successfully rearing offspring. Breeding eagles have established territories and nests and are mated. Losing a juvenile also has an adverse effect by reducing the number of individuals that survive to become reproducing adults.

Similarly, take of nonnesting floaters could have adverse consequences for the population. A sizable number of floaters are needed for healthy, stable populations of raptors in general (Hunt 1998). Floaters function as replacement breeders for territory-holding birds that die. If the local floater population is robust, they quickly fill territories that have lost a breeding adult, helping to maintain stable populations through time. If the local floater population is not robust, loss of a breeding adult can be a more severe effect because the territory is not quickly filled. The size of the floater population is uncertain and difficult to measure in this WRA; but overall there appears to be a reduction in active nests in the immediate project area (Kerlinger et al. 2011). We presume that this reduction is attributable to local wind power development.

Local Effects

Four active nests and territories have been identified within 10 miles of the project area: one nest approximately 1 mile east of the project area, one approximately 5 miles northeast of the project area, and two 10 miles southwest and south of the project area (Figure 3-1). Nesting adults and juveniles from these nests are at risk from project operations. We have evaluated these risks in the context of existing foraging and operational conditions and find that the nest nearest to the project area is at greatest risk. However, due to existing farming operations and a limited prey base, foraging throughout the project area is of lower quality than in nearby grassland areas. Ongoing farming operations have been observed to reduce or eliminate prey such as ground squirrels, because they are killed or their burrows are removed during agricultural operations. Nearby unfarmed areas likely support higher prey populations because of this decreased disturbance, which allows populations to persist and reproduce more readily without periodic fatalities from farming operations. Eagles in this area are more likely to use surrounding grassland and oak woodland habitats with appropriate prey conditions for foraging than the project area itself. In addition, Shiloh I, a wind energy project operated by a different energy producer, lies between the nest and the project area.

Because the Shiloh IV was largely a repowering project—that is, it entailed the removal of 230 old-generation wind turbines and their replacement with 50 new-generation turbines—the project resulted in vastly greater spacing between turbines and the removal of lattice towers that provided perches for eagles and other birds. However, the total risk area to eagles also increased because of the larger size of the turbine blades. The specific fatality estimates for each alternative are described below under "Assessment of Alternatives." Under all alternatives, Shiloh IV will actively discourage establishment of an increased prey base through project design and maintenance, and will coordinate with landowners to encourage responsible livestock husbandry and immediate removal of livestock carcasses to avoid attracting eagles into the project area.

The action alternatives involve power pole retrofits as mitigation for take of eagles. Such retrofits are anticipated to protect eagles from electrocution. It is difficult to predict whether the birds saved will be breeding adults, juveniles, or floaters; however, our REA assumes that the losses to electrocution are proportional to the demographic distribution of the population. Avoided fatalities will help to offset project-related fatalities (i.e., collisions with turbines or other facilities), thereby benefitting the eagle population as a whole. Pole retrofits are also expected to benefit other raptors that may be susceptible to electrocution. Eagles from BCRs 5, 9, and 15 could also be affected, both adversely by the wind project and beneficially by pole retrofits; however, in view of site fidelity and the distances to these outlying BCRs, breeding adults from other regions are less likely than floaters to be present in the project area. In addition, migrants from the northwest may pass through or winter in the project region.

Cultural Effects

Eagles and their feathers are revered and considered sacred in many Native American traditions. Operation of the project, including the take of eagles, is not expected to interfere with cultural practices and ceremonies related to eagles, or to affect the ability to utilize eagle feathers. Further, eagles that are found will be sent to our repository and, if in good condition, will be made available for these practices. Therefore, we do not anticipate any adverse effect on cultural practices.

Other Priority Uses

Other priority uses described in our regulations include safety emergencies, Native American use for rites and ceremonies, activities necessary to ensure public health and safety, renewal of programmatic nest-take permits, and resource development or recovery operations (for inactive golden eagle nests only). Operation of the project, including take of eagles, is not expected to interfere with other priority uses or permits because a no-net-loss standard is expected to be achieved under the action alternatives.

4.2.1.2.2 Cumulative Effects

This cumulative effects discussion evaluates cumulative effects on golden eagles as required by NEPA (CFR 1508.8) and the Eagle Act's permitting regulations. As part of its permit application review process (50 CFR 22.26 (f)(1); Service 2009), the Service is required to evaluate and consider effects of programmatic take permits on eagle populations at three scales: (1) the eagle management unit/BCR, (2) local-area, and (3) project area. Our evaluation also considers cumulative effects. We incorporated data provided by Shiloh IV, other data on mortality, and additional information on population-limiting effects in preparation of this cumulative impact assessment.

The purpose of this cumulative effects evaluation is to identify situations where take, either at the individual project level or in combination with other present or foreseeable future actions and other limiting factors at the local-area scale, may be approaching levels that are biologically problematic or that cannot reasonably be offset through compensatory mitigation. The scale of our analysis is a 140-mile radius around the project site. Climate change effects are addressed at the end of this section.

Eagle Take Policy

To ensure that any authorized take of eagles does not exceed the Eagle Act's preservation standard, the Service has set regional thresholds (i.e., upper limits) for take of each species of eagle, using methodology described in the FEA of the Eagle Permit Rule (Service 2009). The Service used estimates of population levels of eagles in each region and set take thresholds based on estimates of sustainable take in published literature (upper limits on the number of eagle mortalities that can be allowed under permits each year in the BCR and regional management areas).

The Service's analysis in the 2009 FEA identified take thresholds greater than zero for bald eagles in most regional management units. At the time, however, the Service determined that golden eagle populations might not be able to sustain any additional unmitigated mortality, and set the thresholds for this species at zero for BCR-level populations in all regional management units. This means that any new authorized take of golden eagles must be at least equally offset by compensatory mitigation (specific conservation actions to replace or otherwise make up for the loss of each eagle associated with a project).

The Service also put in place measures to ensure that local eagle populations are not depleted by take that would be otherwise regionally acceptable. The local-area population is based on the median distance to which eagles disperse from the nest where they are hatched to where they settle to breed. The Service specified that take rates must be carefully assessed, both for individual projects and for the cumulative effects of other activities causing take, at the scale of the local-area eagle population.

The Service identified take rates of between 1 and 5 percent of the total estimated local-area eagle population as benchmarks, with 5 percent being at the upper end of what might be appropriate under the Eagle Act's preservation standard. Appendix F of the Eagle Conservation Plan Module 1 (Service 2013) provides a full description of take thresholds and benchmarks, and provides suggested tools for evaluating how these apply to individual projects.

As described in ECP Guidance Appendix F (Service 2013), the Service uses a top-down approach for this assessment as shown in the following steps:

1. Identify numbers of eagles that may be taken safely at the national level (i.e., a national-level benchmark).
2. Allocate take opportunities among regional eagle management units (Service 2009) as a function of the proportion of eagles in each unit (i.e., BCR-level benchmarks).
3. Further allocate take opportunities to the local-area population scale as a function of inferred eagle population size at that the BCR scale for golden eagles. This approach assumes in the absence of better population data a uniform distribution of that population.
4. Incorporating benchmarks that can be used to assess the likely probable sustainability of predicted levels of take at the local-area population scale.

Through a spatial accounting system, permitted take is managed to ensure that the benchmarks also consider cumulative effects at the local-area population scale as a guard against authorizing excessive eagle take at this scale.

Shiloh IV Local-Area Population

For this analysis, past, present, and reasonably foreseeable projects comprise the Montezuma Hills WRA, the Altamont Pass WRA, the Pacheco Pass WRA, the Tehachapi WRA and ongoing utility operations. We did not include other sources of fatalities, such as vehicle strikes, illegal hunting, and poisoning, because too few quantitative data were available for these sources. Using an assumption that the take benchmark of 5 percent of the local-area population is sustainable, we extrapolated an acceptable level of take for each BCR within Shiloh IV's local-area population (Table 4-1). Based on our calculations, no more than 25 golden eagles should be removed from this local-area population annually.

To evaluate cumulative impacts for the local-area population, we followed the guidance provided in Appendix F of the Eagle Conservation Plan Guidance (Service 2013). Utilizing this process we estimated annual golden eagle fatality rates within a 140-mile radius around the Shiloh IV Wind Project area (Figure 4-1). This analysis included available data from other wind projects within the Montezuma Hills WRA, the Altamont Pass WRA, and the Tehachapi WRA. Although no data were available for the Pacheco Pass WRA, we estimated annual mortality based on information from other wind energy facilities in similar habitat types. Our analysis also included utility caused mortality data from PG&E.

Table 4-1. USFWS Golden Eagle Management Units and Local-Area Population Estimate

Eagle Management Unit	*Estimated Population Size*[a]	*BCR Size (mi²)*	*Golden Eagle Density (mi²)*[b]	*Percent of BCR*[c]	*Estimated Local-Area Population*[d*]	*5% of Local-Area Population*[e]
BCR 32—Coastal California	960	63,919	0.0150	51%	442	22
BCR 15—Sierra Nevada	84	20,414	0.0041	52%	46	2
BCR 5—Northern Pacific Rainforest	108	68,777	0.0016	3%	6	0
BCR 9—Great Basin	6,859	269,281	0.0255	1%	32	1
				Totals:	526	25

[a] *Taken directly from Service (2009).*

[b] *BCR eagle density = population size / BCR size.*

[c] *From Table 1-2*

[d] *The local-area is the project footprint with buffer radius of 10 miles, plus a buffer of 140 additional miles (140 miles is the average natal dispersal distance for the golden eagles).*

[e] *A take rate of 5% is the Service's upper benchmark for take at the local area population scale. The local-area 5% benchmark = (Local area*Regional Eagle Density)*0.05.*

* *The Service recently reanalyzed natal dispersal distances of eagles (Millsap et al. 2014), but has not yet made the technical and policy assessments of the new information that are necessary before using this new information to modify how we define the local area population around a permitted project.*

We used the a Bayesian modeling approach (Appendix C, Service 2013) to estimate take of eagles at the Montezuma Hills WRA, incorporating data available from mortality monitoring studies conducted at four of the wind projects in this WRA. Each project included in our quantitative risk analysis used similar methods and level of effort in their mortality studies (High Winds, Shiloh I, Shiloh II, and Shiloh III). Our model results are summarized in Table 4-2. These four projects represent 562 MW of the approximately 1,090 MW currently operating in this WRA. We estimated that, collectively, about eight eagles may be taken annually at the four projects for which data were available. This number represents an estimate using the 80th percent quantile of the model outputs, and may overestimate the number of annual eagle fatalities. While other projects within the Montezuma Hills WRA have conducted mortality monitoring studies, their methods and level of effort differed, making direct comparisons difficult. Therefore, we did not include those studies' data in our quantitative analysis. To account for the take of eagles at these remaining wind facilities, representing approximately 528 MW, we simply doubled our quantitative estimated predicted fatalities. This resulted in our total estimate of 16 eagles taken annually within this WRA. The Shiloh IV ECP (Appendix A) mentions two other foreseeable projects: PG&E Collinsville Wind Project and Montezuma Zephyr. Neither of these projects were included in our analysis, because we do not consider them foreseeable actions. Phase II of the Shiloh I Wind Project (30 MW) was included because it represents a project likely to be constructed within the reasonably foreseeable future.

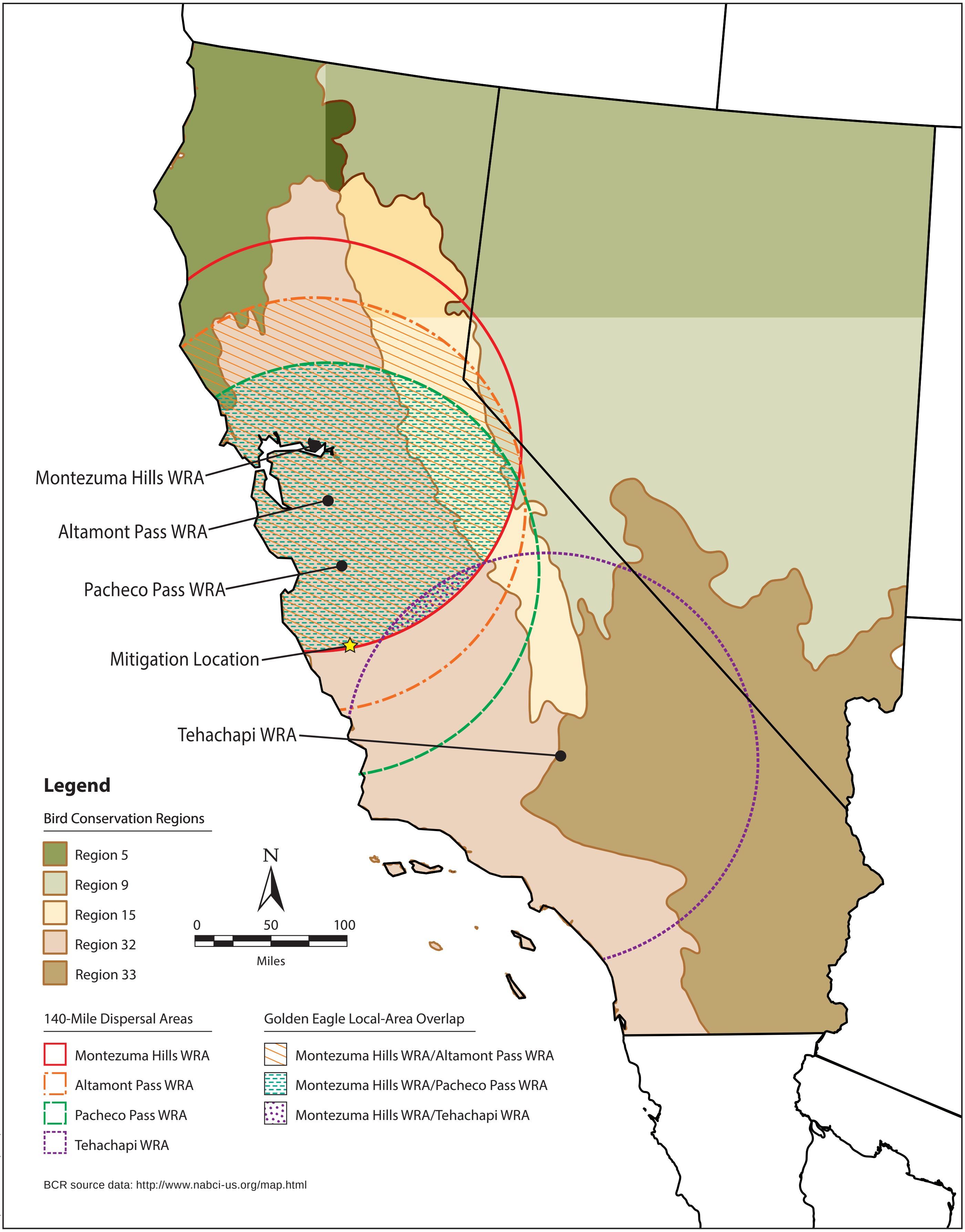

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Figure 4-1
Golden Eagle Local-area Population Overlap for Shiloh IV Cumulative Effects Analysis

Table 4-2. Predicted Annual Eagle Take at Four Wind Projects in the Montezuma Hills WRA.

Wind Project Name	*Mean*	*SD*	*CI80*
High Winds	4.02	5.58	6.12
Shiloh I	0.36	0.24	0.53
Shiloh II	0.75	0.51	1.10
Shiloh III	0.33	0.22	0.48
Total	6.16		8.23

To estimate take of eagles at the Altamont Pass WRA, we examined mean annual take rates for golden eagles at the WRA during 2005–2010 (Table 4-3, ICF International 2012). We estimated that about 47 eagles are taken annually. As indicated in Table 4-3, golden eagle mortality rates at the Altamont Pass WRA have declined in recent years (ICF International 2012). The reduction of annual eagle mortalities can be attributed to multiple factors. As required by settlement agreements with the California Attorney General, some wind projects were required to reduce mortality of four key raptor species, including golden eagle. In efforts to reduce take of the four key species, many turbines have been removed. Some wind facilities are also required to curtail operations during winter to further reduce impacts on raptors, including eagles.

The reduction in annual eagle mortality rates can be attributed to a combination of factors. Reduced eagle mortality is associated with the general decline in installed capacity, the removal of hazardous turbines, an increase in the duration and intensity of the seasonal shutdown, and the repowering of portions of the Altamont Pass WRA (ICF International 2012). We anticipate that as old-generation wind facilities in the Altamont Pass WRA are either decommissioned or repowered with fewer larger turbines, efforts aimed at reducing and minimizing take would be implemented and annual take rates would decrease accordingly.

Table 4-3. Annual Estimated Total Altamont Pass WRA-Wide Golden Eagle Fatalities (95% CI) Based on Modified Smallwood (2007) Detection Probabilities, 2005–2010.*

Year	*Estimated Eagle Fatalities*	*95% Confidence Interval*
2005	57	(53–61)
2006	88	(81–94)
2007	39	(36–41)
2008	26	(24–29)
2009	39	(36–43)
2010	34	(29–39)

* *Fatality estimates provided by Alameda County (ICF International 2012).*

Although no mortality data were available for the Pacheco Pass WRA, which consists of one wind project owned and operated by International Turbine Research, we thought it important to include in our cumulative effects analysis. This WRA is about 70 miles south of the Altamont Pass WRA and is characterized by similar habitat in Pacheco State Park. Given the high-quality nesting and foraging habitat present and limited information about the wind farm itself, we qualitatively estimated a take rate for the Pacheco Pass WRA to be at least two golden eagles a year.

For the Tehachapi WRA, we estimated an annual take rate based on available data. We recognized two distinct geographic areas in the Tehachapi WRA and calculated two different annual golden eagle take rates accordingly. The northeastern portions of the Tehachapis are more rugged and mountainous, supporting a higher density of nesting eagles. Although the southwestern portion of the WRA includes some foothills, it is primarily characterized by flat valley floors, and available data suggest a lower fatality rate here. We extrapolated take rates for each project in the northwestern portion of the WRA to be five golden eagles per year and two eagles per year for each project in the southwestern portion. Accordingly, we estimate an overall annual mortality rate of 34 golden eagles in the Tehachapi WRA.

We used available utility electrocution and collision data to estimate take by BCR and at the local-area population level. Based on available data, on average, 10 golden eagle fatalities are reported annually within BCR 32. We calculated that 4.2 of the 10 eagles taken are within the project's local-area population. In an attempt to account for undetected mortalities, we qualitatively estimated that a total of six eagles are taken each year in the local area by electrocutions and collisions with utility lines.

As described above and summarized in Table 4-4, we used the Service's Bayesian model framework to estimate annual take from the Montezuma Hills WRA, compiled data from Altamont Pass WRA and Tehachapi WRA, and utility electrocution and collision data and extrapolated take rates. We also qualitatively estimated take at the Pacheco Pass WRA. We estimate a total take of 65 golden eagles annually within the Shiloh IV local area population. Consequently, we estimate that 12.3 percent of the local area population is taken annually.

Table 4-4. Shiloh IV Local Area Population Annual Eagle Take Calculations.

Project	*LAP (mi)²*	*Annual Take*	*Overlap*	*Estimated Annual Take*	*Estimated Annual take within Shiloh IV LAP*
Altamont Pass WRA	46,914	47.2	40,327	47.2	40.6
Montezuma Hills WRA	47,697	16	47,697	16	16
Electric Utility (BCR 32)	70,763	10	29,482	10	6
Pacheco Pass WRA	43,302	2	28,816	2	1.3
Tehachapi WRA	34,070	34	581	34	0.6
			Totals:	109.2	64.5

We estimated the annual golden eagle mortality rate within the Shiloh IV local area population (LAP) using the following equation:

$$(Sum\ of\ take\ within\ Shiloh\ IV\ LAP\ \div\ Shiloh\ IV\ LAP) \times 100 = annual\ rate\ of\ mortality\ within\ Shiloh\ IV\ LAP$$

$$(64.5 \div 526) \times 100 = 12.3\%$$

Conclusion

We developed this conservative estimate of population-level effects to be protective of the species. Our mortality estimates for the Montezuma Hills WRA are higher than mortality rates that have been reported in Montezuma Hills WRA project-specific postconstruction monitoring studies. This conservative approach was adopted to ensure that undocumented fatalities are addressed. Based on our assessment, fatalities at the Altamont Pass WRA have the largest overall impact on the eagle population. However, eagle mortality in that WRA may change over time as individual wind projects within the WRA reach their lifespan and are decommissioned or repowered and re-sited per the terms of the existing settlement agreements. According to Sandra Rivera, Alameda County Assistant Planning Director, the repowering and careful re-siting with new-generation turbines is anticipated to be complete by 2018.

Many of the wind energy facilities that are responsible for ongoing golden eagle fatalities within the local-area population were in operation prior to 2009. The majority of estimated annual golden eagle fatalities within the Shiloh IV local-area population (56.6 of 64.5) are attributed to these existing projects. The additional eight eagle fatalities per year are attributed to projects constructed in the Montezuma Hills WRA since 2010. As discussed in the Eagle Take Policy section above, the Service's objective is to manage the species by authorizing take at a level that is less that 5 percent of the local area population. However, in areas such as this, where the annual ongoing fatality of eagles is well above this benchmark, our goals will be focused on additional mitigation and overall reduction of ongoing eagle mortality. The Service will continue to encourage measures to reduce mortality from the sources identified here, including the Shiloh IV project. The ACPs outlined in the applicant's ECP are intended to minimize ongoing take at the facility.

At the same time, the context of the cumulative effect must also be considered. While the incremental effect of the project is small and the impact intensity is lower than that of other WRAs in the local area, the project would contribute to local and possibly regional adverse effects on the species. We anticipate that, by issuing a permit, the Service would ensure that take of eagles would be offset through implementation of ACPs and the retrofitting of additional utility power poles at levels above that currently undertaken by the utility company, and that these activities will help accomplish our population goal for eagles. In addition, by implementing the ACPs, Shiloh IV will contribute information on the effectiveness of experimental ACPs, with the potential to support technological innovations that could minimize avian impacts associated with turbine operations. Because the applicant would offset take though compensatory mitigation, and may reduce the amount of actual take (compared with our take estimates for the project) through the implementation of experimental ACPs, there would be no significant adverse cumulative effects contributed by Shiloh IV.

4.2.1.2.3 Climate Change

The effects of climate change on eagles and other migratory bird species in the region is treated as a cumulative impact because it occurs later in time. Over the life of the project, the effects of climate change in California will likely result in more pronounced seasonal variation. As discussed in section 3.4, *Climate Change*, the project area is anticipated to shift to a warmer and dryer regime. The ultimate effect of these changes on golden eagles in the project area and the region is difficult to predict. However, because the species survives on a wide variety of prey species across a broad gradient of climatic zones, it is reasonable to surmise that golden eagles have the capacity to adapt to minor changes. Because of agricultural practices in the Montezuma Hills, however, the local prey base is not large and is not expected to change substantially as a result of climate change. Moreover, by generating electricity using wind energy rather than fossil fuels, operation of the project could offset production of 93,423–116,779 metric tons of CO_2 equivalent per year (Service 2012b). Over the life of the project, this would equate to approximately 3.3–4.0 million metric tons of CO_2 equivalent. This offset would constitute an indirect beneficial effect.

4.2.2 Assessment of Alternatives

In assessing whether there is a "significant" impact, we have considered both the context and intensity of the action and its effects (40 CFR 1508.27). *Context* refers to the affected environment in which the proposed action takes place and may include the socioeconomic, legal, and political situation surrounding an action. *Intensity* refers to the severity of the proposed action's impact on the environment and may consider environmentally beneficial actions, public health, unique characteristics of the geographic area, controversy, uncertainty, precedent-setting elements, cumulative effects, cultural resource effects, effects on endangered species, and consistency with environmental laws (40 CFR 1508.27[b]). In the case of the Proposed Action—issuance of an eagle take permit—we have assumed that the context is the presence of an already operating wind energy facility within a larger developed WRA, and that a certain amount of take of golden eagles already occurs. Consideration of intensity addresses the relative severity of effects on eagles, the possibility of the Federal action to establish a precedent for future eagle take permits, and the efficacy of the action in mitigating adverse cumulative effects.

4.2.2.1 Alternative 1: No Action

Under the No-Action Alternative, we would take no action or would deny the permit application and would not issue a permit. Under the No-Action Alternative, direct impacts of the operational Shiloh IV Wind Project on the golden eagle population would be quantified during the first 3 years of operational monitoring (2013–2016), which the applicant will conduct in compliance with Solano County requirements. However, longer term monitoring—particularly additional monitoring for eagles in the event that actual eagle fatality rates exceed predicted rates, would not likely occur. Without implementation of the ECP and issuance of an eagle take permit, compensatory mitigation, experimental ACPs, and adaptive management steps designed to reduce take would not be implemented. The project's impacts on eagle populations would be additive and the project would not ensure no net loss to eagle populations.

Under the No-Action Alternative, the project would continue to operate without a take permit. Should direct or indirect take of eagles occur under the No-Action Alternative, the applicant would be in violation of the Eagle Act and would thereby be subject to investigation and possible prosecution by the Office of Law Enforcement.

If we decide not to issue a take permit because we assess the risk to be zero, and take occurs, then we will have been in error and law enforcement action against the applicant would be unlikely. However, following the initial take, the operator (Shiloh IV) would be directed by the Office of Law Enforcement to immediately consult with us and may be directed to shut down wind turbines to avoid additional eagle take until adaptive management measures are implemented. Failure to implement Service recommendations to avoid additional take and/or failure to obtain a permit would likely result in investigation and could result in prosecution under the Eagle Act. In the alternate scenario—in which we do not issue a take permit because the application and conservation commitments made by the applicant fail to meet our issuing criteria—then immediate law enforcement action is more likely.

4.2.2.2 Alternative 2: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan

Under this alternative, we estimate that one eagle would be killed annually, and up to five eagles would be killed over a 5-year period. The ECP includes ACPs that will result in additional monitoring and operational adjustments. If the take is as large as we estimated, the applicant would implement most steps in its stepwise-table as listed below:

- Additional 3 years of eagle mortality monitoring.
- Visual and/or auditory deterrence.
- Studies of deterrence effectiveness.
- Intensified monitoring to determine eagle use patterns.
- Biological monitors to direct curtailment actions.
- Radar systems and biologists to direct curtailment actions.
- Extended eagle movement and mortality monitoring studies.
- Broader seasonal or temporal curtailment.
- Other actions to minimize and compensate for effects.

Subsequent implementation of the ACPs could result in decreased eagle fatalities. Consequently, the fatalities that occur during the initial 5-year period (i.e., five fatalities) cannot be extrapolated to determine a 30-year total (i.e., 30) because it is presumed that ACPs would avoid future fatalities. This anticipated decline would reduce the 30-year total from 30 eagle fatalities to 5–15 fatalities (Table 2-1).

Seventy-five utility pole retrofits would be completed within 1 year of permit issuance under this alternative. Additional retrofits at a rate of 15 per eagle would be provided reactively for eagle compensatory mitigation as take events occur.

The applicant's purposed approach would ensure no net loss to golden eagle populations. Based on the intensity and context of these effects and consideration of the elements associated with this alternative, Alternative 2 is not expected to result in significant adverse effects.

4.2.2.3 Alternative 3: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Additional Mitigation and Monitoring Measures (Service Preferred Alternative)

Under this alternative, we estimate that one eagle would be killed annually, and up to five eagles would be killed over a 5-year period. The ECP includes ACPs that will result in additional monitoring and operational adjustments. As under Alternative 2, ACPs will be implemented based on the number of fatalities, and 30-year total fatalities are expected to be the same. The primary difference under Alternative 3 is the requirement for increased mitigation and monitoring. Our REA shows that 133 retrofits will mitigate the loss of five eagles. Increased mortality monitoring associated with this alternative (i.e., evaluating all turbines during a monitoring year), will help to ensure that fatalities are detected and will support validation of the take estimate. Increased monitoring also has the benefit of accelerating the use of the stepwise table if a fatality is discovered, thereby helping reduce future fatalities. Based on the intensity and context of these effects and consideration of the elements associated with this alternative, Alternative 3 is not expected to result in significant adverse effects on golden eagle populations.

4.2.2.4 Alternative 4: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Seasonal Restrictions

Under this alternative, we estimate that 0.68 eagle would be killed annually and up to 4 eagles would be killed over a 5-year period. The reduced take would be attributed to a reduction in operational hours of the turbines; approximately 780 hours of operational curtailment would be implemented under this alternative. As the Bayesian model is based on exposure minutes, the total estimated number of fatalities is expected to decline with reduced operations. However, this aggressive approach to reducing fatalities may not ultimately reduce fatalities to the degree expected because:

- the eagle density in the area is low and the area has limited foraging opportunities,
- surrounding operational wind turbines will not be seasonally restricted and could kill eagles,
- the optimal time for a seasonal shutdown is speculative and may vary based on eagle productivity and use patterns, and
- there is no existing discernible pattern for determining the cause or time of fatalities.

Alternative 4, like Alternative 3, includes increased mitigation and monitoring to help ensure that effects are avoided. Our REA shows that 101 retrofits would mitigate the loss of 0.68 eagle per year. The increased monitoring associated with this alternative would also help to ensure that fatalities are detected and would support validation of the take estimate. Based on the intensity and context of these effects and consideration of the elements associated with this alternative, Alternative 4 is not expected to result in significant adverse effects to golden eagle populations.

4.2.3 Other Environmental Analysis

This FEA considers direct, indirect, and cumulative effects. According to the CEQ NEPA regulations, direct effects are caused by the action and occur at the same time and place as the action (40 CFR 1509.8[a]); indirect effects are caused by the action but "occur later in time or are further removed in distance but are still reasonably foreseeable." Cumulative effects are those effects that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes the action; cumulative effects can result from individually minor but collectively significant actions that take place over time (40 CFR 1508.7).

As discussed in chapter 1, *Purpose and Need*, previous environmental analyses have been released in the *Final Environmental Impact Report—Shiloh IV Wind Energy Project* (Solano County Department of Resource Management 2011b) and *Final Environmental Assessment for the Shiloh IV Wind Project Habitat Conservation Plan* (Service 2012b). These documents provide an analysis of the effects of the construction and operation of the Shiloh IV Wind Project, which is now operational, and therefore part of the existing physical environment. The analysis here concentrates on the impacts of the Proposed Action (issuance of a programmatic eagle take permit). The analyses applicable to the operations of Shiloh IV are incorporated by reference into this FEA and are summarized below.

4.2.3.1 Aesthetics

The potential effects of the operational Shiloh IV Wind Project on aesthetics were analyzed in detail in pages 3.1-1 through 3.1-11 of the HCP FEA (Service 2012b). The analysis considered existing views and the effects of changes on sensitive viewers (i.e., motorists, residents, and recreationists). Incorporating visual simulations to determine the severity of effects of the Shiloh IV Wind Project on aesthetics and visual resources, the analysis identified four potential impacts.

- Temporary visual impacts caused by construction activities
- Long-term changes in visual character
- Potential increase of light and glare
- Potential aesthetic/visual effects from decommissioning of the Shiloh IV Wind Project

Because of the limited number of viewers, relatively low viewer sensitivity, and existing visual character dominated by operational wind projects, the HCP FEA concluded that no significant adverse effects would result from implementation of the Shiloh IV Wind Project. We have reviewed the analysis in the HCP FEA and have determined that there are no further effects of the Shiloh IV Wind Project on aesthetics and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of aesthetics in the HCP FEA is hereby incorporated by reference into this FEA.

The implementation of visual ACPs could have a minor effect on visual resources, but because ACPs would entail only minor modifications to the existing wind turbines, and the presence of these turbines has been determined not to constitute a significant adverse effect, these modifications would similarly not constitute a significant adverse effect.

4.2.3.2 Agricultural Resources

The potential effects of the operational Shiloh IV Wind Project on agricultural resources were analyzed in detail in pages 3.2-1 through 3.2-7 of the HCP FEA (Service 2012b). The analysis considered the temporary and permanent effects of constructing and operating a wind project on the existing agricultural uses that characterize the Shiloh IV Wind Project area. The analysis identified three potential impacts.

- Conversion of agricultural lands to nonagricultural use
- Potential conflict with Williamson Act contracts
- Soil erosion, soil loss, and decrease in soil productivity

The analysis found that the conversion of a small amount of agricultural land to wind energy production would not constitute a significant adverse effect; that wind energy production is considered a compatible land use for agricultural lands under Williamson Act contracts; that there would be no adverse effects associated with soil erosion, soil loss, or a decrease in soil productivity; and that implementation of environmental commitments would ensure that adverse soil-related effects would not result from decommissioning activities.

We have reviewed the analysis in the HCP FEA and have determined that there are no further effects of the Shiloh IV Wind Project on agricultural resources by impacts to agricultural resources that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of agricultural resources in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.3 Air Quality and Climate Change

The potential effects of the operational Shiloh IV Wind Project related to air quality and climate change were analyzed in detail in pages 3.3-1 through 3.3-17 of the HCP FEA (Service 2012b). The analysis, using the URBEMIS2007 model, considered the emission of criteria pollutants associated with construction of the wind project (i.e., access roads, foundations, wind turbines, support facilities, underground power lines, and construction traffic); maintenance activities (workforce traffic, routine maintenance activities); occasional use of a diesel-powered generator; and routine upkeep of the operations facility. The analysis also considered generation of greenhouse gases (GHGs) in exceedance of local or federal air quality thresholds. The analysis identified three potential impacts.

- Generation of emissions in excess of Federal *de minimis* thresholds
- Generation of a significant level of greenhouse gas emissions
- Exposure of sensitive receptors to substantial amounts of diesel particulate matter

Modeling indicated that construction and operation of the wind project would generate emissions of criteria pollutants well below the established federal *de minimis* thresholds. The analysis of GHG emissions showed that the wind project would neither exceed thresholds established by the Bay Area Air Quality Management District nor result in a significant impact associated with climate change, in part because the project would offset GHGs that would be produced by fossil-fuel generation if the project were not constructed. Because emissions of diesel particulate matter would be of limited quantity and duration, this effect was not considered to be adverse.

We have reviewed the analysis in the HCP FEA and have determined that there are no further effects of the Shiloh IV Wind Project on air quality and climate change and that no additional analysis—beyond the overall effect of climate change on eagles as described later in this chapter—is necessary to support issuance of an eagle take permit. The analysis of air quality and climate change in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.4 Biological Resources

The potential effects of the operational Shiloh IV Wind Project on biological resources were analyzed in detail in pages 3.4-1 through 3.4-17 of the HCP FEA (Service 2012b). The analysis, hereby incorporated by reference into this FEA, considered the effects of the project on wildlife and their habitat. The analysis identified seven potential impacts.

- Potential impacts on habitat for special-status invertebrate species
- Potential impacts on habitat for California tiger salamander

- Potential impacts on western burrowing owl
- Habitat removal, displacement, and disturbance of nesting raptors and special-status birds
- Mortality of raptors, other birds, and bats due to collisions with turbines
- Effects on special-status plants
- Effects on waters of the United States (including wetlands)

In addition, the HCP EA identified a number of environmental commitments, of which those listed below pertain directly to biological resources as considered in this analysis.

- EC-8: Conduct preconstruction surveys for sensitive biological resources
- EC-9: Conduct environmental awareness training for all construction and operational personnel
- EC-10: Avoid and minimize disturbance or removal of sensitive biological resources
- EC-11: Avoid disturbance of wetlands and other aquatic features
- EC-12: Reduce impacts on California tiger salamander through avoidance, minimization, and compensatory mitigation measures
- EC-13: Mitigate potential turbine-related mortality of birds and bats

In addition to these environmental commitments, the BBCS presented a set of 10 conservation measures that would help to avoid, minimize, and mitigate effects on birds (including BCC species) and bats. These are summarized below and presented in full in the BBCS (Appendix B).

- CM-1: Conduct preconstruction surveys
- CM-2: Site turbines to avoid high-risk landscape features
- CM-3: Establish a no-disturbance buffer around potential raptor nesting habitat
- CM-4: Retain nest trees
- CM-5: Incorporate avian-safe practices into design of overhead power lines and other project features
- CM-6: Incorporate features to discourage increased prey base
- CM-7: Install appropriate lighting
- CM-8: Provide training for construction and project personnel
- CM-9: Conduct post-construction mortality monitoring and bird use surveys
- CM-10: Provide offsite compensatory mitigation

The effects identified in the HCP FEA are summarized below.

4.2.3.4.1 Special-Status Invertebrates

Because project activities would be conducted at a sufficient distance to avoid disturbance of habitat, and because environmental commitments EC-8, EC-10, and EC-11 would ensure avoidance of direct and indirect effects on habitat for vernal pool invertebrates, there would be no adverse effect.

4.2.3.4.2 California Tiger Salamander
Potential impacts on habitat for California tiger salamander were addressed through implementation of avoidance measures and preservation of habitat at an approved conservation bank. There would be no significant adverse effect.

4.2.3.4.3 Western Burrowing Owl
Although burrowing owls occur in the project area and could be affected by construction-related activities as well as by turbine collision, implementation of environmental commitments EC-8, EC-9, and EC-10 would avoid and minimize these effects. Implementation of EC-13 would mitigate effects through offsite conservation of suitable foraging habitat. There would be no significant adverse effect.

4.2.3.4.4 Nesting Raptors and Special-Status Birds
Loss and degradation of habitat, displacement of birds, disturbance of nesting birds, and mortality from operations could affect raptors and special-status birds, including BCC species. These effects were addressed through implementation of avoidance, minimization, and mitigation measures. Implementation of EC-8, EC-9, and EC-10 would minimize direct effects associated with construction-related disturbance. CM-10 in the BBCS states that the applicant will voluntarily provide

> offsite compensatory mitigation for raptors in an amount equal to or greater than the total rotor-swept area of the project (i.e., 84 acres). The mitigation habitat will be acquired through the purchase of conservation credits in an approved mitigation bank, in fee title, or through conservation easement, and will be suitable to support breeding and foraging habitat for raptors, including American kestrels, red-tailed hawks, and golden eagles. Suitable nest trees will be protected; if none are available, they will be planted. Alternatively, the applicant may contribute an in-lieu fee to the Solano Land Trust or other conservation entity approved by Solano County in consultation with DFG and USFWS.

CM-10 and the retrofitting of power poles provided for eagle compensatory mitigation will both also mitigate Shiloh IV's impacts on other large raptors, including red-tailed hawks. There would be no additional significant adverse effect on nesting raptors and special-status bird species.

4.2.3.4.5 Mortality Due to Turbine Collision
In addition to the turbine-related effects on golden eagle, which are discussed at greater length in section 4.2.1, "Effects Related to Take of Golden Eagles," project operations were determined to result in turbine-related mortality of other bird species of interest, including BCC species, red-tailed hawk, and American kestrel, as well as bats. EC-13 in the HCP FEA specifies mitigation in the form of offsite conservation of land in perpetuity for the benefit of bird and bat species. The BBCS (Appendix B of this FEA) sets forth 10 conservation measures designed to address avian and bat mortality.

Shiloh IV collected data on observed collision rates from postconstruction monitoring at adjacent projects in the Montezuma Hills WRA with turbines of similar size, RSA, and position on the landscape. Currently, postconstruction monitoring data are available from five facility reports: a 2-year study at the High Winds site (Kerlinger et al. 2006), a 3-year study at the Shiloh I site (Kerlinger et al. 2009b), a 1-year mortality study at the Solano Wind site (Burleson Consulting 2010), a 2-year study at the Shiloh II site (Kerlinger et al. 2012), and a 1-year mortality study at the Montezuma Wind site (ICF International 2013a). Additionally, are other studies are in preparation in the WRA. Together, these studies provide multiple years of empirical fatality data collected throughout much of the Montezuma Hills WRA and surrounding the project area. Estimates for the Shiloh IV project were calculated by multiplying the number of turbines (N=50), times 2.0 MW/turbine, times the average per MW mortality rates (lower range), and highest mortality rates (upper range).

Review of the list of BCC species that were determined likely to be subject to mortality associated with turbine collision indicated that, of the 46 taxa documented in BCR 32, 15 BCCs have been documented in the Montezuma Hills WRA and 16 have potential habitat in the Montezuma Hills WRA. Of these, five of the species have been documented in postconstruction monitoring as turbine-related mortalities (Table 4-5). The Service conducted an analysis of the five species expected to be at risk by reviewing regional and global population estimates (where available) and estimating the risk from the Shiloh IV project (Table 4-5) based on mortality monitoring conducted to date at surrounding operating wind projects. We also considered red-tailed hawk and American kestrel as “birds of interest” for the purposes of this analysis.

Table 4-5. Birds of Conservation Concern and Birds of Interest Affected by the Shiloh IV Project.

		Population Estimates				
Species	*Potentially Affected*[1]	*BCR*	*Global*[2]	*Estimated Fatalities at Shiloh IV*[3] *(birds/year)*	*Estimated Fatalities for MHWRA*[4] *(birds/year)*	*Percent of BCR Population Taken in MHWRA*
Black rail (*Laterallus jamaicensis*)	Yes	unknown	unknown	unknown	unknown	unknown
Long-billed curlew (*Numenius americanus*)	Yes	unknown	161,000[5]	0.2	2.4	NA
Yellow warbler (*brewsteri* ssp.)	Yes	50,000	40,000,000	1.2	13.7	> 0.01%
Common yellowthroat (*sinuosa* ssp.)	Yes	60,000	32,000,000	0.1	0.9	> 0.01%
Tricolored blackbird (*Agelaius tricolor*)	Yes	260,000[6]	unknown	0.5	5.5	> 0.01%
Red-tailed hawk[7] (*Buteo jamaicensis*)	Yes	89,000	2,000,000	18	204.5	> 0.01%
American kestrel[7] *(Falco sparverius)*	Yes	150,000	6,000,000	32	363.5	> 0.01%

1 Species recorded as fatalities at one or more wind projects in the Montezuma Hills were considered potentially affected by the Shiloh IV project.
2 Based on Partners in Flight land-bird population estimation database (http://www.rmbo.org/pif_db/laped/default.aspx)
3 The Service calculated a weighted average annual fatality rate for the MHWRA and extrapolated to the Shiloh IV project size.
4 Current size in megawatts of the Montezuma Hills Wind Resource Area is 1,058.9 MW’s. Although for our analysis we assumed operations of 1088.9 MW. Estimated fatalities for the entire MHWRA were calculated by taking the total number of MW’s times the weighted average annual fatality rate.
5 This estimate was made in 2011. However, another focused survey in 2012, coupled with recent circumstantial evidence, suggests that the population for this species in California is rapidly declining; consequently, this may be an overestimate of the current population.
6 Average of 2 years (2004–2005) of surveys across the range of the species.
7 Red-tailed hawk and American kestrel are not Birds of Conservation Concern, but are considered “birds of interest” for the purposes of this analysis.

The other seven BCCs (peregrine falcon, Whimbrel, burrowing owl, black swift, Nuttall's woodpecker, loggerhead shrike, yellow-billed magpie) documented in the Montezuma Hills WRA have not been detected as fatalities because either no fatalities have occurred or because none have been found and reported. Consequently, this information indicates that impacts on these seven species are less likely to occur at the Shiloh IV project, or, if impacts do occur, they are likely to be infrequent and consist of only a few birds. Fatalities of the BCC species that have been detected at other wind projects have occurred infrequently and at low numbers. Consequently, the Shiloh IV project is anticipated to result in similarly low frequencies and numbers of fatalities (Table 4-5). This is not considered to be a significant adverse effect in the context of the regional (BCR) and global populations of these species.

American kestrels and red-tailed hawks both suffer relatively high mortality rates at wind projects in the Montezuma WRA. The annual fatality estimates we calculated for both Shiloh IV and the Montezuma Hills WRA (Table 4-5) are relatively high. Even so, according to our calculations, these rates do not appear to have population-level impacts. To analyze cumulative impacts on these species, we combined our Montezuma Hills WRA annual mortality estimates with those reported for the Altamont Pass WRA (ICF International 2013b). We used the 5-year average estimates for American kestrel (413.0/year) and red-tailed hawk (274.6/year). Considering these estimates, the combined Montezuma Hills WRA and Altamont Pass WRA annual fatality rates for American Kestrels are well below 0.01% of the BCR population. For red-tailed hawks, 0.01% of the BCR population is taken annually.

The applicant implemented CM-1 through CM-8 as set forth in the BBCS during construction and has purchased offsite mitigation habitat equivalent to the total rotor-swept area of the project (i.e., 84 acres) to provide breeding and foraging habitat for raptors. CM-8, providing for postconstruction mortality monitoring, specifies the following requirements:

- Qualified biologists will conduct annual bird and bat mortality monitoring surveys to validate the risk assessment and to document actual fatalities associated with wind turbines and other project-related activities and facilities (e.g., meteorological towers, overhead power lines). These studies will be conducted in accordance with standardized guidelines as set forth in the CEC Guidelines (2007) for a minimum of 3 years following the first delivery of power. The biologists will conduct bird use surveys—consistent with protocols observed during the preconstruction use surveys—concurrently with mortality monitoring surveys.
- The biologists and Shiloh IV will prepare an annual report documenting the results of each year's monitoring efforts. The report will be submitted to the Service, the California Department of Fish and Wildlife (CDFW), the County, and the County's Technical Advisory Committee within 90 days after the end of each calendar year, unless additional time has been approved by the County. Monitoring data will also be submitted to the Biogeographic Information and Observation System Program in accordance with the CEC Guidelines.
- Shiloh IV will report any discovered injured or dead golden eagles for the life of the project.

The monitoring protocols for the project include annual postconstruction monitoring for 3 years from the initiation of power delivery, with the possibility of extending the monitoring period if results warrant. Three major field components constitute the monitoring program.

- Avian use surveys to determine the seasonal and annual variations in relative abundance and species use patterns.

- Carcass surveys to search for the bodies of birds and bats killed by turbines or power transmission structures.
- Carcass detection probability and carcass removal monitoring for bias correction.

Results will be used by Shiloh IV, the Service, and CDFW to determine the effectiveness of mitigation measures, and to determine which, if any, turbines produce disproportionately high levels of mortality. The results will inform the appropriateness of mitigation measures implemented by Shiloh IV for the benefit of future wind energy projects. Collectively, these measures are expected to reduce potential adverse effects. Additional analysis pertaining to golden eagles is proposed in this FEA to ensure that effects on eagles are detected, avoided, and minimized.

The applicant's new environmental commitments established in the ECP are listed below.

- An adaptive management framework (i.e., ACPs) to monitor, avoid, and minimize the long-term take of eagles; and
- Compensatory mitigation for every eagle fatality.

These commitments are described in more detail in chapter 2, *Alternatives*. With implementation of the environmental commitments, the BBCS CMs, and the additional commitments set forth in the ECP, it is anticipated that turbine-related mortality of birds would not result in significant adverse population-level effects.

4.2.3.4.6 Special-Status Plants

No state- or federally listed species are present in the project area. The three species designated by the California Native Plant Society would be avoided through avoidance and minimization measures. Additionally, implementation of EC-8, EC-9, EC-10, and EC-11 would reduce the potential for inadvertent effects on these species. There would be no additional adverse effect from implementation of the Proposed Action.

4.2.3.4.7 Waters of the United States (Including Wetlands)

Most of the project components have been sited at least 100 feet from any potential waters of the United States; however, some power collection system routes cross potential waters, and a proposed access road is adjacent to a wetland. Use of horizontal directional drilling and implementation of EC-11 would address these potential effects. There would be no additional significant adverse effects.

4.2.3.4.8 Summary Biological Resources

We analyzed the potential effects of the operational Shiloh IV Wind Project on biological resources in detail in the HCP FEA (Service 2012b). The analysis identified seven potential biological resources that could be affected by Shiloh IV. The HCP FEA considered the effects of Shiloh IV on wildlife and their habitat; that analysis was incorporated by reference into this FEA, although we further analyzed impacts on sensitive bird species in this FEA. We quantified population-level effects for BCC species for which turbine-related mortality has been documented in the Montezuma Hills WRA. We also analyzed Shiloh IV's population-level impacts on red-tailed hawks and American kestrels because of known high mortality rates for these species in the WRA (Table 4-5). With implementation of the environmental commitments in the HCP FEA, the BBCS CMs, and the additional commitments set forth in the ECP, it is anticipated that the Shiloh IV Wind Project would have no significant adverse effects on biological resources.

4.2.3.5 Cultural Resources

The potential effects of the construction and operational Shiloh IV Wind Project on cultural resources were analyzed in detail in pages 3.5-1 through 3.5-12 of the HCP FEA (Service 2012b). The analysis considered the potential effects of constructing and operating a wind project on archaeological and historical resources that could be present in the Shiloh IV project area. Archaeologists and architectural historians conducted pre-field literature searches and field surveys of the Shiloh IV and identified several historic-period resources that warranted consideration for potential eligibility for inclusion in the National Register of Historic Places or the California Register of Historic Resources. The analysis identified three potential impacts.

- Change in significance of known archaeological sites
- Change in significance of potential buried archaeological sites
- Change in significance of a historical resource

The analysis found that the single identified archaeological resource—a windmill and well—would be avoided through implementation of EC-14. Potential buried archaeological sites would be addressed through implementation of EC-15 and EC-16. The single historical resource—the Donald Ranch complex—is sufficiently removed from project features and activities to protect it from adverse effects.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on cultural resources are adequate to address impacts on cultural resources that may result from the alternatives analyzed in this FEA. We have determined that no additional analysis beyond the effects of issuing a take permit on cultural practices described in section 4.2.1, "Effects Related to Take of Golden Eagles," is necessary to support issuance of an eagle take permit. The analysis of cultural resources in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.6 Geology, Seismicity, Mineral Resources, and Paleontological Resources

The potential effects of the operational Shiloh IV Wind Project on geology, seismicity, mineral resources, and paleontological resources were analyzed in detail in pages 3.6-1 through 3.6-6 of the HCP FEA (Service 2012b). The analysis considered the potential effects of constructing and operating a wind project in the context of seismicity, soils, mineral resources, and paleontological resources. The analysis identified five potential impacts.

- Increased exposure to risk from ground shaking and landslides
- Potential loss of soil from erosion
- Location of facilities on expansive soils
- Potential loss of availability of mineral resources
- Potential damage or destruction of significant paleontological resources

The analysis found that the Shiloh IV Wind Project would not affect any known mineral resources in the project area. Moreover, the analysis concluded that implementation of environmental commitments specifying preparation of a geotechnical study, a stormwater pollution prevention plan (SWPPP), and a fugitive dust control plan; requiring restoration of disturbed areas to preproject conditions; and providing for cessation of work in the event of discovery of unknown paleontological resources would ensure that there would be no significant adverse effects.

We have reviewed the analysis in the HCP FEA and have determined that there are no additional effects from the Shiloh IV Wind Project on geology, seismicity, mineral resources, and paleontological resources that may result from the alternatives analyzed in this FEA. No additional analysis is necessary to support issuance of an eagle take permit. The analysis of these resources in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.7 Growth-Inducing Effects

The potential growth-inducing effects of the Shiloh IV Wind Project were evaluated on page 21-25 in the Shiloh IV Wind Energy Project Draft Environmental Impact Report (Solano County Department of Resource Management 2011a). The analysis concluded that because the production of wind energy would supply the existing power demand in the region in support of the California Renewable Portfolio Standards, would not conflict with the area's exclusive agriculture zoning designation, and would only require long-term employment of six individuals, there would be no growth-inducing effects.

We have reviewed the analysis in the EIR and have determined that the analysis and the conclusions regarding the growth-inducing effects of the Shiloh IV Wind Project are adequate to address growth-inducing impacts that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of growth-inducing effects in the Draft EIR is hereby incorporated by reference into this FEA.

4.2.3.8 Hazardous Materials

The effects of the operational Shiloh IV Wind Project related to hazardous materials were analyzed in detail in pages 3.7-1 through 3.7-4 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project to expose people or properties to hazardous materials. The analysis identified two potential impacts.

- Potential hazardous materials spills
- Encountering hazardous materials during construction

The analysis found that construction and operation of the wind project would not introduce substantial amounts of hazardous materials to the project area. Moreover, environmental commitments specifying preparation and implementation of a SWPPP, a business plan, and a waste management plan would avoid adverse effects. The results of the Phase I study conducted for the Shiloh IV Wind Project indicated a low likelihood of encountering hazardous materials in the project area. Nevertheless, environmental commitments have been established specifying implementation of appropriate measures should hazardous materials be encountered. Consequently, there would be no significant adverse effects.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project related to hazardous materials are adequate to address impacts of hazardous materials that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of hazardous materials in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.9 Hydrology and Water Quality

The potential effects of the operational Shiloh IV Wind Project on hydrology and water quality were analyzed in detail in pages 3.8-1 through 3.8-8 of the HCP FEA (Service 2012b). The analysis considered the temporary and permanent effects of constructing and operating a wind project on the hydrology that characterizes the project area as well the potential for the Shiloh IV Wind Project to affect water quality. The analysis identified five potential impacts.

- Potential to substantially deplete groundwater supplies
- Potential to substantially increase erosion or siltation associated with alteration of existing drainage patterns
- Potential to substantially increase the rate or amount of surface runoff
- Potential to substantially degrade water quality
- Potential to create substantial flood hazards

The analysis found that the Shiloh IV Wind Project would use a very small amount of groundwater. Project construction and features would generally avoid surface drainages and wetlands; where avoidance is not possible, environmental commitments would ensure that there would be no adverse effects related to erosion or siltation. Because of the limited extent and dispersed character of new impervious surfaces, runoff rates would not appreciably change from existing conditions. Environmental commitments designed to minimize erosion and sedimentation and to avoid sensitive biological resources would prevent adverse effects on water quality. Finally, although some project features would be constructed within a 100-year floodplain, no project components would increase flood elevations. There would be no significant adverse effects on hydrology or water quality.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on hydrology and water quality are adequate to address impacts on hydrology and water quality that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of hydrology and water quality in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.10 Land Use and Planning

The potential effects of the operational Shiloh IV Wind Project related to land use and planning were analyzed in detail in pages 3.9-1 through 3.9-10 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project construction and operations to conflict with existing or future land use plans and policies. The analysis identified two potential impacts.

- Potential to conflict with land use plans and policies
- Potential to inhibit future land use of the Plan Area

The analysis found that the Shiloh IV Wind Project has been designed in accordance with land use and zoning designations; that appropriate setbacks from roads, property lines, and residences have been observed; and that the wind project is consistent with relevant airport compatibility plans. Moreover, because proper decommissioning activities were included as part of the Shiloh IV Wind Project, there would be no significant adverse effect on future land use of the project area.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on land use and planning are adequate to address impacts on land use and planning that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of land use and planning in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.11 Noise

The effects of the operational Shiloh IV Wind Project related to noise were analyzed in detail in pages 3.10-1 through 3.10-7 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project to expose sensitive receptors (i.e., residences) to noise levels in excess of established thresholds. The analysis identified two potential impacts.

- Exposure of residences to short-term noise from construction activity
- Exposure of residences to long-term noise from operation of wind turbines

The analysis found that construction would not result in significant adverse effects because the activities would not be conducted during evening and nighttime hours, they would be of limited duration, the number of potentially affected residences would be small, and noise levels would be reduced as feasible. The landowners potentially affected by increased noise levels have signed waivers regarding noise, and because changes from the existing background would be within acceptable limits, there would be no significant adverse effect.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on noise are adequate to address impacts from noise that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of noise in the HCP FEA is hereby incorporated by reference into this FEA.

Auditory ACPs could be implemented at some future date as a component of adaptive management. While it is not currently possible to determine the precise noise-related effects, Shiloh IV would site such modifications to ensure that sensitive receptors are not adversely affected.

4.2.3.12 Public Health Hazards

The potential effects of the operational Shiloh IV Wind Project related to public health hazards were analyzed in detail in pages 3.11-1 through 3.11-10 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project to expose people or structures to risk of loss, injury, or death resulting from wildland fire or associated with project infrastructure or operations. The analysis identified six potential impacts.

- Increased risk of wildfire
- Turbine or meteorological tower failure
- Electrical shock and accidents
- Accidents involving the general public (other than turbine failure)
- Impacts from shadow flicker
- Safety impacts related to accidentally damaging or uncovering gas storage wells in the Plan Area

The analysis found that safety restrictions (e.g., spark arresters, vegetation management requirements) and environmental commitments would ensure that there are no adverse effects related to wildfire. Because of safety features incorporated into turbine design and adherence to setback requirements, there would be no adverse effect associated with turbine or meteorological tower failure. Specifications included in environmental conditions would address the risk of electrical shock and accidents. Because the public would not have access to the wind project, there would be no exposure of the public to potential accidents during construction or operation. A limited number of residents would be exposed only for short times to shadow flicker; those that would experience shadow flicker are already subject to it from the existing Shiloh I project. Finally, no natural gas wells are known to be present in the project area. There would be no significant adverse effects related to public health hazards.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project related to public health hazards are adequate to address impacts from public health hazards that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of public health hazards in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.13 Recreation

The potential effects of the operational Shiloh IV Wind Project on recreation were analyzed in detail in pages 3.12-1 through 3.12-3 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project to conflict with existing and planned park and recreation facilities or to increase demand for recreation facilities. The analysis identified three potential impacts.

- Potential to affect operation of the Western Railway Museum
- Potential conflict with planned regional park
- Potential effect on Suisun Marsh recreation areas

The analysis found that construction and operation of the Shiloh IV Wind Project would not have an adverse effect on the Western Railway Museum or a planned regional park adjacent to it because the museum is more than 3 miles from the wind project and because the area is already characterized by abundant wind turbines. Similarly, because of its distance from the Suisun Marsh and the presence of existing wind farm development between the project area and the marsh, there would be no adverse effect on Suisun Marsh recreation areas.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on recreation are adequate to address impacts on recreation that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of recreation in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.14 Traffic and Transportation

The potential effects of the operational Shiloh IV Wind Project on traffic and transportation were analyzed in detail in pages 3.13-1 through 3.13-10 of the HCP FEA (Service 2012b). The analysis considered the potential of the construction and operation of the Shiloh IV Wind Project to increase traffic; create safety hazards for motorists, bicyclists, pedestrians, or rail operations; interfere with public or emergency access; lead to deterioration of transportation infrastructure; interfere with air traffic patterns; or conflict with planned transportation projects or transportation policies. The analysis identified six potential impacts.

- Temporary increase in traffic during construction
- Temporary disruptions of traffic flow during construction
- Damage to existing roads as a result of construction
- Operations-related traffic impacts
- Potential to affect aviation patterns
- Reduction in probability of detection for Travis AFB ASR-11 radar

The analysis found that construction activities would lead to a substantial increase in local traffic, but that local traffic volume is generally low. Implementation of a traffic control and transportation plan as specified in the environmental commitments addresses this effect. Although heavy vehicles associated with project construction could damage roadway surfaces, any damaged roads would be repaired to preconstruction conditions. Operations-related traffic would be very limited. Because the project is subject to review by appropriate air traffic authorities, it has been determined to be consistent with air safety requirements. Finally, extensive analysis found that there would be no significant adverse effect on Travis AFB radar systems.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on traffic and transportation are adequate to address impacts to traffic and transportation that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of traffic and transportation in the HCP FEA is hereby incorporated by reference into this FEA.

4.2.3.15 Utilities and Public Service Systems

The potential effects of the operational Shiloh IV Wind Project on utilities and public service systems were analyzed in detail in pages 3.14-1 through 3.14-8 of the HCP FEA (Service 2012b). The analysis considered the potential of the Shiloh IV Wind Project to increase demands on existing public service systems (i.e., police, fire, medical, recreational, or educational services) or utilities (e.g., water supply, wastewater treatment, communication systems, and electrical transmission). The analysis identified five potential impacts.

- Potential to adversely affect public utilities and services
- Potential to interfere with existing utility service or infrastructure

- Potential to interfere with microwave transmissions
- Interference with television or radio reception
- Potential to cause navigational system interference

The Shiloh IV Wind Project would require up to 12 million gallons of water for construction, but would require only limited water during operations. Portable restrooms would be used during construction; the operations building would use an onsite well and septic system designed in accordance with County requirements. Solid waste disposal would not exceed existing capacity at the Potrero Hills Landfill. Connection of the wind generation facilities to the existing PG&E grid would not entail any disruption of service to the grid or to area residences. Because the Shiloh IV Wind Project does not entail any increase in population, there would be no adverse effect on long-term requirements for firefighting, police, or school services. Safety provisions incorporated into the project design and environmental commitments addresses the increased risk of wildfire.

Compliance with relevant County requirements would ensure that there would be no adverse effect on existing utility lines. Analysis of existing microwave paths and notification requirements would ensure that there would be no adverse effect on microwave transmission. Similarly, any interference with television or radio reception would be addressed by enhancing receiving equipment as necessary. Because of its distance from the nearest VOR station at Travis AFB, the wind project does not interfere with navigational systems.

We have reviewed the analysis in the HCP FEA and have determined that the analysis and conclusions regarding the effects of the Shiloh IV Wind Project on utilities and public service systems are adequate to address impacts on utilities and public service systems that may result from the alternatives analyzed in this FEA, and that no additional analysis is necessary to support issuance of an eagle take permit. The analysis of utilities and public services in the HCP FEA is hereby incorporated by reference into this FEA.

Chapter 5

Summary and Conclusion

In our NEPA analysis we considered four alternative actions:

- Alternative 1: No Action
- Alternative 2: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan
- Alternative 3: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Additional Mitigation and Monitoring Measures **(Service Preferred Alternative)**
- Alternative 4: Issue 5-Year Permit Based on Applicant's Proposed Eagle Conservation Plan with Seasonal Restrictions

The alternatives were focused and narrow because the project has been constructed and is operational; however, they provide a reasonable range to assess differing potential environmental effects associated with issuance of an eagle take permit. Alternative 1 does not achieve a net conservation benefit to eagles and would not meet the underlying purpose or need we have identified in this FEA. Alternatives 2, 3, and 4 have similar but slightly differing environmental effects—namely the level of take and approach to mitigation and monitoring. All alternatives are based on a set of underlying assumptions that we will validate through implementation. The applicant favors Alternative 2 because it most closely resembles Shiloh IV's application. Alternative 3 is our Preferred Alternative because it provides mitigation consistent with our mortality estimate and ensures that eagle fatalities are detected. Alternative 4 is potentially the most protective of eagles and identified as the Environmentally Preferable Alternative.

In our evaluation of the risk of the project to eagles, we considered the available information on number and status of golden eagle nests and occurrences near the project, the number of known and projected fatalities near the project, the existing land uses and land use practices near the project, and population trends in the BCRs. We evaluated the eagle use data developed by the applicant during preconstruction surveys, compared the applicant's estimated golden eagle fatality rates with our predicted annual eagle fatalities based on those data, and used our more conservative estimate. We will be able to address future possible take through implementation of ACPs that require increasing levels of effort to reduce eagle mortalities. These ACPs are the essence of our ECP Guidance and ensure that effects on eagles are avoided, minimized, and mitigated consistent our requirements under 50 CFR 22.26.

Chapter 6
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Chapter 7

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Appendix A

Applicant's Eagle Conservation Plan

DRAFT EAGLE CONSERVATION PLAN
FOR THE
SHILOH IV WIND PROJECT

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August 2012

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ICF International. 2012. *Draft Eagle Conservation Plan for the Shiloh IV Wind Project*. August. (ICF 00122.12.) Sacramento, CA. Prepared for Shiloh IV Wind Project, LLC, San Ramon, CA.

Contents

Tables and Figures

Table

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Acronyms and Abbreviations

ACP	Advanced Conservation Practice
AMM	avoidance and minimization measure
ANOVA	Analysis of Variance
BBCS	Bird and Bat Conservation Strategy
BCR	Bird Conservation Region
BGEPA	Bald and Golden Eagle Protection Act
BUC	bird use count
CEC Guidelines	*California Guidelines for Reducing Impacts to Birds and Bats from Windplant Development*
CEC	California Energy Commission
CFR	Code of Federal Regulations
County	Solano County
DDT	dichloro diphenyl trichloroethane
DFG	California Department of Fish and Game
draft Guidance	Draft Eagle Conservation Plan Guidance
ECP	eagle conservation plan
FR	Federal Register
GANDA	Garcia and Associates
GPS	global positioning system
kV	kilovolt
kW	kilowatt
MBPM-2	Migratory Bird Permit Memorandum
MBTA	Migratory Bird Treaty Act
MW	megawatts
NFWF	National Fish and Wildlife Foundation's
O&M	operations and maintenance
PG&E	Pacific Gas and Electric Company
project	Shiloh IV Wind Project
REA	resource equivalency analysis
RSA	Rotor Swept Area
Shiloh IV	Shiloh IV Wind Project, LLC
SMUD	Sacramento Municipal Utility District
USC	United States Code
USFWS	U.S. Fish Wildlife Service
WRA	Wind Resource Area

Chapter 1
Introduction

Shiloh IV Wind Project, LLC (Shiloh IV), a subsidiary of enXco, an EDF EN Company, is developing the Shiloh IV Wind Project (project) (Figure 1-1), a commercially viable wind energy facility in Solano County, California, that would deliver renewable energy to the Pacific Gas and Electric Company (PG&E)/California Independent System Operator power grid. The project would contribute to meeting California's Renewable Portfolio Standard goals and would help to reduce greenhouse gas emissions pursuant to Assembly Bill 32 and Solano County's (County's) general plan. Shiloh IV has developed this eagle conservation plan (ECP) to avoid, minimize, and mitigate potential eagle mortality associated with project operations and to support an application for a programmatic eagle take permit from the U.S. Fish Wildlife Service (USFWS). The project was approved by Solano County on December 15, 2011. The project will be operational by December 31, 2012, to qualify for federal production tax credits, and to meet the Commercial Delivery terms of a long-term Power Purchase Agreement.

1.1 Corporate Policy

enXco, the parent company of Shiloh IV Wind Project, LLC, is committed to implementing feasible measures to avoid and minimize avian and bat mortality associated with construction and operation of its wind energy projects. These measures include—but are not limited to—siting considerations; facility layout and turbine design; incorporation of safety features into appurtenant facilities (e.g., transmission lines, meteorological towers); identification of high-risk turbines; compensatory mitigation; and adaptive management measures in response to availability of new scientific data or new technological innovations that may contribute to reduction of mortality.

1.2 Project

Shiloh IV is a repowering and infill project to be developed in the Montezuma Hills adjacent to the existing Shiloh I, High Winds, and Montezuma II projects. Shiloh IV has decommissioned and removed approximately 230 existing wind turbine generators installed in the late 1980s and started to install approximately 50 new RePower MM92 wind turbines (Table 1-1) in the approximately 3,513-acre project area (Figure 1-2). The project will have an installed capacity of 102.5 megawatts (MW) of electrical energy production, generating electricity for distribution to customers throughout northern California.

Table 1-1. Turbine Specifications

Turbine Characteristic	REpower MM92-2.0 MW
Number of turbines	50
Rotor type	3-blade/horizontal axis
Blade Length	46.5 m (153 ft)
Rotor diameter	93 m (305 ft)
Rotor swept area	6,793 sq m (73,126 sq ft)
Rotational speed	Variable: 7.8–15 rpm
Tower type	Tubular
Tower (hub) height	80 m (262 ft) or 70 m (230 ft)
Rotor height (from ground to lowest tip of blade)	33.5 m (110 ft) or 23.5 m (77 ft)
Total height (from ground to top of blade)	126.5 m (415 ft) or 116.5 m (382 ft)

Physical access is by existing public roads to the edge of the project area, at which point new access roads are being constructed in the project area, or existing roads are being improved to accommodate project requirements.

The power generated by the turbines will be conveyed to a new 230 kilovolt (kV) substation (built on an existing pad) by an electrical power collection system that will be installed as part of the project. The system will comprise pad-mounted transformers, buried cables, and junction boxes. The pad-mounted transformers will be connected to each turbine by buried power cables. Junction boxes—part of the buried cable system—will house cable splices and allow access to the cables. The cables will be buried between turbines and transformers and between transformers and the new substation. The existing operations and maintenance (O&M) facility, currently used to provide service to other surrounding wind projects in the vicinity of Shiloh IV, will be expanded by 8,000 square feet.

The project requires the construction of access roads, foundations for wind turbine towers and meteorological towers, underground power collection lines, a 230 kV substation, and other minor support facilities such as staging, storage, and parking areas. Grading is required for the construction of new access roads, the improvement of existing access roads to deliver project materials, and the construction of pads to support wind turbine foundations. To minimize the amount of earth movement, grading follows existing elevation contours to the degree possible; moreover, the project has been designed to avoid wetlands, low-lying drainage areas, and residences throughout the project area.

The existing 230 turbines that are part of the enXco V wind project have been decommissioned in compliance with the permit for that project, which expires in 2014 (decommissioning was completed slightly ahead of schedule to accommodate the project).

1.3 Existing Conditions

1.3.1 Overview of the Montezuma Hills Wind Resource Area

The project area is within the Montezuma Hills Wind Resource Area (WRA), north of the Sacramento–San Joaquin Rivers in Solano County, California. The Montezuma Hills WRA was first

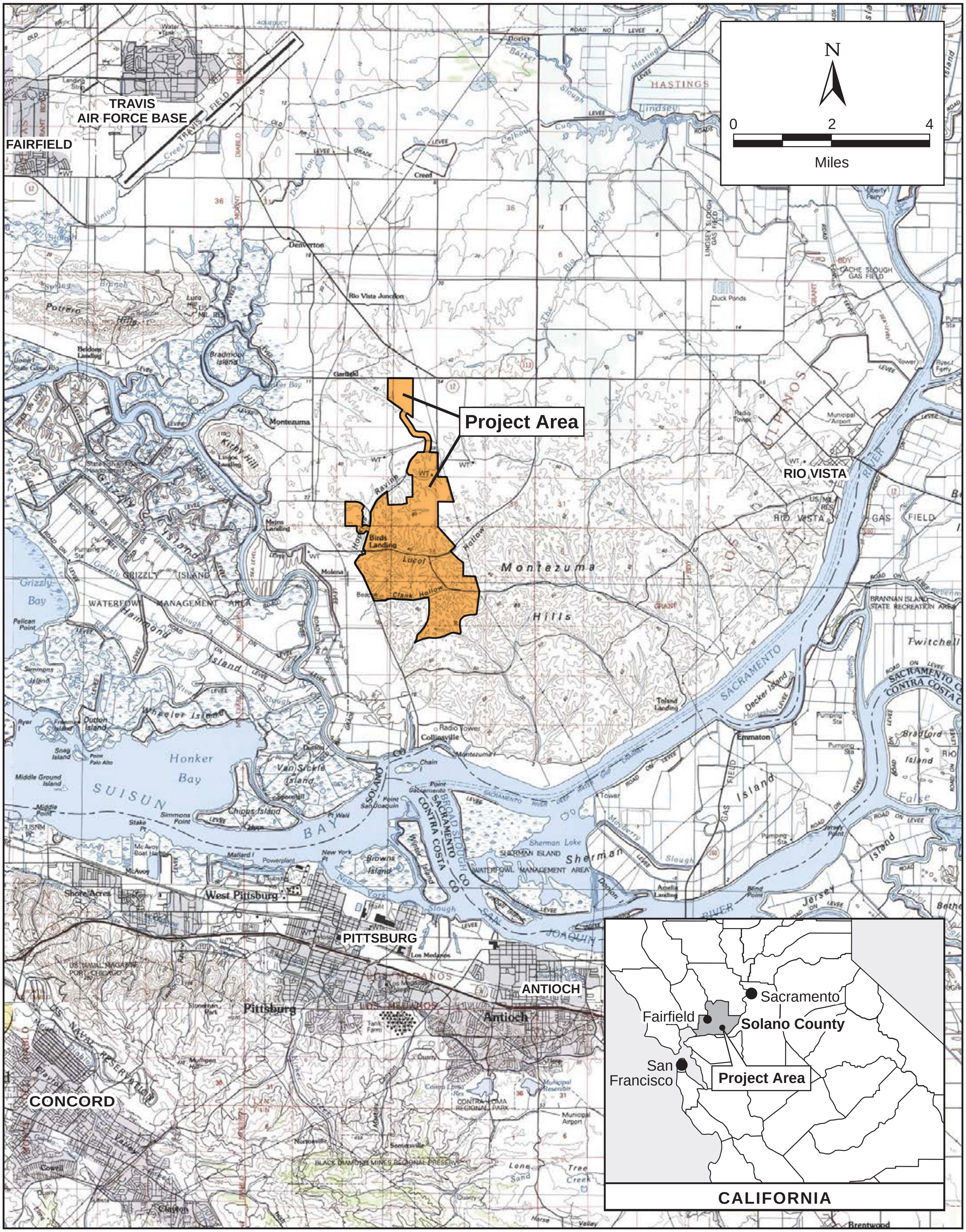

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Figure 1-1
Shiloh IV Project Location

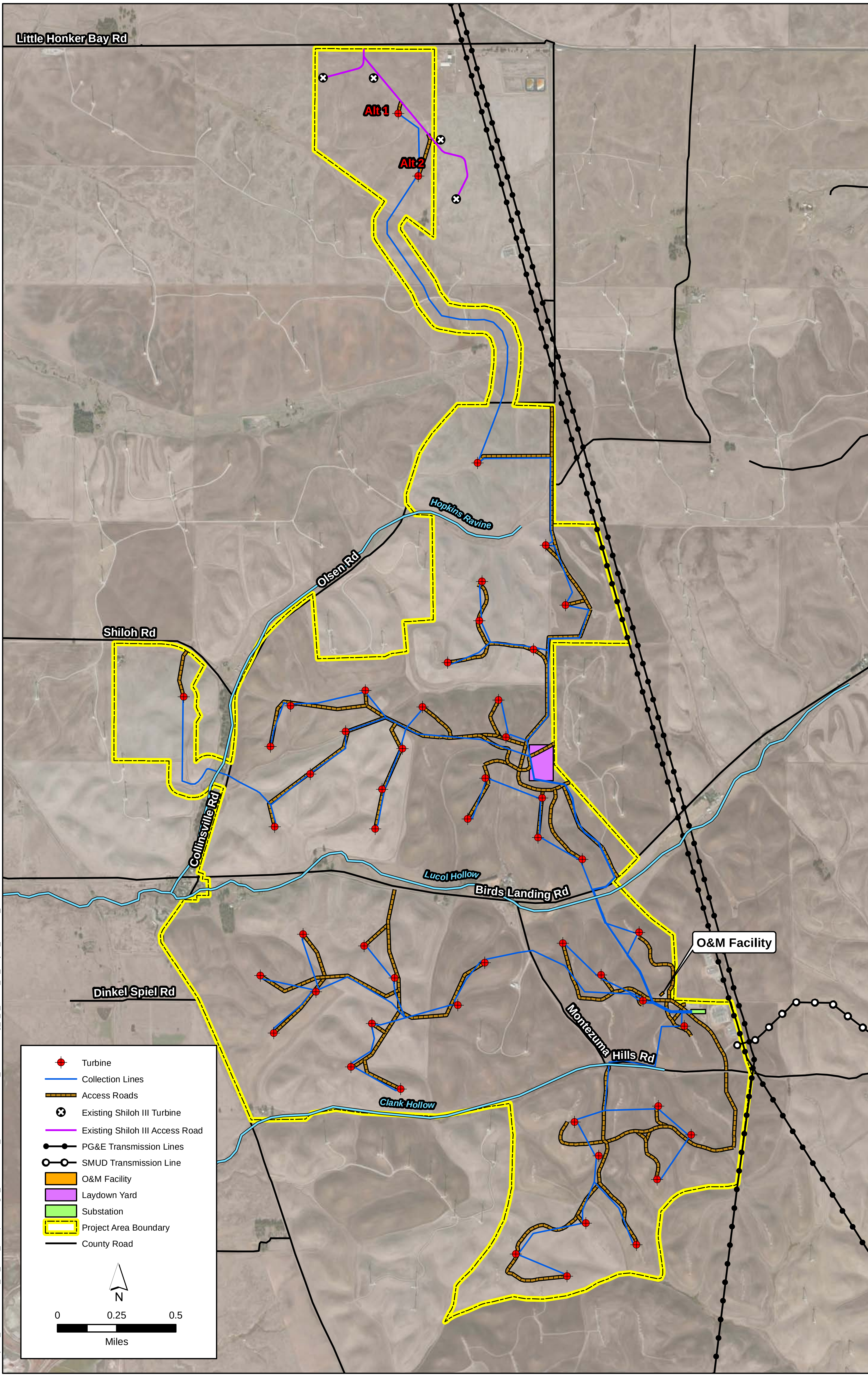

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Figure 1-2
Shiloh IV Wind Project Features

designated as a WRA by Solano County in its 1987 Wind Turbine Siting Plan because of favorable and predictable wind conditions. Since that time, several wind energy facilities have been constructed and/or proposed; these are listed in Table 1-2 and depicted in Figure 1-3.

Table 1-2 Commercial Wind Plants in the Montezuma Hills Wind Resource Area

Project (owner)	Number of Turbines	Turbine Rating	Total Megawatts	Status
Existing Projects				
enXco V[a] (enXco)	59 U.S. Windpower KCS-56-100	100 kW	5.9	Constructed in 1989–1990; in operation
High Winds (NextEra)	90 Vestas V-80	1.8 MW	162	Constructed in 2003; in operation
Solano Wind Phase 1 (Sacramento Municipal Utility District [SMUD])	23 Vestas V-47	660 kW	15	Constructed in 2004; in operation
Shiloh I (Iberdrola Renewables)	100 GE 1.5	1.5 MW	150	Constructed in 2006; in operation
Solano Wind Phase 2A (SMUD)	8 Vestas V-90	3 MW	24	Constructed in 2006; in operation
enXco V repowering (enXco)	6 GE 1.5	1.5 MW	9	Constructed in 2006; in operation
Solano Wind Phase 2B (SMUD)	21 Vestas V-90	3 MW	63	Constructed in 2007; in operation
Shiloh II (enXco)	75 REpower MM92	2.0 MW	150	Constructed in 2008; in operation
Montezuma I (NextEra)	16 Siemens 2.3	2.3 MW	36.8	Constructed in 2010; in operation
Montezuma II (NextEra)	34 Siemens 2.3	2.3 MW	78.2	Constructed in 2011; in operation
Shiloh III (enXco)[b]	50 REpower MM92	2.0 MW	100	Constructed in 2011; in operation
Approved Projects				
Solano Wind Phase 3 (SMUD)	55 Vestas V-90	3 MW	165	Currently under construction
Phase II of Shiloh I (Iberdrola Renewables)	20 GE 1.5	1.5 MW	30	EIR has been certified; owner has no current plans to build
Shiloh IV[c] (enXco)	Up to 50 REpower	2.0 MW	100	Currently under construction
Foreseeable Projects				
PG&E Collinsville	Up to 13	2.3–3.0 MW	30	Unknown
Montezuma Zephyr	Up to 43 Siemens 2.3 MW (speculative)	2.3 MW	98.9	Partial use permit application submitted; determined incomplete

Sources: Solano County Department of Resource Management 2011; ICF file information.

[a] The use permits for enXco V expire in 2014 and 2015 and require removal of all older turbines and related features. Approximately half of the enXco V project was located on the Montezuma II project site and were removed in 2011.

[b] Two additional turbines approved for future construction.

[c] Portions of Shiloh IV would be located on parcels presently containing approximately 230 enXco V turbines.

1.3.2 Overview of the Project Area

The project area is in an actively farmed area of Solano County already supporting extensive wind farm development. The Sacramento and San Joaquin Rivers lie to the south; the Suisun Marsh lies to the west. The predominant landform is a relatively uniform pattern of treeless hills with crest elevations of 100–272 feet above mean sea level, separated by narrow valleys and drainages. The valleys in the project area transition to sloped hillsides with relatively flat ridgelines. In this portion of the county, the topographic and meteorological conditions consistently produce strong, steady winds.

Dryland farming, livestock grazing, and wind energy development are the dominant land uses in the project area. Farmers in the Montezuma Hills typically use a 1- to 3-year crop rotation cycle, where grazing and fallow years follow planting and harvesting. As of mid-2011, approximately 98% of the project area was in wheat production or preparation for wheat production (i.e., cultivated). Several groves of eucalyptus and other ornamental trees, encompassing approximately 13 acres, are present in the project area. These groves are typically found around residences or abandoned homesteads and were planted as windbreaks or for landscaping. Eucalyptus and other ornamental trees can provide roosting and nesting habitat for a variety of raptors, including golden eagles, as well as passerines, other birds, and bats. The remainder of the project area consists of narrow wetland corridors that are typically too wet to farm and thus remain uncultivated.

In addition to agricultural uses, approximately half of the project area was being used for the enXco V wind project. The enXco V project was originally constructed in 1989 and 1990 and consisted of small, 100kw, early generation wind turbines (Kenetech 56-100).

1.4 Regulatory Setting

1.4.1 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) (16 United States Code [USC] 668) prohibits take and disturbance of individuals and nests. Take permits for birds or body parts are limited to religious, scientific, or falconry pursuits. However, the BGEPA was amended in 1978 to allow mining developers to apply to USFWS for permits to remove inactive golden eagle (*Aquila chrysaetos*) nests in the course of "resource development or recovery" operations.

In 2009, USFWS issued a final rule on new permit regulations that would allow some disturbance of eagles "in the course of conducting lawful activities" (74 Federal Register [FR] 46836–46879). USFWS's description of its 2009 rule suggests that physical take of an eagle will only be authorized if every avoidance measure has been exhausted. Removal of nests will still generally be permitted only in cases where the nest poses a threat to human health, or where the removal would protect eagles. Explanations of the rule on USFWS's website specify that take permits may be issued when "necessary for the protection of… other interests in any particular locality" (U.S. Fish and Wildlife Service 2009). The discussion expands the definition of such public and private interests to include utility infrastructure development and maintenance. The website states that due to concerns about population declines, permits for take of golden eagle are likely to be restricted throughout the eagle's range (U.S. Fish and Wildlife Service 2009). Considerations for issuing take permits include the health of the local and regional eagle populations, availability of suitable nesting and foraging

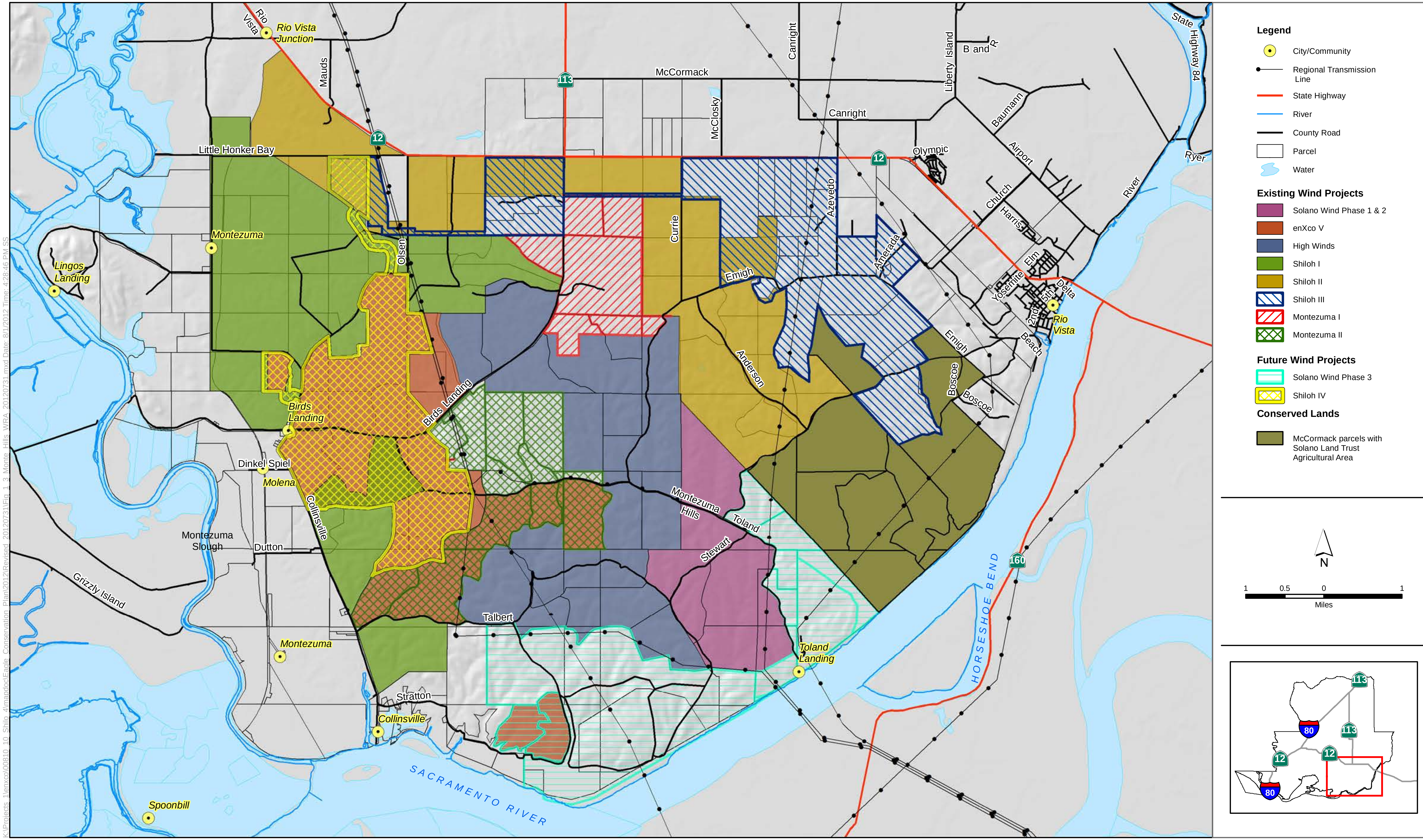

Figure 1-3
Montezuma Hills Wind Resource Area

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habitat for any displaced eagles, and whether the take and associated mitigation provides a net benefit to eagles (74 FR 46836–46879). The website goes on to say that permits will be issued that "result in a reduction of ongoing take or a net take of zero" (U.S. Fish and Wildlife Service 2009).

In January 2011, USFWS issued the *Draft Eagle Conservation Plan Guidance* (draft Guidance) intended to assist parties to avoid, minimize, and mitigate adverse effects on bald and golden eagles. The draft Guidance calls for scientifically rigorous surveys, monitoring, assessment, and research designs proportionate to the risk to eagles. The draft Guidance describes a process by which wind energy developers can collect and analyze information that could lead to a programmatic permit to authorize unintentional take of eagles at wind energy facilities. USFWS recommends that ECPs be developed in five stages. Each stage builds on the prior stage, such that together the process is a progressive, increasingly intensive look at likely effects of the development and operation of a particular site and configuration on eagles. This document follows that process. Additional guidance from USFWS and revisions to the draft Guidance is expected in the spring of 2012.

1.4.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (Title 16 USC 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 Code of Federal Regulations [CFR] 21, 50 CFR 10). Most actions that result in taking of or the permanent or temporary possession of a protected species constitute violations of the MBTA. The MBTA also prohibits destruction of occupied nests. The Migratory Bird Permit Memorandum (MBPM-2) dated April 15, 2003, clarifies that destruction of most unoccupied bird nests is permissible under the MBTA; exceptions include nests of federally listed threatened or endangered migratory birds, bald eagles, and golden eagles. USFWS is responsible for overseeing compliance with the MBTA. Most bird species and their occupied nests that occur in the project area are protected under the MBTA.

Shiloh IV is currently preparing a separate Bird and Bat Conservation Strategy (BBCS), in coordination with USFWS, that addresses bats and migratory birds and sets forth measures to avoid, minimize, and mitigate effects of the project on those species (ICF International in prep).

1.5 Purpose of the Eagle Conservation Plan

Shiloh IV has prepared this ECP to ensure that feasible avoidance and minimization measures are implemented into project design and operation; that the project remains in compliance with BGEPA requirements; and that mitigation for impacts that cannot be avoided or minimized are addressed through an appropriate program of compensatory mitigation. Many of the practices that have been adopted by the wind power industry are described in the California Energy Commission's (CEC's) *California Guidelines for Reducing Impacts to Birds and Bats from Windplant Development* (2007) (CEC Guidelines) and are incorporated in this ECP.

Golden eagles, due to their regulatory status, population trends in some locations (e.g., in the nearby Altamont Pass WRA), and charismatic public image, have become a species of particular concern in the context of wind projects. Several facets of golden eagle behavior and biology bring eagles into potential conflict with wind energy production. Measures particularly relevant to golden eagles include avoiding artificial increases of the mammalian prey base, selecting a project site that does not support high-density eagle populations, establishing standard setbacks from nest sites, and considering micro-siting when placing wind turbines.

This ECP has been prepared to establish measures to ensure that these effects are "compatible with the preservation of the bald eagle and the golden eagle" as set forth in the draft Guidance (U.S. Fish and Wildlife Service 2011).

The emphasis of the current guidance appears directed toward the establishment of new projects, addressing the importance of siting these projects at certain minimum distances from golden eagle use areas. However, in the case of the Montezuma Hills WRA, much of the area has already been developed with wind energy projects, and three of the four documented nest locations are within the footprints of projects that have already been permitted and built and are currently operational. No documented nest locations are within the Shiloh IV project area.

1.6 Contents of this Eagle Conservation Plan

This ECP has been developed in accordance with requirements set forth in the draft Guidance (U.S. Fish and Wildlife Service 2011). The draft Guidance is a work in progress, with additional drafts expected to be available for public review in the near future. The currently available draft Guidance focuses on the development of ECPs in five stages, with each stage building on the prior stage. However, the Guidance also notes that "for projects already in the development or operational phase, implementation of all stages of the recommended approach may not be applicable or possible." Shiloh IV is currently in the construction phase of the project, and accordingly has worked closely with USFWS staff regarding the contents and analysis in this ECP.

Because the project site has already been selected and the project has entered the construction phase, this ECP focuses on Steps 2–5 of the draft Guidance and does not focus on Step 1, the landscape-scale evaluation (although landscape-level analysis is used in the effects analysis). In summary, these steps entail a site-specific assessment of golden eagle use, a fatality risk assessment, identification and evaluation of advanced conservation practices (ACPs), and monitoring of results. Each stage is discussed in the following chapters.

Chapter 2
Landscape and Site-Specific Assessment (Stages 1 and 2)

2.1 Overview of Eagle Biology

2.1.1 Golden Eagle

Golden eagle is a large, long-lived raptor whose range extends throughout western North America across a broad range of elevations and open and semi-open grassland, shrub-steppe, desert, tundra, and forested habitats (Kochert et al. 2002). Southern breeding populations are largely sedentary, whereas most birds from Canada and Alaska are migratory and spend the winter on the dry prairies and deserts of the western Great Plains, central Rocky Mountains, Colorado Plateau, and desert southwest. Evidence collected to date suggests that relatively few northern migrants winter in California (e.g., McIntyre et al. 2008; Goodrich and Smith 2008), probably due in part to high densities of year-round residents in many areas of the state (Hunt 2002). Even in areas where established breeders are primarily sedentary, however, young birds may wander extensively, especially subadults during summer. As established breeders, golden eagles show high breeding site fidelity. Data on natal dispersal distances are sparse, but USFWS (2009) has established a radius of 140 miles as the scale required for inferring local population effects based on natal dispersal distances. Evidence collected to date also suggests that migratory eagles, at least adults, tend to show high winter site fidelity as well (Kochert et al. 2002).

Golden eagles occupy a wide variety of habitats and their tolerance for human activity varies, but they generally avoid densely populated and agricultural areas, preferring relatively open and undisturbed rangelands and native landscapes. Nevertheless, the highest known density of nesting golden eagles is found in central California among the rolling hills of Alameda and Contra Costa counties, where wind-driven updrafts facilitate movement and hunting, and where mature oaks (*Quercus* spp.) interspersed with grassland provide both ideal nest sites and abundant California ground squirrels (*Spermophilus beecheyi*) (Peeters and Peeters 2005:225–230). Due to the very high abundance of ground squirrels, the home ranges of breeding eagles in this area are much smaller than that throughout most of the rest of the species' range (Kochert et al. 2002).

Golden eagles are most likely to occur where there are dense populations of ground squirrels or hares. In many areas their breeding efforts are strongly tied to the cyclical abundance patterns of species such as black-tailed jackrabbit (*Lepus californicus*) throughout much of the interior West, and snowshoe hare (*L. americanus*) across much of Alaska and northern Canada. Where ground squirrels predominate as favored prey, such as in central California, interannual cycling of breeding activity tends to be less pronounced. Besides hares and ground squirrels, golden eagles may take a wide variety of other food items, including larger birds, reptiles, mammals, and carrion. They may hunt by diving from a high soar, but often fly low, following the contours of the land to surprise their prey.

Throughout most of their range, golden eagles nest on cliffs and other elevated rocky substrates, building stick nests that often grow very large from continuous use and augmentation over many years (Kochert et al. 2002). In other areas, they nest in large, mature conifers, and in central California they frequently nest in large, mature oak and eucalyptus trees (Peeters and Peeters 2005). Nesting occurs in association with open-country grassland, prairie, savanna, shrubsteppe, desert, and tundra habitats where foraging occurs. Like many species of large raptors, golden eagles routinely construct and maintain multiple nests in their breeding territories, rotating use among them over the years. These alternative nest sites, which may number more than a dozen per territory, are often separated by distances of 0.5 mile, or more depending on breeding densities. Pairs often tend and refurbish more than one nest each year, but reuse intervals for individual nests may extend to several years or more.

Where golden eagle home ranges have been documented, they have typically ranged in extent from 8 to 13 miles during the breeding season; for year-round residents they may encompass much greater areas during the winter (Kochert et al. 2002). Where they have been quantified (e.g., in southwest Idaho), foraging distances have averaged around 0.6 mile during the breeding season and 1.9 miles during winter (Marzluff et al. 1997), but excursion distances of several miles are not uncommon.

In evaluating the status of the breeding population in the Montezuma Hills WRA, several biological considerations come into play. Eagles mature slowly, reaching breeding age in the fourth or fifth year. Some pairs may not nest in some years, even when prey supplies are sufficient (Kochert et al. 2002; Peeters and Peeters 2005). In central California, courtship and nest tending/building generally take place December through February, and fledging usually occurs between late May and early July. In healthy golden eagle populations, typically only adult eagles breed. The presence of subadult birds in the breeding population may be an indicator of a declining population. Because the hunting skills of juveniles are not well developed, first-year birds frequently subsist on carrion or stolen prey. In contrast, because they typically hunt live prey, adults and older subadults may be more susceptible to turbine collision than juveniles, because the act of predation may be more likely to bring individuals into the paths of turbine blades (Hunt 2002). This distinction is important in that the fatality of even a single adult bird can have a greater impact on a population's reproductive status than the loss of a juvenile or subadult.

2.1.2 Bald Eagle

Bald eagle, the largest raptor in North America next to California condor, is broadly distributed throughout North America and into northwestern Mexico (Buehler 2000). California's resident breeding populations of bald eagle exhibit high fidelity to both breeding and wintering sites. Resident breeding pairs overwinter in California and do not disperse far from their nest sites, unless harsh weather drives them to lower elevations. Unlike northern breeding populations of golden eagles, bald eagles that breed in northwestern Canada and the United States migrate southward in large numbers to California to overwinter; these populations are most prevalent between September and March, with some remaining in California until as late as April.

Bald eagle habitat use is largely correlated with proximity to substantial bodies of water (Buehler 2000), because fish constitute a large proportion of the species' diet. Breeding habitat is typically in forested areas adjacent to rivers, lakes, or wetlands (Buehler 2000). Breeding populations in California are predominantly concentrated in the northern counties of Shasta, Siskiyou, Lake, Trinity, Lassen, Butte, Modoc, and Plumas (California Department of Fish and Game 1999). However, nests have been observed in lower numbers throughout counties farther south since the late 1980s (California Department of Fish and Game 2011). Nests have been documented in the 1990s and

2000s within 60 miles of the Montezuma Hills WRA at Lake Berryessa (Napa County) and near reservoirs in Alameda and Contra Costa counties (California Natural Diversity Database 2011).

Bald eagles are opportunistic foragers that take both live prey and carrion. They are known to hunt for live fish in shallow water, but more frequently they scavenge dead or dying fish. They also forage on other aquatic and terrestrial animals including waterfowl, muskrats, raccoons, and small mammals, which are taken alive or scavenged as carrion (Stalmaster 1987; Jackman et al. 1999). Bald eagles hunt in flight or detect prey from perches, and they frequently steal food from other animals. Favored foraging habitat usually includes water that is less than 1,600 feet from suitable perching trees (Buehler 2000), although they also forage in habitat that provides ample opportunities for scavenging carrion.

In California, the breeding season lasts from January through August. Bald eagles typically build stick nests in trees within mature and old-growth forests. More rarely, nests are built on cliff faces or on the ground (Buehler 2000). Nest sites are usually adjacent to large bodies of water or other suitable foraging habitat. Bald eagles build their nests in the upper canopy, generally selecting the tallest trees in the area. In California, ponderosa pine and sugar pine are the most frequently used tree species for nesting, and 87% of nest sites are within 1 mile of water (Lehman 1979; Anthony et al. 1982). Where no large conifers are present, bald eagles nest in deciduous trees such as oaks and cottonwoods (Anthony et al. 1982; Buehler 2000). Bald eagles construct from one to five additional nests within their breeding territories (Lehman 1979; Stalmaster 1987) and pairs alternate between these nests over multiple years. Bald eagles are sensitive to anthropogenic disturbance and typically do not nest if there is evidence of human activity (Lehman 1979; California Department of Fish and Game 1999).

The home range size varies widely with age of the bird, season, and distance to available food resources (Buehler 2000). Home range size of breeding adults in Saskatchewan ranges from 2.3 to 47 square miles (Gerrard et al. 1992), averaging approximately 8.5 square miles for both breeding and nonbreeding pairs (Monte et al. 1993). Juvenile bald eagles have significantly larger home ranges than adults, likely because immature bald eagles are not tied to a breeding territory. Weeks after leaving the nest, juveniles from California's breeding populations migrate to post-nesting dispersal sites hundreds of miles north (Hunt et al. 1992). These sites, as far as northern Canada (Jenkins et al. 1999), provide rich foraging opportunities (e.g., high concentrations of salmon carcasses).

2.2 History and Summary of Avian Monitoring in the Montezuma Hills

Avian use of the Montezuma Hills WRA has been studied over a nearly 25-year period, and several studies are ongoing. Howell and DiDonato (1988) conducted the first avian use monitoring study related to wind turbine siting in the Montezuma Hills. During this study, which was conducted in 1987–1988, the researchers surveyed portions of the Montezuma Hills that were part of the U.S. Windpower Montezuma Hills Windfarm project (since renamed enXco V). Data were collected on species diversity, species abundance, migratory use, nesting, and behavioral characteristics (e.g., flight patterns, altitudes, and perching). From 1990 to 1991, Howell and Noone (1992) conducted additional avian surveys as part of the postconstruction monitoring of the enXco V project.

Additional survey efforts have continued in the Montezuma Hills since the development of the enXco V project. Such efforts include several recent large-scale avian use/abundance surveys conducted in association with the development of the High Winds project (2000); the Shiloh I (2001), Shiloh II (2003), and Shiloh III (2005) projects; the Montezuma Wind project (2005); and the Shiloh IV project (2010). Each of these survey efforts employed a similar method of establishing fixed observation points across the landscape that incorporate as much of the project area as possible in accordance with guidance from the National Wind Coordinating Committee (Erickson et al. 2001). The surveys were designed to assess avian abundance, diversity, distribution, habitat use, and behavior.

In addition to observational surveys, each survey effort also entailed a survey of breeding raptors in and around each project area. In 2007, Hunt et al. (Hunt et al. 2007) conducted nesting raptor surveys encompassing the entire Montezuma Hills WRA, including a 5-mile buffer zone, to the extent visible from aerial surveys and public roads. In 2011, Garcia and Associates (GANDA) conducted another survey for nesting eagles for the Collinsville wind project (GANDA 2011), including a 10-mile buffer zone, consistent with USFWS survey guidance.

Through postconstruction monitoring, each new facility has also generated data regarding avian mortality in the Montezuma Hills WRA. All facilities in operation have conducted at least 1 year of postconstruction mortality surveys. Other mortality and injury data, derived from incidental observations during project operations, are also collected. Collectively, these surveys form a robust body of baseline biological data for the area. These studies have documented avian mortality, including occasional golden eagle mortalities, associated with turbine collisions.

2.3 Point Counts

2.3.1 Shiloh IV Project Area

Avian abundance and use surveys (bird use counts [BUCs]) were conducted on the Shiloh IV site in 2007 and 2008 consistent with the CEC/California Department of Fish and Game (DFG) guidelines, which specify the selection of fixed observation points in areas with unobstructed views that encompass the project area (Kerlinger et al. 2011). The 30-minute BUCs were conducted once per week at each location for a year, with the time of day randomized to cover a variety of daylight hours and weather conditions. The locations of the observation points are shown in Figure 2-1.

The point counts resulted in a total of 19,888 observations of 27 avian species recorded at the two observation points on the Shiloh IV project site during the yearlong study. The most common avian species group observed was small songbirds, which accounted for 94.29% of all bird observations (N=18.752). Of these small songbirds, blackbird species (mostly red-winged blackbirds and Brewer's blackbirds) comprised 90.46% (N=16,964), and they made up 85.29% of the total number of avian observations. The point counts included a total of 14 golden eagle observations. Of these observations, 10 were above the rotor swept (RSA) area and 4 were within the RSA. Table 2-1 summarizes the eagle observations in the Shiloh IV project area.

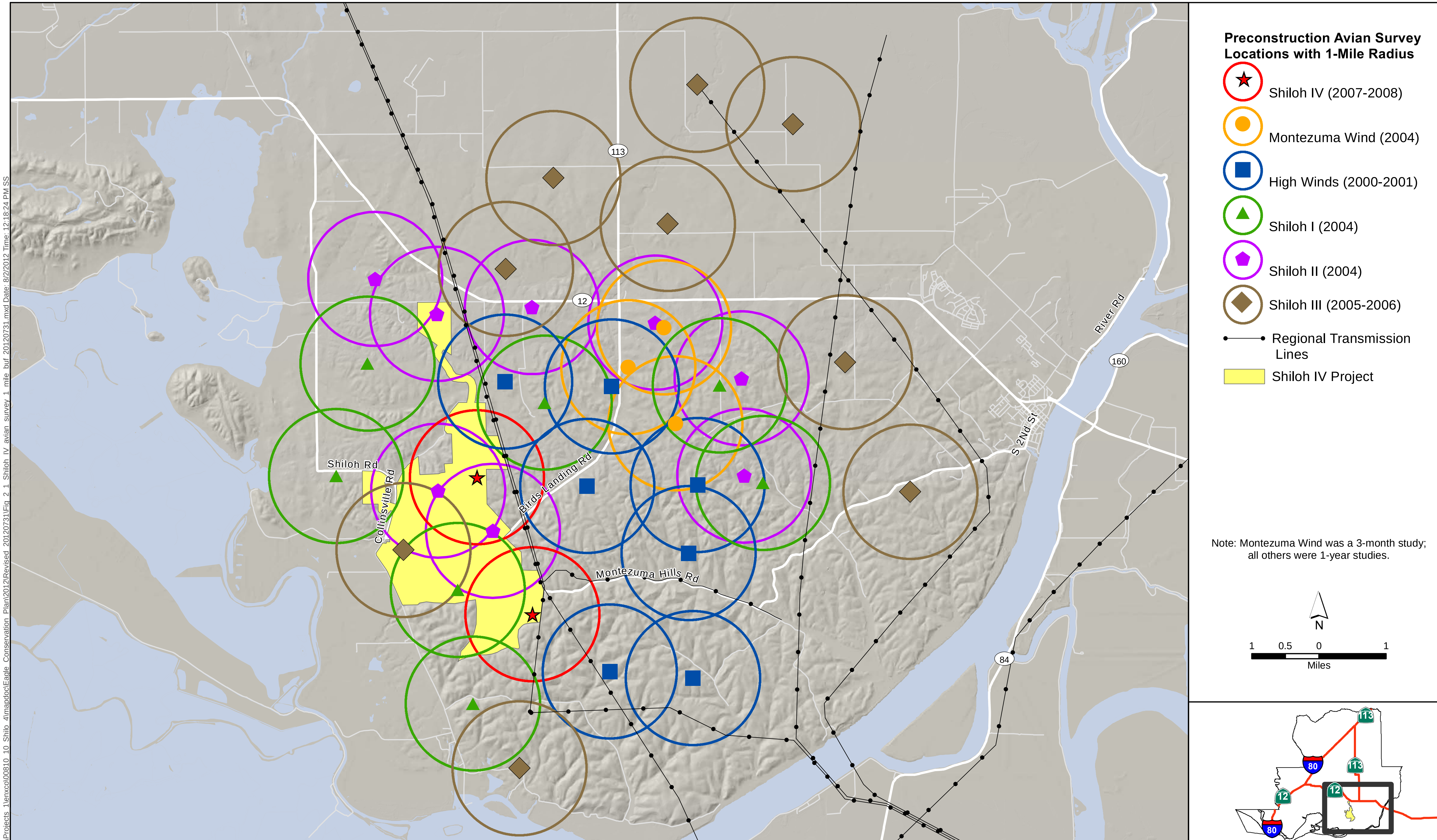

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Figure 2-1
Regional Avian Surveys — Montezuma Hills Wind Resource Area

Table 2-1. Summary of Golden Eagle Observations in the Shiloh IV Project Area

Observation Point	Date	Total Viewing (minutes)	Height	Behavior	Number of Minutes in Rotor Swept Area (RSA)
2	4/26/2007	2	High	Flapping	Above RSA
2	5/16/2007	2	Medium	Flapping	2
2	6/13/2007	2	Medium	Flapping	2
1	6/20/2007	5	High	Soaring	Above RSA
1	7/4/2007	6	High	Soaring	Above RSA
1	7/20/2007	2	High	Soaring	Above RSA
2	8/7/2007	5	High	Soaring	Above RSA
1	10/1/2007	4	High	Soaring	Above RSA
2	10/17/2007	1	High	Soaring	Above RSA
1	11/8/2007	2	High	Soaring	Above RSA
2	11/19/2007	2	Medium	Soaring	2
2	12/12/2007	5	High	Soaring	Above RSA
1	2/5/2008	4	Medium	Soaring	4
1	3/5/2008	6	High	Soaring	Above RSA

Source: Unpublished data from Curry & Kerlinger.

2.3.2 Comparison with Other Areas

As shown in Figure 2-1, numerous other preconstruction surveys have been conducted in the Montezuma Hills WRA. Kerlinger et al. (2009a:19) documented 31 golden eagle observations during their 2007–2008 avian use studies conducted on the 4,500-acre Shiloh III wind project site northeast of the project area. In contrast, an avian use study conducted in association with the first year of avian mortality monitoring for the 400-acre Buena Vista Wind Farm repowering project in the Altamont Pass WRA documented more than 110 golden eagle observations (Insignia Environmental 2009)—or more than three times as many golden eagle observations in a project area less than one-tenth the size. These results indicate a low to moderate use of the Montezuma Hills WRA in comparison to a known high use area such as the Altamont Pass WRA.

2.4 Nesting Surveys

In the Montezuma Hills, dominated by mostly treeless rolling hills, raptor nesting habitat is generally limited to small groups of nonnative eucalyptus trees. Nest surveys that included golden eagles were conducted sporadically between the late 1980s and late 1990s and more frequently in the 2000s, with the most current data provided in Kerlinger et al. (2006a, 2009a), GANDA (2011), and ICF International (2011a:Appendix B).

In March 2007, Hunt et al. (2007) conducted a raptor nesting survey of the entire Montezuma Hills WRA (plus a 3-mile radius for all species and a 5-mile radius for golden eagles) using both aerial and ground-based surveys (results also summarized in Kerlinger et al. 2009a). Hunt et al. (2007) and Curry & Kerlinger found four nest sites within the Montezuma Hills WRA during raptor nesting surveys conducted in 2004–2005 and 2007. In April and May 2011, GANDA conducted additional bald and golden eagle surveys in support of an adjacent project. In accordance with USFWS (2008, 2011) guidance, these surveys encompassed a 10-mile radius around the project area. GANDA's approach entailed literature reviews, consultation with area biologists, extensive ground surveys, and a helicopter search. The GANDA surveys (2011) documented four currently occupied nesting territories within a 10-mile radius of the project area (Figure 2-2). Nesting was confirmed at one site west of the Montezuma Hills WRA and suspected at one site northwest of the Montezuma Hills WRA; these sites are discussed below. The other two territories are south of the Sacramento–San Joaquin River confluence and the Pittsburg–Antioch urban area. While nesting was not confirmed for either of these two territories, the GANDA biologists expressed confidence that they were active nesting territories on the basis of observed adult behaviors. Additionally, the GANDA surveys detected a third territory south of the river confluence outside the 10-mile radius.

Based on the data presented in reports for the High Winds and Shiloh I, II, and III projects, there were seven known nesting attempts in five years (2001, 2004, 2005, 2006, 2007) in the vicinity of the Montezuma Hills WRA. Three of those attempts produced at least one fledgling. One of the failed attempts involved two subadults. All three successful nests were at site 2, the Callahan Property. Based on these data, there have been no more than two pairs of golden eagles nesting in the Montezuma Hills WRA in any given breeding season. Significantly, Curry & Kerlinger surveys of these nests since 2007 have indicated no further nesting activity within the Montezuma Hills WRA (ICF International 2011:Appendix B). Consequently, with the possible exception of the two occupied territories GANDA (2011) located across the river south of the Montezuma Hills WRA, the only recently active golden eagle nesting territory in the vicinity of the Montezuma Hills WRA is the nest discovered in 2011 at Meins Landing, the outcome of which was not determined.

General descriptions of the three historic nest sites within and two current nest sites near the WRA are provided below, and their locations are shown in Figure 2-3.

- **Site 1—Masson Property.** Site 1, within the Shiloh I project area, is approximately 0.25 mile north of the northernmost boundary of the Shiloh IV project area in a grove of eucalyptus on the Masson Property. Golden eagles are presumed to have nested here in 2001 based on observations of eagle presence in the area and on examination of the nest site following the 2001 breeding season. The outcome of that attempt is unknown. No nesting attempts have been documented since. As of 2011, the nest structure is still extant but appears to be deteriorating. This site is slightly less than 0.5 mile from the nearest Shiloh IV turbine; however, it is situated among several existing Shiloh I turbines that are much closer. No nesting or attempted nesting was observed in 2011.
- **Site 2—Callahan Property.** Site 2 is a grove of eucalyptus on the Callahan property in the central section of the Montezuma Hills WRA within the Montezuma II project area, approximately 0.75 mile east of the eastern Shiloh IV project area boundary. It is the only historically successful nest site described in the available reports. Two nest trees have been identified in this grove. Only one nest structure, in the southeastern section of the grove, was detected in 2010. The fate of the other nest structure is currently unknown. Curry & Kerlinger biologists reported that high winds blew down several raptor nests in the Montezuma Hills WRA in 2004. In 2011, red-tailed hawk activity in this grove suggested an absence of nesting golden eagles.

  Curry & Kerlinger, LLC reported that a pair successfully fledged at least one chick at this nest in 2001. No information is available for 2002 and 2003. One young was fledged in 2004, but a 2005 attempt failed. An adult and a subadult were observed in the grove in 2006, but no formal

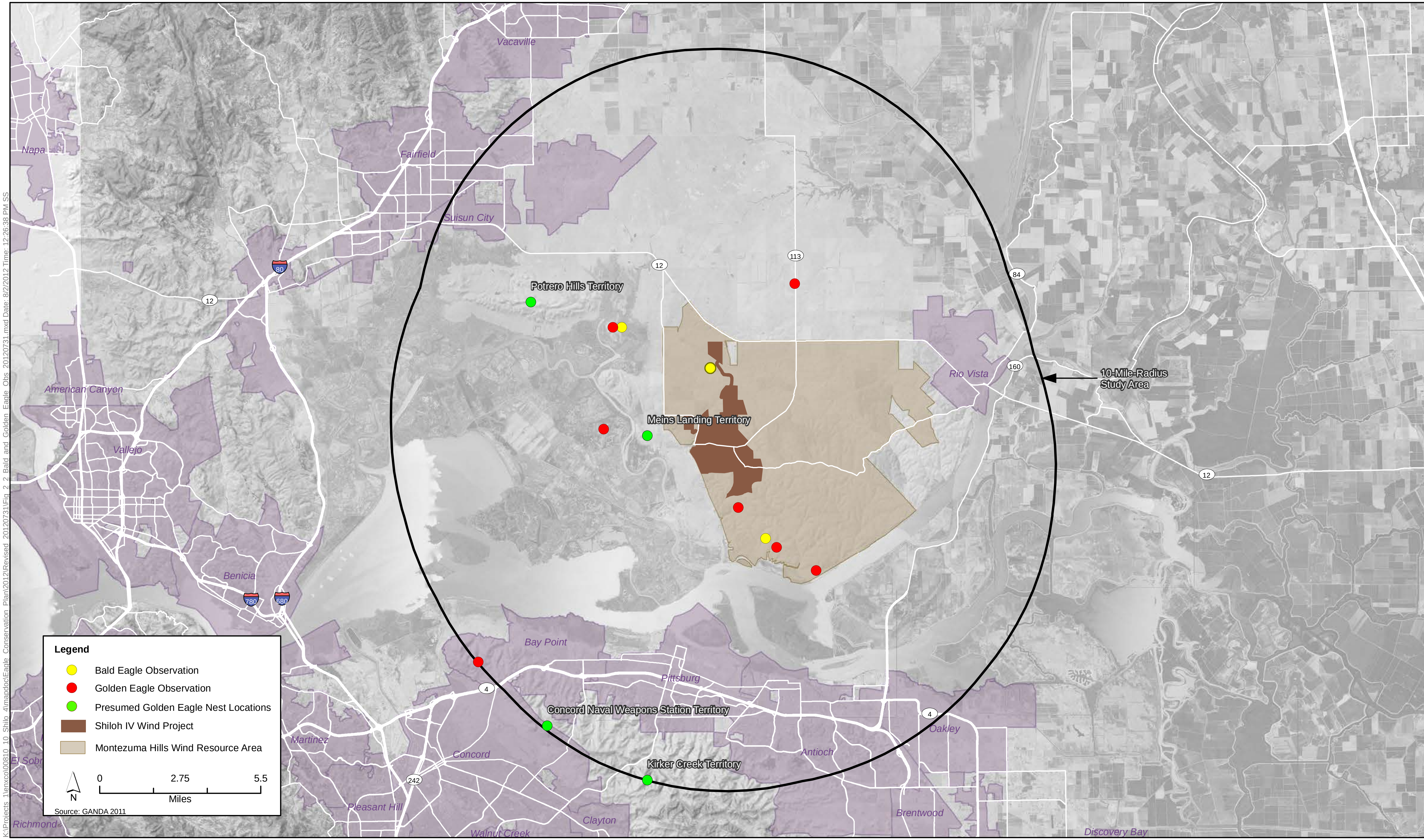

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Figure 2-2
Bald and Golden Eagle Observations and Nest Locations

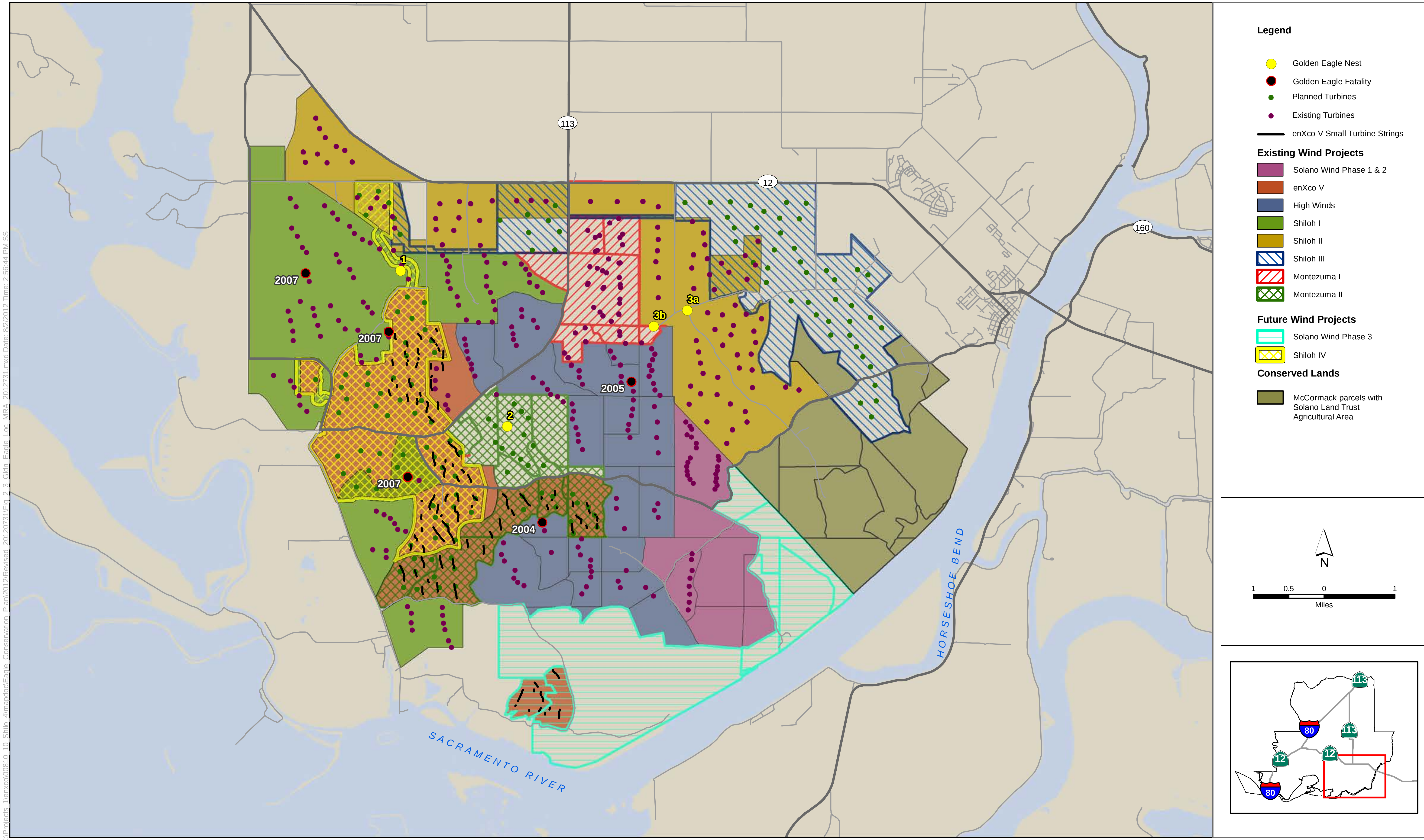

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Figure 2-3
Historic Golden Eagle Nest and Fatality Locations in the Montezuma Hills Wind Resource Area

surveys were conducted and the status of the nest site was undetermined. At least one young was fledged in 2007. No golden eagles were detected in the nest grove in 2008. No data are available for 2009. In 2010, biologists visited the grove twice and observed one subadult on the first visit, but detected no eagles in or around the grove or any signs of nesting activity on a second visit.

- **Site 3—Intersection of Currie and Emigh Roads.** These two sites are more than 3 miles east of the Shiloh IV project area. Site 3a is in a eucalyptus east of the road intersection; site 3b is in a eucalyptus west of the road intersection. In 2004, nesting was attempted but failed at site 3a. In 2005, a pair of subadult eagles attempted to nest at site 3b in a structure formerly used by great horned owls, but they failed by mid-May. Both sites are situated among much nearer turbines that are part of the Shiloh II project. As of 2011, neither nest could be located; they may have been blown out of the trees during winter storms. No nesting or attempted nesting has been observed this year.
- **Site 4—Potrero Hills.** During a nest survey in 2007, a fourth potential breeding area was identified in the Potrero Hills approximately 5 miles west of the Montezuma Hills WRA. This possibility was based on the detection of a pair performing courtship flights (Kerlinger et al. 2009a:47). Similar behavior was observed in 2011, though no nest was confirmed (GANDA 2011).
- **Site 5—Meins Landing.** The GANDA helicopter survey in May 2011 detected a previously undocumented golden eagle nest in the Meins Landing area, about 1.75 miles west of the nearest point of the project area. The nest was in a eucalyptus tree, and at the time of the observation it contained two 7-week-old fledglings. This site is outside the Montezuma Hills WRA (GANDA 2011).

2.5 Bald Eagle Observations

The GANDA (2011) team also recorded three observations of adult bald eagles during their 2011 survey: one observation of a pair and another single observation within the project area (Figure 2-2). GANDA speculated that, on the basis of flight direction, this pair may have nested in the Grizzly Island area, which lies between Suisun Bay and the Montezuma Hills WRA. These are the first observations of this species recorded during a survey encompassing the Montezuma Hills WRA, and no bald eagle fatalities have been documented in the WRA. The lack of previous observations may reflect two possible factors: (1) bald eagles continue to reoccupy many habitats from which they were extirpated during the dichloro diphenyl trichloroethane (DDT) era, and individuals may have moved into the Suisun Marsh to breed only in the past few years; and (2) bald eagle foraging in the area undoubtedly focuses on the marsh and river areas adjacent to the Montezuma Hills WRA where favored prey such as waterfowl and fish are present. The habitat preferences and foraging habits of this species and the evidence to date suggest that wind energy facilities pose less risk for this species than for golden eagle; nevertheless, the mitigation approaches developed for the project will apply to both bald and golden eagles in the event that fatalities should occur.

There are no documented nests within a 10-mile radius of the Montezuma Hills WRA. However, the GANDA survey (2011) observed behavior suggesting that a pair of bald eagles may be nesting in the Grizzly Island area of Montezuma Slough, west of the WRA.

2.6 Mortality Monitoring

Mortality data in the Montezuma Hills WRA have been collected since the early 1990s. Howell and Noone (1992) conducted a study to determine mortality rates over time on the enXco V project. Current postconstruction data are available from five facilities' reports: a 2-year study at the High Winds site (Kerlinger et al. 2006), a 3-year study at the Shiloh I site (Kerlinger et al. 2009a), a 1-year mortality study at the Solano Wind site (Burleson Consulting 2010), a 2-year study at the Shiloh II site (Kerlinger et al. 2011), and a 1-year mortality study at the Montezuma Wind site (ICF International 2012a). Together, these studies provide multiple years of empirical mortality data for the area surrounding the project.

Mortality search efforts by the windfarms in operation at the Montezuma Hills WRA have been relatively consistent between facilities and for the most part have generated datasets that can be compared with a degree of confidence. Mortality estimates for the project were based on the methodologies, results, and range of mortality rates developed in these earlier studies.

While all the studies met CEC Guidelines and are generally comparable, there are differences in study methodologies that could translate into differences in reported mortality rates. Some of these issues are discussed below.

The SMUD mortality surveys entailed a significantly smaller search area around each turbine (out to 62.5 meters as opposed to 105 meters), a longer search interval (14 days as opposed to 7), a greater distance between search transects, and the smallest percentage (approximately 30%, or 16 out of 52) of total turbines searched. Moreover, the SMUD surveys used searcher efficiency and scavenger removal adjustment rates from neighboring studies that may or may not be accurate when applied to the SMUD site's topography and search methodology.

The High Winds survey covered nearly 100% of operational turbines, but surveyors searched approximately half the ground area at each turbine as that covered at Shiloh I and used a 14-day search interval.

Shiloh II mortality surveys will cover 100% of the project's 75 operational turbines over the course of 3 years of study, but only 25 will be covered in any given year. This methodology leaves room for the dilution of mortality effects of turbine groupings near microhabitats (e.g., wetlands and mortality of waterbirds including California black rail) if data are compiled into a multiyear average.

The Shiloh I surveys provide the longest term dataset, used the shortest search interval (7-day), and searched the most ground (to 105 meters from the turbine base, equivalent to twice the area searched for the High Winds mortality surveys) with the narrowest transect spacing (particularly when transect spacing was reduced in the third year). Moreover, this mortality study included onsite searcher efficiency and scavenger removal trials, and is thus most likely to have site-accurate adjustment factors. Years 2 and 3 may provide the most accurate estimates from which to derive an average estimated mortality per MW, as the search effort was augmented, and the adjustment factors for scavenger removal and searcher efficiency were made more robust. In addition, an elevated level of small-bird use of the project area was observed in the first year of the mortality surveys and may account for the significantly higher mortality rate reported for that year (Kerlinger et al. 2009a).

The postconstruction survey efforts conducted in the Montezuma Hills WRA to date are summarized in Table 2-2. Incidental mortality monitoring also takes place during project operation by maintenance staff, and data collected from enXco V over the past 7 years, between January 2005 and February 2012, indicate that there have been three golden eagle fatalities and one injury (taken to a rehabilitation center). Dead eagles were collected and reported to USFWS under a special purpose permit held by the facility operator. One of the three eagles was believed to have been electrocuted on an electric distribution line in the area.

2.7 Summary and Conclusions

Golden eagle presence in the Montezuma Hills WRA has been well studied, and the effects of other wind projects adjacent to Shiloh IV have been monitored and reported. Based on point count information, it is apparent that golden eagles routinely forage in and around the Montezuma Hills WRA throughout the year. Overall activity levels appear low, at least in comparison to areas such as the relatively nearby Altamont Pass WRA. Because most of the Montezuma Hills WRA consists of active croplands (dryland grain crops), which do not support significant populations of ground squirrels and other prey species, and hinder accessibility of prey during much of the year, the area is likely less attractive to foraging golden eagles than the open naturalized grasslands at the Altamont Pass WRA, which have a comparatively high abundance of accessible ground squirrels (Orloff and Flannery 1992).

It is also apparent that although nesting has historically occurred in the Montezuma Hills WRA, suitable nesting habitat has been, and still is, limited. No eagles have attempted to nest in the WRA since 2007.

Overall, the body of information regarding golden eagle use, abundance, behavior, and collision risk in the Montezuma Hills WRA and the Shiloh IV project area appears to be well documented and provides a good baseline upon which to base the risk assessment.

Table 2-2. Summary of Postconstruction Mortality Survey Efforts at Montezuma Hills WRA Wind Project

	High Winds	Shiloh I	Shiloh II	Solano Wind	Montezuma Wind	CEC Guidelines
Number of turbines at facility	90	100	75	52	16	NA
Turbine type(s)	1.8 MW	1.5 MW	2 MW	66 MW and 3 MW	2.3 MW	NA
Duration and dates of study	2 years (completed) Aug 03–Jul 05	3 years (completed) Apr 06–Apr 09	2 of 3 years completed Apr 09–Apr 11	1 year (14 mo, non-consecutive; completed) Jun–Dec 08, May–Jun 09, Dec 09–April 10.	1 of 3 years completed Jan 11–Jan 12	Minimum 1 year for Category 1.
Search interval	14 days	7 days	7 days	14 days	7 days and 14 days for a portion of turbines	Average every 14 days unless likelihood of impact on small birds and bats, in which case more frequently. Establish interval based on results of pilot scavenger trials onsite.
Search radius (from base)	75 meters (m)	105 m (= 2x area of High Winds search)	105 m (= 2x area of High Winds search)	62.5 m	105 m	Search diameter = maximum rotor tip height; more if needed to encompass 80% of carcasses.
Distance between transects	15 m/10 m 15, 30, 40, 50, 60, 70 meters	15m/10m first 2 years: Base, 15, 30, 40, 50, 60, 70, 80, 90, 100 m Year 3: Base, 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 m	5m/10 m 0–30 m (area with greatest likelihood of bat carcasses) searched every 5 m to 30 m, then every 10 m: Base, 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 m	1@ 6 m then18 m/12 m/14 m (Base, 20, 80, 120, 160, 205 feet) Base, 6.1 m, 24.4, 36.6, 48.7, 62.5		Standard 6 m transect (20 feet). Appropriate to vegetation.
Number turbines searched/total (%)	100%	100%: 50 (every other turbine)/first 18 months, then switched, for total of 100, divided amongst two turbine types in same proportion as turbines. Each turbine searched for 18-month cycle.	100%: 25/year for three years until all 75 turbines have been searched for 1 full year	30.7%: 16/52	100% for half of first year, 50% for remaining portion of year	At least 30% of total.

Table 2-2. Continued

	High Winds	Shiloh I	Shiloh II	Solano Wind	Montezuma Wind	CEC Guidelines
Scavenger removal trials	Onsite study, December 04. 48 carcasses, varying sizes	Onsite study: May 06, Oct 07, Feb 08, Mar 08, May 08, Jun 08, Jul 08, Oct 08, Dec 08, Feb 09, Mar 09. 180 bird carcasses, 134 bat carcasses varying sizes, daily monitoring, all veg types, all seasons, most turbines.	Onsite study: 4 seasonal trials Sep, Jan, Mar, Apr, (year 1) and Aug, Nov, Feb, Apr (year 2). Small carcasses, medium–large carcasses, bat carcasses, daily monitoring in all veg types and heights, most turbines.	Derived from High Winds b/c matched search interval of 14 days.	Onsite study: 2 seasonal trials	Conduct onsite unless strong evidence suggests different location data will be accurate. Carcass removal rates differ between sites.
Searcher efficiency trials	Onsite study, December 04. 48 carcasses, varying sizes.	Onsite study: same dates and carcasses as described above.	Onsite study: Sep, Jan, Mar, Apr, (year 1) and Aug, Nov, Feb, Apr (year 2). Conducted for each observer with bat carcasses and varying sizes bird carcasses.	Derived by averaging High Winds and Shiloh I "proximity, similar groundcover, bird spp. topography".	Onsite study	Test each searcher under different field conditions (veg, carcass size, etc.) different season, over entire space.
Land Use	Ag, crop rotation, grazed pasture, isolated wetland (cattail marsh) trees near residences and in few valleys, most nonnative.	Ag, crop rotation, grazed pasture, isolated wetland (cattail marsh & 1 sm. reservoir) trees near residences and in few valleys, most nonnative.	Ag, crop rotation, grazed pasture, isolated wetland (cattail marsh & stock ponds) trees near residences and in few valleys, most nonnative.	Ag, grazed pasture, isolated wetland (intermittent creek and related seasonal wetland) trees near residences and in few valleys, most nonnative.	Ag, grazed pasture, wetlands, olive orchard.	NA
Non-characteristic habitat features		Westernmost section of windfarms. Southernmost tip of area is in proximity to Broad's Slough and Sac River.		Proximity to Sac River, including one small area immediately adjacent to river.	Olive orchard, northern end of wind resource area.	NA

Chapter 3
Risk Analysis (Stage 3)

The Shiloh IV project is an infill and repowering project in a developed WRA that has been studied intensively for avian use. As such, it is a CEC Guidelines Category 1 project, defined as projects for which there is existing information sufficient to predict the project's potential impacts with a reasonable degree of accuracy. Multiple years of defensible, empirical mortality data exist for neighboring wind facilities, in addition to at least 5 years of avian use and abundance data collected from a significant portion of the WRA.

Data from the extensive studies conducted in the Montezuma Hills WRA have been used to develop mortality projections for the Shiloh IV project. These studies were conducted in accordance with protocols set forth in *Studying Wind Energy/Bird Interactions: A Guidance Document—Metrics and Methods for Determining or Monitoring Potential Impacts on Birds at Existing and Proposed Wind Energy Sites* (Anderson et al. 1999) and the CEC Guidelines (California Energy Commission and California Department of Fish and Game 2007).

3.1 Nesting and Breeding

The project's risk to nesting and breeding eagles is low to moderate. The project area provides relatively poor foraging conditions because of agricultural practices and the corresponding sparse prey base, and the relatively flat terrain constrains the thermal updrafts needed to support productive nesting. These conditions differ markedly from those of the Altamont Pass WRA, 25 miles to the south, where the entire WRA and most of its surroundings are hilly and the golden eagle population is accordingly robust (Hunt and Hunt 2006). Also, there are a limited number of nest trees and there has been a lack of successful nesting within the WRA since 2007. However, there remains a moderate risk given historical nesting in the area and the currently active nest to the west of the WRA. This risk may be partially ameliorated by the removal of 230 Kenetech turbines that may pose a greater risk than the fewer modern turbines with which they are being replaced.

3.2 Fatality Estimates

3.2.1 Overview

Modeled fatality estimates are not used in this analysis because actual fatality data are available from several adjacent operational projects in the Montezuma Hills WRA. Furthermore, there are no outlying habitat elements, topographical features, or land use practices that would materially distinguish the project area from neighboring windfarms or provide cause for presuming a significant difference in avian use and abundance or mortality risk for eagles.

3.2.2 Observed Collision Rate

Methods

The observed collision rates developed from postconstruction monitoring results at adjacent projects in the Montezuma Hills WRA were gathered and summarized to extrapolate projected collision rates at the Shiloh IV project. It is assumed for purposes of this assessment that changes in mortality associated with differences in turbine output or individual turbine characteristics would be negligible because the turbine models are substantially similar in their key characteristics, such as size, RSA, color, and position on the landscape. Monitoring is ongoing at two projects (i.e., Shiloh II and Montezuma 1) and is just beginning for two other projects (i.e., Shiloh III and Montezuma 2). Currently, postconstruction monitoring data are available from five facility reports: a 2-year study at the High Winds site (Kerlinger et al. 2006), a 3-year study at the Shiloh I site (Kerlinger et al. 2009a), a 1-year mortality study at the Solano Wind site (Burleson Consulting 2010), a 2-year study at the Shiloh II site (Kerlinger et al. 2011), and a 1-year mortality study at the Montezuma Wind site (ICF International 2012a). Together, these studies provide multiple years of empirical fatality data collected throughout much of the Montezuma Hills WRA and surrounding the project area. Estimates for the Shiloh IV project were calculated by multiplying the number of turbines (N=50), times 2.0 MW/turbine, times the average per MW mortality rates (lower range), and highest mortality rates (upper range). Additionally, Dave Johnston of H.T. Harvey and Associates stated in a phone conversation with ICF in February 2012 that his firm has conducted a 2-year autumn research study under contract with the California Energy Commission at the High Winds and Shiloh 1 project areas; although a final report has not been prepared, information on additional eagle mortality is available.

Results

The monitoring data indicate that a total of eight golden eagles have been killed (five detected during standardized mortality monitoring and three detected incidentally by operations and maintenance personnel at enXco V) over the past 7 years, between January 2005 and February 2012. Table 3-1 shows the estimated annual mortality rate (adjusted using scavenger removal and searcher efficiency correction factors) for the surrounding projects per MW and per turbine, as well as the mortality estimates for the Shiloh IV project based on the observed collision rates (i.e., using the standardized mortality monitoring results and excluding the incidental reports). There are no bald eagle mortality estimates because no bald eagle fatalities have been documented in the Montezuma Hills WRA and none are anticipated.

Table 3-1. Adjusted Mortality Estimates for Golden Eagle

Mortality Estimates	Per MW per Year	Per Turbine per Year
High Winds (2-year average)	0.01	0.018
Shiloh I (3-year average)	0.005	0.008
Shiloh II (2 year)	0	0
Solano Wind (1 year)	0	0
Montezuma Wind (1 year)	0	0
Average rate for five studies	0.004	0.007
Weighted average for five studies	0.005	0.008
Total estimated fatalities for Shiloh IV project		
Average	0.40	0.35
Weighted average	0.50	0.40

Sources: High Winds: Kerlinger et al. 2006; Shiloh I: Kerlinger et al. 2009b; Shiloh II: Kerlinger et al. 2010; Solano Wind: Burleson Consulting 2010; ICF 2012.

Note: Mortality estimates exclude three mortalities associated with enXco V between 2005 and 2012 because they were not found during standardized searches and thus cannot be directly compared with other studies.

Using the approach outlined above, the data suggest a mortality rate of 0.004–0.005 golden eagle per MW per year (Table 3-1). As shown in the table, this rate would equate to 0.40–0.50 eagle per year for the Shiloh IV project. The same survey data yield a mortality rate of 0.007–0.008 eagle per turbine per year, or 0.35–0.40 eagle per year for the Shiloh IV project. This range of estimates can be attributed to the differing approaches to analyzing the data. Although fatalities per MW per year have been used to help standardize estimates across widely varying turbine types and capacities, with the transition to new-generation, large-capacity turbines, there appears to be a trend toward assessing mortality on a per-turbine basis. Accordingly, the full range of estimated mortality presented here—0.35–0.50 eagle per year—could be considered for the purposes of this ECP as equating to an estimate of one eagle every other year for the Shiloh IV project.

3.2.3 Discussion

Repowering

Approximately half the Shiloh IV project area is within the former enXco V project area. The enXco V project was constructed in 1989–1990 using small Kenetech 56–100 wind turbines with hub heights of approximately 60 feet (18.3 meters), contrasting with the RePower turbines for Shiloh IV, which have a hub height of at least 262 feet (80 meters). That project was constructed prior to the design and widespread implementation of current mortality monitoring standards, and data are limited on the project with respect to avian and bat mortality.

Howell and Noone (1992) conducted mortality monitoring at the enXco V project site following construction and one eagle mortality was recorded; however, the methods differ from those used in current studies, making a direct comparison to other, more recent studies in the Montezuma Hills WRA difficult. In general, early studies on avian mortality, such as the Howell and Noone study, did not employ the same survey methodology standards as the current studies. The survey area was not well defined as in current studies, scavenger trials did not account for small birds or bats, and searcher efficiency studies were not conducted. Each of these differences makes a direct comparison with current studies difficult.

Extensive studies on Kenetech 56–100 turbines have been conducted at the Altamont Pass WRA, which differs substantially from the Montezuma Hills WRA. Accordingly, some caution is warranted in comparing the two areas. Recent studies in the Altamont Pass WRA conducted under the supervision of the Alameda County Scientific Review Committee (ICF International 2012b) have included mortality monitoring at repowered projects. To date, there have been two repowering projects in the Altamont Pass WRA, entailing the replacement of older turbines with new generation turbines: the Diablo Winds repowering project and the Buena Vista repowering project. The Diablo Winds repowering project was evaluated by Western EcoSystems Technology (WEST) (2006), Smallwood and Karas (2009), and ICF International (2012b). The Buena Vista repowering project was evaluated by Insignia Environmental (2009).

In the Diablo Winds repowering project, 169 FloWind vertical axis turbines were replaced with 31 660 kilowatt (kW) Vestas V47 turbines in 2005 (Western EcoSystems Technology 2006). Although these Vestas turbines were larger than the FloWind turbines and structurally very different (the FloWinds were vertical axis turbines; the Vestas are horizontal axis turbines on tubular towers), they are smaller than the modern turbines (1 MW or more) that have become standard. Mortality rates reported by WEST (2006) for the first year of operation (March 2005–February 2006) were estimated to be approximately 0.32 raptor/MW/year and 1.8 birds/MW/year, excluding incidental finds. These estimates were significantly lower than those reported by Smallwood and Thelander (2004) for the rest of the Altamont Pass WRA, but were not directly comparable because the projects were sampled during different years using different sampling schemes.

Smallwood and Karas (2009) attempted to evaluate the effects of repowering by comparing estimated annual mortality rates for the Diablo Winds project area before and after repowering. Using this approach, the estimates of the number of birds killed during 1998–2002 prior to repowering were lower than the estimates of mortality during 2005–2007 after repowering. However, the sampling scheme and sampling intensity used during the period prior to repowering were substantially different from those used after repowering. Data used to estimate mortality rates prior to repowering were from Smallwood and Thelander (2004), while data used to estimate mortality rates subsequent to repowering were from the ICF fatality study (ICF International 2012b). Given the vast differences between the two study periods in sampling duration and intensity, the lack of precision in estimates produced by the prevailing estimation method, and the known or perceived high level of interannual variation in bird use and fatality rates, the appropriateness of this comparison is questionable.

Smallwood and Karas (2009) compared estimated mortality rates from the Diablo Winds project site using data from the ICF fatality study to concurrent estimates of mortality rates from non-repowered turbines in the Altamont Pass WRA. Estimated mortality rates were 1.8 raptors/MW/year and 5.7 birds/MW/year for repowered turbines, compared to 2.2 raptors/MW/year and 7.5 birds/MW/year for concurrently operating old-generation turbines across the rest of the Altamont Pass WRA. These estimates are substantially higher than those reported by WEST, but they nevertheless provide strong evidence of a beneficial effect of repowering. Based on an Analysis of Variance (ANOVA), estimated mortality rates were significantly lower for several species and species groups: red-tailed hawks (64% lower), American kestrel (92% lower), all raptors (54% lower), and all birds (66% lower). Estimated mortality rates were 84% lower for golden eagle, 24% lower for burrowing owl, 95% lower for barn owl, 83% lower for horned lark, 73% lower for mourning dove, 44% lower for loggerhead shrike, and 44% lower for western meadowlark, though these decreases were not statistically significant. The authors concluded that careful repowering could reduce avian fatalities by up to 54% for raptors and 65% for all birds.

ICF also compared estimated mortality rates at the repowered Diablo Winds project site to concurrent estimates from the rest of the Altamont Pass WRA, using 3 years of data instead of the 2 years presented in Smallwood and Karas (2009). ICF presented mortality rates for four species: American kestrel, golden eagle, red-tailed hawk, and burrowing owl. For all species, mortality rates were lower for the repowered turbines than for the old-generation turbines—substantially so for American kestrel and golden eagle. Burrowing owl mortality rates, though lower, were similar to Altamont Pass WRA-wide estimates. However, burrowing owls are believed to occur in significant numbers in that part of the Altamont Pass WRA (Western EcoSystems Technology 2006; ICF file data), suggesting that the "treatment effect" of repowering may be greater than the mortality rate estimates would indicate.

The Buena Vista project site was repowered in 2005 and became operational in December 2006. A total of 179 old-generation 150 and 160 kW turbines were replaced with 38 new Mitsubishi 1 MW turbines. Although monitoring is ongoing, the only report available is for the first year, covering the period February 2008–February 2009 (Insignia Environmental 2009). Postconstruction monitoring at Buena Vista uses modern industry standard techniques such as a census of the turbines, a 2-week search interval, and ongoing monitoring of carcass removal and searcher efficiency rates.

Estimated annual mortality rates were 0.44 raptor/MW/year and 1.15 birds/MW/year, substantially lower than estimates for the Diablo Winds project site. Although estimated mortality rates were lower for burrowing owl and red-tailed hawk and slightly higher for American kestrel and golden eagle than those at the Diablo Winds project site (ICF International 2012b), the mortality rates are generally similar in magnitude. Because the Buena Vista project was not part of the current Altamont Pass WRA monitoring program, it is not possible to make direct comparisons between the historic and current fatality rates at the site. However, the preponderance of evidence from the Buena Vista postconstruction monitoring and the current Altamont Pass WRA-wide monitoring program suggests that repowering, in combination with careful siting using behavioral data, has reduced fatality rates at the project.

In all studies of the two repowered project sites within the Altamont Pass WRA, 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 nameplate capacity, for all species groups and for all individual species. In addition, although the nameplate capacity of the repowered turbines is the same as that of the turbines being replaced, the amount of energy actually produced by new-generation turbines is greater. Therefore, the total number of fatalities per MW is even smaller for repowered project sites.

Overall, the results of monitoring indicate that repowering in the Altamont Pass WRA has resulted in a reduction in overall mortality for those projects. It is reasonable to assume that repowering in the Montezuma Hills WRA would have a similar effect for most species overall. Although not specifically considered in the mortality estimates for the project, the replacement of the existing enXco V turbines in the project area is likely to reduce avian mortality, including mortality of golden eagles, from the current baseline conditions.

3.3 Site Categorization Based on Mortality Risk to Eagles

The ECP Guidelines recommend that project proponents use a standardized approach to categorize the likelihood that a project will meet the standards for issuance of a programmatic eagle take permit. Those categories are listed below.

- Category 1—High risk to eagles/potential to avoid or mitigate impacts is low.
- Category 2—High to moderate risk to eagles/opportunity to mitigate impacts.
- Category 3—Minimal risk to eagles.
- Category 4—Uncertain risk to eagles.

Shiloh IV is considered a Category 2 project based on the risk analysis described above and because there are opportunities to mitigate impacts. There is a reasonable probability that take of golden eagles will occur; however, take is expected to be low because of local habitat characteristics and fatality estimates derived from extensive local postconstruction monitoring efforts. Repowering is likely to reduce the risk associated with current conditions.

Chapter 4
Avoidance and Minimization of Risk, Advanced Conservation Practices, and Mitigation (Stage 4)

Shiloh IV has adopted an array of avoidance and minimization measures (AMMs), as well as compensatory mitigation, as part of its permitting and environmental compliance processes for the project. Additionally, ACPs) are proposed, consistent with current ECP Guidance. ACPs are defined in 50 CFR 22.3 as "scientifically supportable measures that are approved by the Service and represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable." Thus, the overall eagle conservation strategy includes three elements: avoidance and minimization of risk, advanced conservation practices to reduce ongoing mortalities, and compensatory mitigation to ensure there is no net loss to the eagle population.

4.1 Project- and Population-Level Effects

4.1.1 Project-Level Effects

Without a conservation strategy, the project could result in construction disturbance of nesting golden eagles, introduce hazards into the landscape, and create other hazardous conditions for golden eagles. As described in the Stage 3 analysis, the data suggest that operations could result in a mortality rate of 0.004–0.005 golden eagle per MW per year (Table 3-1), or approximately one eagle every other year for the Shiloh IV project.

4.1.2 Population-Level Effects

The ECP Guidelines recommend assessing effects on the population. Golden eagle populations are defined by Bird Conservation Region (BCR). The project area is within the Coastal California BCR BCR 32), which extends from Shasta County in the northern Sacramento Valley to Baja California (Figure 4-1), encompassing more than 71,000 square miles. Most of California's wind energy projects are within this BCR, which includes the Altamont Pass, Pacheco Pass, Tehachapi, San Gorgonio, and San Diego WRAs. Golden eagle presence in the vicinity of the project—the Montezuma Hills WRA, Altamont Pass WRA, East Bay Regional Park District, and nearby migration corridors—has been studied.

It is challenging to draw definitive conclusions about possible population-level effects on the basis of available data on the Montezuma Hills WRA and population data within BCR 32. Golden eagle nesting opportunities within a 10-mile radius appear to be declining, with fewer active nest territories available. Fatalities within this area appear stable, and are likely to remain so even with the addition of the project, because of the infill and repowering characteristics of this project. However, in view of the limited number of breeding attempts observed at the Montezuma Hills WRA, the slow sexual maturation of the species, and the periodic mortality that occurs, it is possible that the death of an adult golden eagle could have an adverse effect on the local breeding population.

Within a 140-mile radius of the project (Figure 4-1)—an area that encompasses the Altamont Pass WRA and Pacheco Pass WRA—the death of an adult golden eagle could similarly constitute an adverse effect. However, a core segment of the BCR 32 population, encompassing Alameda and Contra Costa Counties near the Altamont Pass WRA, appears to be stable, suggesting that mortality associated with wind turbines is not resulting in a net decline of the population or the species in this region (Hunt and Hunt 2006; ICF International 2011:Appendix B). However, with a population of 800 or more birds within the BCR (Rocky Mountain Bird Observatory 2012), there does not appear to be a surplus of individuals or breeding pairs. Accordingly, additional conservation measures are necessary to ensure no net loss of the species and to offset the potential for an effect on the regional population.

4.2 Construction-Related Avoidance and Minimization Measures

Shiloh IV has committed to implementing the following AMMs before and during construction to avoid and minimize effects on golden eagle.

AMM-1: Conduct preconstruction surveys

A qualified biologist will conduct preconstruction surveys of all potential golden eagle nesting habitat within 1 mile of construction areas within 30 days prior to construction. These surveys were conducted by biologists with Curry & Kerlinger in March 2012, and no eagles were detected within 1 mile of the project site.)

AMM-2: Site turbines to avoid high-risk landscape features

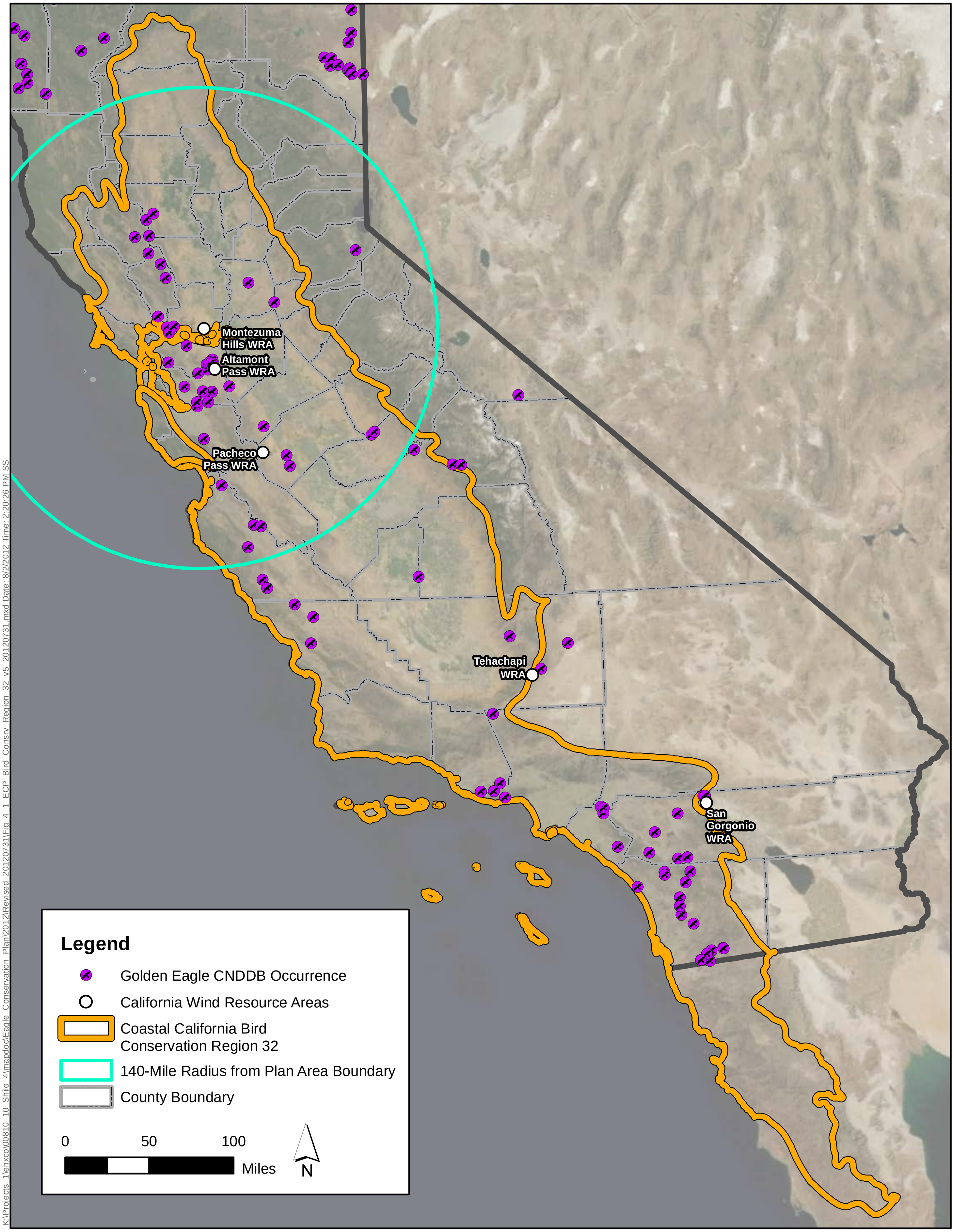
Shiloh IV will site turbines to avoid features of the landscape known to attract eagles to the extent feasible. The distance of the lowest point of the turbine rotor (i.e., the tip of any blade at the 6:00 position) will be no less than 29 meters (95 feet) from the ground surface. This design characteristic addresses the finding that roughly 74% of all bird observations (54% of raptor observations) occurred at heights lower than 30 meters (Kerlinger et al. 2009a).

AMM-3: Establish a no-disturbance buffer around potential eagle nesting habitat

If nesting eagles are identified in areas susceptible to disturbance from construction activities, a 1-mile no-disturbance buffer will be created around active golden eagle nests during the breeding season or until young have fledged. The buffer may be reduced to 0.5 mile or less, based on guidance from USFWS, and depending on site-specific factors. Factors to be considered include intervening topography, roads, development, type of work, visual screening from the nest, and nearby noise sources. Buffers will not apply to construction-related traffic using existing roads that are not limited to project-specific use (e.g., county roads, highways, farm roads). If no nests are observed during the preconstruction survey but nesting occurs following the start of construction, Shiloh IV will consult with USFWS to determine if additional protective measures are required.

AMM-4: Retain nest trees

Shiloh IV will retain any trees with active or suspected eagle nests. Any trees (without nests) that cannot be avoided must be replaced with similar native trees of comparable size, unless otherwise requested in writing by the landowner.



ICF INTERNATIONAL

Figure 4-1
Coastal California Bird conservation Region 32

AMM-5: Incorporate avian-safe practices into design of overhead power lines and other project features

Shiloh IV will incorporate avian-safe design characteristics for any overhead power lines. These include following avian-safe practices as outlined in *Suggested Practices for Avian Protection on Power Lines* (Avian Powerline Interaction Committee 1994, 2006): using insulated jumper wires; covering all exposed terminals at the substation (e.g., pot heads, lightning arresters, transformer bushings) with wildlife boots or other insulating materials; using nonconductive materials on riser poles; spacing energized wires a safe distance apart; installing perch discouragers when appropriate on crossarms; using conductor wire no smaller than 4/0 to ensure visibility; and installing bird flight diverters on all overhead lines to further reduce the risk of avian collisions. In addition, the overhead 230 kV transmission line will be installed in accordance with Avian Power Line Interaction Committee (1994, 2006) requirements.

Where feasible, permanent meteorological towers will be freestanding to reduce the potential for avian collisions. Where freestanding meteorological towers are not feasible, guy wires will be marked with recommended bird deterrent devices (i.e., daytime visual markers) to prevent diurnally moving species (e.g., eagles) from colliding with them.

AMM-6: Incorporate features to discourage increased prey base

Site preparation will entail moving rock piles away from wind turbines; turbine foundations will be designed and constructed to prevent under-burrowing by small mammals.

At the completion of project construction, Shiloh IV will prepare road edges such that agricultural activities can be conducted immediately adjacent to the road surface. This preparation will entail clearing excess gravel and soil from the shoulder, feathering road edges for runoff control, and replacing topsoil to support farming operations to the same grade as the roadway or adjacent drainage channel. In areas where topography precludes this approach, the road edges will be smoothed and compacted. 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.

AMM-7: Provide training for construction and project personnel

A qualified biologist will conduct a preconstruction (*tailboard*) education session at the project site prior to construction. Specific information will focus on the distribution, general behavior, and ecology of special-status species that could occur in the project area; the protection afforded to such species by the MBTA, BGEPA, and the federal and California Endangered Species Acts; the procedures for reporting contacts with listed and proposed species; and the importance of following all the applicant-proposed measures. The tailboard session will include discussion and overview of the general constraints associated with biological resources in the project area and the timing and processes required for project implementation. Employees will be informed that they are not authorized to handle or otherwise move any special-status species that they may encounter. Employees will participate in the education program prior to engaging in fieldwork. Shiloh IV will maintain appropriate records to ensure that employees have attended the education program prior to working in the project area.

AMM-8: Coordinate with landowners to ensure responsible livestock husbandry

Shiloh IV will coordinate with local landowners and ranchers to ensure that carcasses, which can attract eagles, are removed from the project area.

AMM-9: Reduce vehicle collision risk to wildlife

Shiloh IV will ensure that operations and maintenance personal and other visitors to the project site drive at low speeds to avoid impacts on small mammals and other wildlife, thereby reducing potential sources of attractants to eagles.

4.3 Advanced Conservation Practices

ACPs are defined in 50 CFR 22.3 as "scientifically supportable measures that are approved by the Service and represent the best available techniques to reduce eagle disturbance and ongoing mortalities to a level where remaining take is unavoidable."

The body of knowledge concerning the interaction of wind energy generation with eagles is continually growing. Currently, most ACPs can be considered "experimental" because they have not yet been implemented at a scale that can be scientifically evaluated. An adaptive management strategy that adjusts to results of monitoring, development of new technologies, and new ecological information is a key component of the stepwise approach and is likely to assist in ensuring that impacts are minimized to the greatest extent feasible. Additionally, the stepwise approach relies on a project-specific technical advisory committee (hereafter referred to as the Shiloh IV TAC) that will be made up of knowledgeable individuals at USFWS. The stepwise approach recommended by the draft Guidelines will provide a framework to facilitate eagle permit conditions as well as eagle permit renewals in the future.

Table 4-1 outlines the stepwise approach to mitigation—thresholds and the ACPs to be implemented if eagle fatalities occur.

Table 4-1. Summary of Advanced Conservation Measures Using a Step-wise Approach: to be Implemented when Eagle Take Occurs on Shiloh IV

Step	Advanced Conservation Measures	Threshold or Trigger
Step I	Initiate consultation with the TAC to illuminate appropriate conservation measures to minimize likely hood of existing take. Mortality monitoring for eagles, using approved protocol (as described in Chapter 5 of this ECP) for 3 consecutive years.	One eagle taken.
Step II	Initiate advanced conservation measures involving visual and/or auditory deterrence procedures and consultation with Shiloh IV TAC to design a protocol to evaluate effectiveness of these methods. For example, painting a statistically meaningful subset of blades or installing auditory deterrence measures on a subset of blades. Intensify eagle monitoring studies to define seasonal and diurnal flight patterns within the project area to inform development/ implementation of future ACPs. For example, monitoring flight patterns in the wind resource area. Conduct 3 years mortality monitoring (as described in Chapter 5 of this ECP) to evaluate effectiveness of deterrence methods.	Two eagles taken within any 12-month period or three eagles taken within a 5-year period.

Step	Advanced Conservation Measures	Threshold or Trigger
Step III	Qualified biological monitors (i.e., with suitable eagle experience) will be employed onsite during daylight hours and have the ability to temporarily modify the operation of particular turbine(s) (i.e., feathering turbines) when an eagle/large raptor approaches the rotor swept area (RSA). Alternatively, the latest proven avoidance technique or experimental techniques such as radar systems will be selected and implemented in consultation with the Shiloh IV TAC. Initiate consultation with Shiloh IV TAC to refine and evaluate the operations modification protocol utilizing data from monitoring efforts initiated in Step II. Extend or reinitiate eagle movement studies if demonstrated to generate useful information. Conduct 3 years mortality monitoring (as described in Chapter 5 of this ECP) to evaluate effectiveness of deterrence methods.	Three eagles taken within any 12-month period or four eagles taken within any 5-year period.
Step IV	Deploy radar system(s) designed to allow real time temporary operational modifications to turbine blade rotation as eagle(s)/large raptors approach particular turbines, or the latest proven avoidance technique or experimental techniques that would provide an equivalent level of potential protection for eagles. In consultation with the Shiloh IV TAC, design and implement a protocol for determining the effectiveness of the radar system(s) or other techniques. Conduct 3 years mortality monitoring (as described in Chapter 5 of this ECP) to evaluate effectiveness of radar system at reducing eagle take.	Four eagles taken within any 12-month period or five eagles taken within any 5-year period.
Step V	Initiate consultation with Shiloh IV TAC to determine operational modification schedules based upon evaluation of data collected in previous phases. Options may include operational modification in appropriate season and time of day, or at identified problem turbines/strings. Eagle movement monitoring and mortality monitoring will be extended for a 3-year period.	Five eagles taken within any 24-month period or six eagles taken within the first 5 years of operations.
Step VI	In consultation with the Shiloh IV TAC, determine other appropriate actions necessary to minimize and compensate for additional impacts on eagle populations.	Seven eagles taken within a 5- year period.

4.4 Mitigation

With the implementation of the AMMs and ACPs described above, some unavoidable eagle mortalities may still occur. Additional compensatory mitigation will be necessary to ensure that the standard of no net loss to the population is achieved.

4.4.1 Mitigation Considered and Evaluated

Golden eagle breeding performance is dependent on population density, but this characteristic is relative to the carrying capacity and productivity of the environment. Turbine-related fatalities decrease the productivity of a local population by directly removing individuals, thereby reducing the population's reproductive potential. The goal of mitigation should be to increase the overall production of birds relative to the current condition, despite the ultimate construction and implementation of the wind project.

An ideal net-benefit mitigation program would consist of an array of efforts to improve reproductive success (i.e., address non-turbine sources of direct mortality), to increase environmental productivity through management actions, and to improve environmental conditions through education and outreach. Eight different approaches can be considered for mitigating turbine-related fatalities in terms of their benefits to the population, expected benefit, and certainty in outcome (Table 4-2).

Table 4-2. Potential Golden Eagle Mitigation Techniques and Their Expected Influence on Productivity and Capacity

Mitigation Technique	Certainty	Influences Environmental or Eagle Productivity	Influences Capacity	Level of Benefit
Range management/prey enhancement	No	Yes	Medium	Medium
Utility pole retrofit	Yes	Yes	Medium	High
Lead abatement	No	Yes	Medium	Low
Lead rehabilitation	No	Yes	High	High
Other collision sources	No	Yes	Medium	Low
Education and outreach	No	No	Medium	Low to Medium
Contribution to research	No	No	No	Low
Nesting platform construction	No	Yes	Medium	Medium

Range Management/Prey Enhancement

Improved range management can be used to increase foraging opportunities. However, within the Montezuma Hills WRA, this option is not feasible because of agricultural land use practices and because the land is controlled by the property owners. Further, modifications within the WRA are not desirable because of the potential to increase foraging and future risk to eagles. Shiloh IV Wind LLC is proposing to purchase grasslands outside the WRA that will benefit raptors, and this habitat acquisition could serve as foraging habitat for golden eagles. Beyond this, no readily available range management/prey enhancement program currently exists to specifically benefit eagles.

Utility Pole Retrofit

Electrocutions are known to cause mortality of golden eagles and other raptors. Of 1,428 electrocution records reported by electric utility companies throughout the United States during an 11-year period, 19% were golden eagles (Harness and Wilson 2001). Hunt (2002) also found that 12% of 100 golden eagle deaths over 7 years resulted from electrocution. On this basis and as inferred from the draft Guidelines, utility pole retrofits are currently the preferred mitigation approach because of the tangible benefits to golden eagle and several other raptor species. The requirements for *bird-safe* utility poles are well known and are being effectively implemented by PG&E and other utilities in the region. The reduction of electrocutions will benefit eagle productivity directly by reducing this source of mortality. This is Shiloh IV's preferred mitigation approach.

Lead Abatement

Lead abatement is another possible mitigation option to offset the project's effects. Lead poisoning in golden eagles results primarily from the ingestion of lead shot or lead fragments in wounded prey or carcasses. Lead shot is no longer allowed for waterfowl hunting in the United States, but is still commonly used in hunting other game. Lead abatement involves removing lead from habitats that have high concentrations of lead (e.g., at and near shooting ranges). Other indirect abatement efforts include subsidizing non-lead shot for hunters or conducting non-lead shot education campaigns. While lead poisoning is a significant issue for golden eagles, it is challenging to develop a lead abatement program that can be shown to demonstrate significant benefits.

Lead Rehabilitation

Lead rehabilitation entails treating birds that have ingested lead (a process called chelation). Lead-poisoned birds are sometimes found as mortalities, but are often discovered as injured birds exhibiting risky behaviors. Lead poisoning is treatable, and this treatment, if successful, returns birds directly to the population. However, detecting, capturing, and delivering these individuals to a skilled treatment center is challenging. This practice has more commonly been employed in other states where lead blood levels in eagles are typically higher than in California. In a phone conversation with Dr. Bruce Stedman of the U.C. Davis Raptor Center in February 2012, Dr. Stedman indicated that a small number of golden eagles are treated each year at the raptor center and that no viable eagles are euthanized because of a lack of resources or equipment. Because the need is apparently filled, it would be difficult to develop a lead rehabilitation program that could serve as a meaningful mitigation approach in this region.

Other Collision Sources

Non–turbine-related collisions—for example, collisions with vehicle traffic, electrical wires, towers, or other structures—represent a broad and potentially significant source of golden eagle fatalities. However, it may not be practicable to address collisions at a broad scale because of the variability of strike locations and cost to alter existing infrastructure. It is possible that there are individual known sources of collisions that could be addressed through modification or deterrence; however, the overall benefit to eagles is expected to be low.

Education and Outreach

Wildlife agencies and organizations work to reduce bird mortality and to maximize habitat capacity through education and outreach. Education efforts can result in reduced shootings, reduced use of lead shot, and improved land use activities that may benefit Golden Eagle productivity. The success of hunter education and outreach programs is difficult to quantify. However, it has been proposed that hunter education may be more effective than simply placing a ban on lead shot (Ross-Winslow and Teal 2011). Survey results have shown that hunters respond positively to education programs (Tsuji et al. 1999); moreover, there is evidence that providing information on impacts of lead shot and associated risks to wildlife can incentivize hunters to use non-lead shot (Sieg et al. 2009).

Contribution to Research Efforts

Shiloh IV could contribute funding to support research and evaluation of new technologies that could help to reduce turbine-related mortality as well as research to increase the understanding of bird-turbine interactions; similarly, Shiloh IV could deploy experimental technologies (if appropriate innovations become available) at its facilities to test their efficacy in reducing mortality.

Nesting Platform Construction

The construction of nesting platforms and the use of nesting platforms to relocate golden eagles have been used successfully in the western United States and Canada. Identifying areas with a high concentration of golden eagles and installing nesting platforms could benefit the species. However, platforms would ideally be installed in areas that are protected, that support a surplus prey base, and that do not interfere with existing eagle territories. While this approach could directly benefit eagles, locating appropriate areas is problematic; accordingly, this approach is not proposed.

4.4.2 Proposed Mitigation

Based on the evaluation of the currently available mitigation (excluding experimental options or options with a high degree of uncertainty), and considering all constraints, the following mitigation has been developed for the Shiloh IV project.

Mitigation Measure 1: Retrofit high-risk electrical facilities

Shiloh IV will retrofit electrical facilities—high-risk power poles—as compensation for anticipated golden eagle mortality. Based on the resource equivalency analysis (REA) provided by USFWS and subsequent discussions with USFWS staff, the rate of compensatory mitigation proposed for the project is 15 poles per year (totaling 75 poles for the 5-year permit term).

USFWS staffpersons have stated that current estimated retrofit costs average approximately $4,500 per pole. Additionally, they have indicated that the National Fish and Wildlife Foundation's (NFWF's) Bald and Golden Eagle Protection Act account, the preferred method for payment of mitigation, is not yet available to accept deposits, but may be available soon. Consequently, Shiloh IV will deposit the funds into the NFWF account if available at the time the eagle take permit is issued, or Shiloh IV will contract directly with a utility to complete the required number of retrofits.

The mitigation proposed above is intended to compensate for the unavoidable take of eagles during the permit term. If the levels of take are less than anticipated, Shiloh IV will apply any excess mitigation to subsequent permit renewals. Similarly, if the levels of take are more than anticipated, enXco will either contribute additional funds to the NFWF account (if available) at the rate described above, or contract with a utility to complete the required number of retrofits.

4.5 Effects of the Conservation Strategy

4.5.1 Methods

A population analysis was developed for the Shiloh IV project to determine the impacts of the project on the population and the benefits of mitigation for the population. Different mitigation techniques provide different returns on investment, and the ultimate calculation is highly sensitive to the mitigation approach. Estimates of the mitigation requirements and benefits were developed by building population models. Thus, the determination of appropriate compensatory mitigation for the anticipated effect on the population is an iterative process.

To evaluate the combined effects of the project and the conservation strategy, Shiloh IV assumed that retrofitting 15 electric power poles to minimize electrocution would yield an annual net benefit to the population of 0.5 eagle every year. This conclusion is based on the assumptions of an annual loss of 1 eagle every other year due to turbine strikes, and a gain of 1 eagle per year from the retrofit of 15 poles. Shiloh IV will retrofit 75 poles within the first 6 months of operation to cover the first 5-year permit term, and will make subsequent contributions in future 5-year periods, as described above in Migitation Measure 1, for the operational life of the project.

Retrofitting the electrical poles will directly mitigate each unavoidable eagle mortality, resulting in no net loss to the population. Assuming a breeding population of 800 birds or 400 pairs within the BCR (Rocky Mountain Bird Observatory 2012), this strategy would result in an overall improvement in annual survival of 0.5/800 = 0.06%. The improvement in survival is less than the annual variance in survival (see below), and would not necessarily result in an improvement to the short-term population. It would, however, benefit eagles when evaluated in the context of overall long-term population performance.

In order to estimate the net benefits of mitigation to golden eagles in BCR 32, ICF used a Moffat's equilibrium model (Moffat 1903) for golden eagles (Hunt 1998; Hunt and Law 2000). This model allows for survival and reproductive rates that are high enough to produce floaters at "Moffat's equilibrium," which in turn assumes that the number of birds within the BCR is greater than the number of serviceable breeding territories. This approach allows for the direct examination of mitigation that benefits productivity (i.e., survival and fecundity) versus the limitations of capacity (i.e., the number and density of breeding territories).

The Moffat's equilibrium model was initialized using estimates of golden eagle survival and fecundity under existing conditions for the BCR (Hunt 2002). The model was initialized for 25 years to achieve a stable equilibrium, and then used to project performance for 30 years into the future. In addition to estimating population size, the model was used to estimate age structure and abundance of juveniles, floaters, and breeding birds such that the ratio of floaters to breeders could be evaluated. To allow for variance in survival rates, the model assumes that 83.97% of juveniles live at least 1 year, 79.44% of subadults/floaters live at least 1 year, and 90.87% of breeding eagles live at least 1 year, with standard errors of 3.67%, 2.15%, and 2.46%, respectively (Hunt 2002). This introduced variance produced a stochastic (i.e., non-deterministic) outcome, meaning that the model will produce slightly different results every time it is run. ICF ran the model 30 times for two scenarios: current conditions and future conditions with net benefit due to mitigation actions. In addition, ICF used the above assumptions to estimate the potential impact of mitigation on the population growth rate (lambda) using various models. However, ICF was not able to detect a change in the population growth rate for BCR 32 due to take or mitigation because it is not detectable within the standard error of the models, so those methods and results were not included in the final analysis.

4.5.2 Project-Level Effects

Project-level effects are expected to be equal to or less than those estimated within this ECP for the following reasons.

- The landscape is dryland farmed and has few ground squirrel burrows, providing limited foraging habitat for eagles.
- Nests within the WRA have not been used recently and are not likely to be used because of existing land use practices and operational wind farms in the area.

- Overall eagle use information indicates that the area is less productive and less used by eagles than other nearby WRAs.

The project will avoid disturbance of nesting golden eagles and will avoid the introduction of other hazards (e.g., prey attractants) into the project area that could cause effects on eagles. The project will include ACPs in a step-wise manner that are also expected to reduce the potential for mortality over time by implementing new avoidance strategies and monitoring the effectiveness of those strategies. The project may still result in occasional effects on individual eagles during operation; however, those effects would be mitigated such that there is no net loss to the population.

The combination of AMMs, the adaptive management strategy for ACP implementation, and compensatory mitigation commitments will ensure that the net effect of Shiloh IV's operations on the eagle management population is, at a minimum, no net loss. Under the no-net-loss standard, the overall USFWS goal of maintaining stable or increasing breeding populations of golden eagles within BCR 32 will be achieved.

4.5.3 Population-Level Effects

The model—taking into account both turbine-related fatalities and compensatory mitigation—predicts a long-term increase in abundance of 10 birds for the BCR as a whole, or an increase of approximately 0.7%. Due to the relatively high survival of adult birds, the BCR is believed to produce a large number of floaters and to be, on average, saturated with breeding birds. Nevertheless, it is not possible to predict the status (e.g., floater versus breeder) of any particular bird—or fraction of the population—that might be influenced by the project or by mitigation actions. Consequently, it is similarly not possible to predict the specific consequences of such actions.

The proposed mitigation would entail retrofitting 15 poles per year, which could benefit one eagle each year; note that 75 poles—or the total proposed mitigation for the first 5-year permit term—will be retrofitted in year 1. Consequently, the mitigation action in year 1 could prevent the electrocution of five eagles, which would constitute an increase in the population, with a concomitant potential to contribute to overall productivity. Overall, the model indicated that the proposed mitigation actions would increase the long term average floater-to-breeder ratio from 0.099 (standard deviation = 0.014) to 0.101 (standard deviation = 0.024). In view of the model results, ICF concludes that the proposed level of mitigation is sufficient to produce an increase in long-term steady-state abundance.

4.5.4 Cumulative Effects

Analysis of cumulative effects typically considers the effects of a proposed project in combination with the effects of past, present, and reasonably foreseeable projects. To date, multiple postconstruction monitoring efforts have detected a total of eight golden eagle fatalities in the Montezuma Hills WRA since 2004 (ICF 2011a:Appendix B). In view of the variability in data collection, the number of projects, and duration of sampling efforts, it is difficult to precisely quantify the percentage of total losses these fatalities represent. Nevertheless, these results generally confirm that the losses of golden eagles in the Montezuma Hills WRA are low. Furthermore, considering the persistence of decaying carcasses of large birds such as golden eagle, it is assumed that operational staff in the project area would be likely to detect incidental fatalities.

The Montezuma Hills WRA is nearing buildout. The total number of turbines at buildout is anticipated to be approximately 550, or roughly 300 fewer than the current total of approximately 850 turbines, because several projects—notably the proposed Shiloh IV project—involve replacing old-generation turbines with larger new-generation turbines. Because old-generation turbines pose a greater risk of avian mortality, the repowering efforts are anticipated to reduce actual mortality rates in the Montezuma Hills WRA. Nevertheless, the addition of the 50 Shiloh IV turbines could result in a small cumulative contribution to the existing and anticipated risks to golden eagles in the area, though this risk is likely equal to or lower than that presented by the previous enXco V project on the site.

Throughout the entire BCR 32, additional wind projects will be constructed. However, these projects are subject to the same regulations, and will be required to ensure that their effects are avoided, minimized, and mitigated, and that there is no net loss to the population.

4.6 Summary and Conclusions

Shiloh IV will adhere to the avoidance measures and conservation approach described above. The design- and construction-related AMMs are expected to help avoid direct effects during construction and long-term operations. Operational ACPs using the step-wise approach will help to ensure that the project operates within the take levels anticipated and will provide a framework for additional management actions should they prove necessary. Lastly, compensatory mitigation will ensure that any remaining unavoidable take of eagles is mitigated to a no-net-loss standard. With implementation of these measures—and particularly the compensatory mitigation—effects will be avoided, minimized, and mitigated, resulting in no net loss to the golden eagle population within BCR 32.

Chapter 5
Postconstruction Monitoring (Stage 5)

Shiloh IV will implement a postconstruction monitoring program comprising three main components.

1. Standardized mortality monitoring for a period of 3 years beginning upon the first delivery of power, and that is consistent with CEC Guidelines and Solano County requirements.
2. Additional ACP monitoring in 3-year increments (unless such monitoring overlaps with the County-required monitoring period) designed to determine the effectiveness of measures implemented to reduce or eliminate eagle mortalities (i.e., monitoring required to validate the stepwise ACP approach).
3. Incidental monitoring and reporting during O&M activities.

While these are essentially separate components, all will feed into the overall goal of monitoring eagle mortality and any measures implemented to reduce mortalities. All monitoring and reporting under the overall monitoring program will be completed under a valid MBTA Special Purpose Utilities Permit, obtained by the person or persons responsible for the monitoring.

5.1 Standardized Monitoring (Years 1–3)

Qualified biologists will conduct annual bird and bat mortality monitoring surveys to validate the risk assessment and to document actual fatalities associated with wind turbines and other project-related activities and facilities (e.g., meteorological towers, overhead power lines). These studies will be conducted in accordance with standardized guidelines as set forth in the CEC Guidelines (2007) for 3 years following the first delivery of power. The biologists will conduct bird use surveys—consistent with protocols observed during the preconstruction use surveys—concurrently with mortality monitoring surveys.

Annual postconstruction monitoring, using CEC recommended monitoring techniques, will be conducted for 3 years from the initiation of power delivery. There are four major components of the monitoring program.

- Avian use surveys to determine the seasonal and annual variations in relative abundance and species use patterns.
- Carcass surveys to search for the bodies of birds and bats killed by turbines or power transmission structures.
- Bias correction surveys, entailing carcass detection probability and removal monitoring .
- Reporting.

5.1.1 Avian Use Surveys

Postconstruction monitoring will include avian use surveys of the project area to estimate relative abundance and relative use of the project area. Information describing the relative abundance of raptor species in the project area is crucial to interpreting the results of carcass surveys and to guide adaptive management of the facility. Observation stations will be established on the basis of topography and turbine configuration and will be stratified to cover all major habitat types and geographies in the project area in accordance with the CEC Guidelines (2007). CEC recommendations for the number of sample sites are flexible, depending on specific location attributes and areas of special concern. The number of stations selected will be based on the number necessary to adequately sample the habitat types and topographies present in the project area.

Surveys will consist of two 30-minute sessions per day (one in the morning, one in the afternoon) at each observation point once per week for a minimum of 1 year. A qualified observer will survey a 360° viewshed at each location, recording the number of individuals of each species detected out to the maximum distance possible based on visibility at each station and weather conditions on any given day. To avoid nonrepresentative days, observations will not be conducted on days with outlying weather conditions. Observers will make note of any raptor prey species detected from the observation station and any unusual raptor behavior observed. The need to extend avian use surveys beyond the first year will be evaluated in light of the first year of mortality data.

5.1.2 Carcass Surveys

Monitored Turbines

The project will comprise up to 50 turbines, each with a ground to rotor tip height of approximately 130 meters. The CEC Guidelines recommend that the width of the search area should equal the maximum rotor tip height; in this case, 65.5 meters from the base of the turbines. However, the search area used for the Shiloh I and II projects extended out 105 meters from each turbine's base (Kerlinger et al. 2009b, 2010). Accordingly, to ensure comparability with recent datasets from neighboring projects, the proposed protocol exceeds the CEC Guidelines by adopting the 105-meter-radius search area.

The CEC Guidelines suggest searching 30% of the turbines in most cases. However, more recent practices entail searching at least 50% of turbines. Differences in fatality patterns among individual turbines and seasonal changes in fatality patterns at the same turbine can result from small differences in habitats and topography, changes in micro-scale bird and bat use patterns, and random processes. Accordingly, turbine sampling will use an appropriate design for postconstruction monitoring to ensure meaningful and scientifically valid representation of project-wide conditions. For example, one subset of turbines could be sampled continuously through the 3-year monitoring period as a reference set to account for broad annual variations in bird use. A second subset could be selected randomly and rotated each year to ensure that local variations in mortality rates are captured and that the entire project area is adequately evaluated.

Search Interval

The CEC Guidelines (2007) recommend a minimum 2-week search interval, which was the standard applied during earlier projects in the Montezuma Hills WRA (e.g., Kerlinger et al. 2006); however, a 7-day search interval has been the standard applied in the Montezuma Hills WRA in more recent assessments (Curry & Kerlinger 2008; Kerlinger et al., 2009b, 2010). Accordingly, the Shiloh IV survey effort will adopt a 7-day search interval.

Searches

A clean sweep survey will be conducted over the entire search area to locate and remove any preexisting bird and bat carcasses the day prior to the start of standardized searches at each turbine. Surveyors will walk circular transects under each turbine to a distance of 105 meters from the base of the turbine. Circular transects will be spaced 5 meters apart from the base of the turbine out to a distance of 35 meters, and spaced 10 meters apart thereafter out to 105 meters, resulting in 14 concentric transects for each turbine. Surveyors will use a belt-transect technique, visually searching the ground for any avian or bat fatalities out to 5 meters on either side. Transect locations may be adjusted to adapt to visibility effects of vegetation height and topography. Searchers will verify the accuracy of their transect spacing through periodic confirmation with a laser rangefinder.

Each turbine will be surveyed on the same day each week, but the order in which turbines are searched on a given day will be scheduled to ensure that each turbine is searched at varying times of day throughout each season to avoid time-of-day biases.

Fatalities

Fatalities comprise partial or intact carcasses and collections of feathers that meet the diagnostic criteria of a fatality. Data will be collected describing the condition and location of the find, and the identity of the nearest structure will be recorded. Locations will be documented using handheld global positioning system (GPS) units. Photographs will be taken of the carcass as it was found and to indicate its location relative to nearby turbines or other structures. All carcass remnants will be collected and placed in plastic ziplock bags and frozen for future use during bias correction surveys, release to USFWS, research use, or donation to the USFWS National Eagle Repository, as appropriate.

Any avian or bat carcasses found onsite incidentally by surveyors or onsite staff will be recorded as incidental finds and handled in the same manner as the regular search carcasses. Injured birds will be reported as fatalities unless they have been successfully rehabilitated and released. All bird deaths will be reported to the Wildlife Response and Reporting System database.

Each time an area is searched, data will be recorded regarding weather conditions; groundcover classification by height and type; turbine functionality; search area access issues; and any incidental observations of birds, bats, and raptor prey species.

5.1.3 Bias Correction Surveys

The number of fatalities detected during the carcass surveys is not equal to the actual number of fatalities at a turbine or project. Carcasses can be missed by surveyors (searcher efficiency) or can be removed from the search area during the interval between deposition and the survey (carcass removal), resulting in a downward bias of the annual estimate. Bias correction monitoring provides estimates of these biases, the level of which can be used to estimate the true total number of turbine-related fatalities that occur each year.

Searcher efficiency may be influenced by vegetation, topography, and searcher-specific variability. In addition to directly biasing the fatality estimate, searcher efficiency can bias the estimation of scavenger removal rates because scavenger removal studies rely on searchers, are influenced by their biases, and exert quasi-experimental influences on estimators.

Scavenger Removal Estimates

Some fatalities cannot be detected because scavengers or other factors remove them. Carcass removal trials will therefore be conducted to determine the rate at which carcasses are removed from the survey area. Accordingly, independent scavenger removal trials will be conducted once per season using 20 birds—10 small birds and 10 medium to large birds—and 20 bats (native species will be used if available). Carcasses will be placed across the project area at randomly selected bearings and distances from turbines. Each carcass will be marked with green electrical tape on one leg to distinguish it from searcher-efficiency trial birds and bats and actual turbine fatalities. Upon placement in the field, the carcasses will be checked daily for 7 days and every 2 days thereafter for an additional 7 days.

During each check, the carcass will be classified into one of the following categories.

- Intact (whole, unscavenged).
- Scavenged (signs of scavenging present, dismemberment, or feather spot remaining).
- Feather spot (the carcass was scavenged and removed, but more than 10 feathers remained).
- Removed (not enough remains of carcass to be considered a fatality, hereby defined as at least five tail feathers or two primaries within at least 5 meters of each other, or a total of 10 feathers in standardized carcass search).

Searcher Efficiency Estimates

Searcher efficiency trials will be conducted to estimate the proportion of carcasses missed during carcass searches. Searcher efficiency trials will be conducted four times per year, once during each season. Trials will be conducted on dates when carcass surveys are scheduled and searchers will be "blind" to the fact that trials are being conducted.

During each trial, a total of 20 birds—10 small birds and 10 medium to large birds—and 20 bats will be placed in the field. Carcasses will be marked to distinguish them from actual mortalities and placed in the field early in the morning prior to surveyor arrival. Carcasses will be placed at random distances and bearings from turbines. Turbines will be selected such that all major habitat types and topographies are represented. At the end of each trial day, the supervisor will contact the surveyors to determine how many of the placed carcasses were detected. The supervisor will then give the surveyors the locations of any remaining carcasses so they can be immediately retrieved.

5.1.4 Reporting

Shiloh IV will prepare annual reports documenting the results of each year's fatality monitoring efforts. The reports will be submitted to the Shiloh IV TAC (USFWS), DFG, and the Solano County TAC within 90 days after the end of each complete year of monitoring. USFWS will be notified within 24 hours upon positive identification of a golden eagle injury or fatality.

5.2 ACP Effectiveness Monitoring (As Necessary)

Under the stepwise approach to implementation of the ACPs, additional monitoring may be required to evaluate the effectiveness of the measures. The type of monitoring is difficult to define at this time because the stepwise approach is designed to be adaptive; that is, it may change over time based on new information, and certain steps may not be triggered (i.e., if mortality estimates stay within the expected range). For the initial 5-year permit term, it is likely that the standardized monitoring will be sufficient to address ACP monitoring needs, perhaps with minor augmentations or changes. For the period outside the standardized monitoring timeframe, it is likely that some combination of O&M monitoring (as described below) and some supplemental monitoring will be sufficient to address the monitoring needs for each step.

Supplemental monitoring would be limited to detecting golden eagle carcasses (for evaluation of the implemented ACPs), which are known to persist longer than smaller birds, and which are easier to detect because of their size. These factors suggest that the monitoring frequency and/or the search transects could likely be increased from those used during the standardized monitoring. With these factors in mind, and considering the need, a monitoring protocol would be designed in consultation with the Shiloh IV TAC. Considering the size of the project area and number of turbines, one additional biological monitor could be contracted for 6 months each of the 3 years to perform the following tasks.

1. Review data collected from O&M staff.
2. Test the searcher efficiency of O&M staff by placing trial carcasses in the field.
3. Conduct additional searches around selected turbines.
4. Develop recommendations for future more detailed monitoring, should it be necessary.
5. Note other observations regarding eagle use and potential problem areas.

The data collected and intensity of monitoring could be varied over time as steps are reached, in consultation with the Shiloh IV TAC, and as necessary to evaluate ACPs.

5.3 Operations and Maintenance Monitoring (Years 1–30)

Shiloh IV O&M staff conduct semiannual and annual maintenance visits to each turbine as well as incidental visits for “errors” or other unanticipated maintenance needs. This frequency equates to approximately 3–4 individual turbines visited each week for each year during operations (approximately 25–30% of the 50 project turbines each month for the life of the project). O&M staff are trained to monitor for dead or injured golden eagles (as well as other birds) during their work activities (i.e., incidental finds). A data sheet that describes how project personnel can recognize an injured or dead golden eagle will be posted in the maintenance facility. The data sheet will include instructions and the procedures that personnel shall take in the event that an injured or dead golden eagle is discovered onsite, including whom to notify and what actions shall be taken. USFWS will be notified within 24 hours upon positive identification of a golden eagle injury or fatality. Additionally, a summary report will be prepared and sent to USFWS at the end of each year documenting any incidental fatalities discovered.

Chapter 6
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Appendix B

Applicant's Bird and Bat Conservation Strategy

Bird and Bat Conservation Strategy for the Shiloh IV Wind Project

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August 2012

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Acronyms and Abbreviations

BBCS	Bird and Bat Conservation Strategy
BGEPA	Bald and Golden Eagle Protection Act
BO	biological opinion
CEC	California Energy Commission
CEC Guidelines	*California Guidelines for Reducing Impacts to Birds and Bats from Windplant Development*
CESA	California Endangered Species Act
County	Solano County
DFG	California Department of Fish and Game
ECP	Eagle Conservation Plan
EIR	environmental impact report
ESA	federal Endangered Species Act
FR	Federal Register
GPS	global positioning system
HCP	habitat conservation plan
Interim Guidelines	*Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities*
kV	kilovolt
kWh	kilowatt hours
MBTA	Migratory Bird Treaty Act
MW	megawatt
O&M	operations and maintenance
project	Shiloh IV Wind Plant Project
project area	3,100-acre Shiloh IV property
SSP	Species of Special Concern
TAC	Technical Advisory Committee
USFWS	U.S. Fish and Wildlife Service
WRA	Wind Resource Area

Chapter 1
Introduction

Shiloh IV Wind Project, LLC (Shiloh IV), a subsidiary of enXco, an EDF EN Company, will operate a commercially viable wind energy facility in Solano County, California, that would deliver renewable energy to the Pacific Gas and Electric Company (PG&E)/California Independent System Operator power grid (Figure 1-1). The project will contribute to meeting California's Renewable Portfolio Standard goals and would help to reduce greenhouse gas emissions pursuant to Assembly Bill 32 and Solano County's (County's) General Plan. Shiloh IV has developed this bird and bat conservation strategy (BBCS) to avoid, minimize, and mitigate potential avian and bat mortality associated with the proposed project; it serves to compliment Shiloh IV's eagle conservation plan (ECP), specifically developed to address the federal permitting requirements for bald and golden eagles.

1.1 Background

The operation of wind turbines is known to result in avian and bat mortality (California Energy Commission 1989; Orloff and Flannery 1992; Erickson et al. 2001). This phenomenon was initially identified in the mid-1980s, since which time research has been ongoing to determine the causal mechanisms of fatality, as well as to identify improvements in design, operational characteristics, and siting of wind turbines to reduce mortality levels. This research has helped identify wind resource areas (WRAs) that are of lower collision risk, such as the Tehachapi WRA (Anderson et al. 2000); higher risk areas, such as the Altamont Pass WRA (Orloff and Flannery 1992; Smallwood and Thelander 2004); and moderate risk areas, such as the Montezuma Hills WRA (Howell and Noone 1992; Kerlinger et al. 2006a). The science associated with risk and mortality continues to evolve in these and other WRAs. Research has led not only to significant design modifications thought to reduce collision potential while maximizing energy-generating capacity, but also to standardized methods of assessing and monitoring the effects of wind energy development at existing and proposed windfarms (Anderson et al. 1999).

A substantial amount of baseline data on bird use and monitoring data on avian mortality has been collected for various existing and proposed wind projects in the United States and Europe. Avian baseline data on bird use are primarily used to estimate overall project impacts on birds, especially raptors and special-status species.

In addition to avian fatalities, bat fatalities have been an unanticipated consequence of some wind projects. In the late 1990s biologists began to discover bat carcasses during postconstruction avian mortality monitoring of wind projects. High-profile incidences of bat mortality at wind projects, especially in the Appalachian Mountains, have led to growing concerns about the impacts of wind projects on bats. Since the early 2000s, researchers have been studying bat mortality resulting from wind projects and have consistently found bat carcasses at wind energy sites, with some sites—primarily in the eastern United States—resulting in unexpectedly high rates of bat mortality.

The Montezuma Hills WRA was first designated as a WRA by Solano County in its 1987 Wind Turbine Siting Plan. Since that time, a number of wind energy facilities have been constructed and proposed; these are shown in Table 1.

Table 1. Commercial Wind Plants in the Montezuma Hills Wind Resource Area

Project (owner)	Number of Turbines	Turbine Rating	Total Megawatts	Status
Existing Projects				
enXco V[a] (enXco)	510 U.S. Windpower KCS-56-100	100 kW	51.6	Constructed in 1989–1990; in operation
High Winds (NextEra)	90 Vestas V-80	1.8 MW	162	Constructed in 2003; in operation
Solano Wind Phase 1 (Sacramento Municipal Utility District [SMUD])	23 Vestas V-47	660 kW	15	Constructed in 2004; in operation
Shiloh I (Iberdrola Renewables)	100 GE 1.5	1.5 MW	150	Constructed in 2006; in operation
Solano Wind Phase 2A (SMUD)	8 Vestas V-90	3 MW	24	Constructed in 2006; in operation
enXco V repowering (enXco)	6 GE 1.5	1.5 MW	9	Constructed in 2006; in operation
Solano Wind Phase 2B (SMUD)	21 Vestas V-90	3 MW	63	Constructed in 2007; in operation
Shiloh II (enXco)	75 REpower MM92	2.0 MW	150	Constructed in 2008; in operation
Montezuma I (NextEra)	16 Siemens 2.3	2.3 MW	36.8	Constructed in 2010; in operation
Montezuma II (NextEra)	34 Siemens 2.3	2.3 MW	78.2	Constructed in 2011; in operation
Shiloh III (enXco)	50 REpower MM92	2.0MW	100	Constructed in 2011; in operation
Approved Projects				
Solano Wind Phase 3 (SMUD)	36–75	—	114	Currently under construction
Phase II of Shiloh I (Iberdrola Renewables)	20 GE 1.5	1.5 MW	30	EIR has been certified; owner has no current plans to build
Shiloh IV[b] (enXco)	50 REpower MM92	2.0 MW,	100	Currently under construction

Source: Solano County Department of Resource Management 2010, ICF file information.

[a] The use permits for enXco V expire in 2014 and 2015 and require removal of all older turbines and related features.

[b] Portions of Shiloh IV would be located on parcels presently containing approximately 200 enXco V turbines to be removed.

Each new facility has generated data regarding avian and bat presence in the Montezuma Hills WRA. Many of the facilities have contributed intensive preconstruction avian use surveys, and all facilities in operation have conducted at least 1 year of postconstruction bird and bat mortality surveys. Combined, these surveys form a robust body of baseline biological data for the area. These studies have documented avian and bat mortality associated with turbine collisions. However, overall mortality rates in the area are low to moderate compared to other WRAs in the United States, with most of the fatality burden on species that are common and abundant (Kerlinger et al. 2009a).

1.2 Proposed Project

Shiloh IV is a repowering project in the Montezuma Hills adjacent to the Shiloh I, High Winds, and Montezuma II projects. Shiloh IV has decommissioned and removed approximately 230 existing wind turbine generators installed in the late 1980s and is currently in the process of to installing approximately 50 new Repower MM92, 2.0MW wind turbines in the proposed project area (Figure 1-2). The project would have an installed capacity of up to approximately 100 MW of electrical energy production (depending on the make and model of wind turbine selected), generating electricity for distribution to customers throughout northern California.

Support facilities, storage, and parking areas would also be included to provide for operational access to the projects. Physical access to the project would be by existing public roads to the edge of the project area, at which point new access roads would be constructed in the project area, or existing roads would be improved to accommodate project requirements.

The power generated by the turbines would be conveyed to a new 230 kilovolt (kV) substation (built on an existing pad) by an electrical power collection system that would be installed as part of the proposed project. The system would comprise pad-mounted transformers, buried cables, and junction boxes. The pad-mounted transformers would be connected to each turbine by buried power cables. Junction boxes—part of the buried cable system—would house cable splices and allow access to the cable. The cables would be buried between turbines and transformers and between transformers and the new substation. The existing operations and maintenance (O&M) facility would be expanded by 8,000 square feet.

The project would require the construction of access roads, foundations for wind turbine towers and meteorological towers, underground power collection lines, a 230 kV substation, and other minor support facilities such as staging and storage areas. In addition, 5,000 square feet would be added to the existing O&M facility. Grading would be required for the construction of new access roads, the improvement of existing access roads to deliver project materials, and the construction of pads to support wind turbine foundations. To minimize the amount of earth movement, grading would follow existing elevation contours to the degree possible; moreover, the project has been designed to avoid wetlands, low-lying drainage areas, and residences throughout the Plan Area.

The existing 230 turbines that are part of the enXco V wind project would be decommissioned in compliance with the permit for that project, which expires in 2014.

Because of the potential for wind energy projects to result in mortality of birds and bats, and because of the concern that such mortality could result in cumulative effects on bird and bat populations, the U.S. Fish and Wildlife Service (USFWS) has issued *Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities* (Interim Guidelines). According to the Interim Guidelines:

> An Avian and Bat Protection Plan (ABPP) is a project-specific document that delineates a program designed to reduce the operational risks that result from bird and bat interactions with a specific wind energy facility…Ultimately, the ABPP can and should result in an agreement between the project proponent and the Service as a "good faith" effort to conserve migratory birds and bats while still allowing for the development of wind energy projects and production of renewable electricity in the most environmentally friendly ways possible and practicable.

Following he Interim Guidelines, the USFWS has requested that these plans be called Bird and Bat Conservation Strategies (BBCS's). Regardless of the name, the Interim Guidelines have been used in the development of this document.

1.3 Regulatory Setting

Both federal and state regulations require protection for bird and bat species. These are briefly summarized below.

1.3.1 Federal Regulations

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 United States Code [USC] 703–712) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 Code of Federal Regulations [CFR] 21; 50 CFR 10). Most actions that result in *take*—defined as hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof—are prohibited under the MBTA. Examples of permitted actions that do not violate the MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. USFWS is responsible for overseeing compliance with the MBTA.

Federal Endangered Species Act

USFWS has jurisdiction over species listed as threatened or endangered under Section 9 of the federal Endangered Species Act (ESA). The ESA protects listed species from harm, or *take*, which is broadly defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." For any project involving a federal agency in which a listed species could be affected, the federal agency must consult with USFWS in accordance with Section 7 of ESA. USFWS issues a biological opinion (BO) and, if the project does not jeopardize the continued existence of the listed species, issues an incidental take permit. When no federal context is present, proponents of a project affecting a listed species must consult with USFWS and apply for an incidental take permit under Section 10 of the ESA. Section 10 requires an applicant to submit a habitat conservation plan (HCP) that specifies project impacts and mitigation measures.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) (16 USC 668) prohibits take and disturbance of individuals and nests. Take permits for birds or body parts are limited to religious, scientific, or falconry pursuits. However, the BGEPA was amended in 1978 to allow mining developers to apply to USFWS for permits to remove inactive golden eagle (*Aquila chrysaetos*) nests in the course of "resource development or recovery" operations.

In 2009, USFWS issued a final rule on new permit regulations that would allow some disturbance of eagles "in the course of conducting lawful activities" (74 Federal Register [FR] 46836–46879). USFWS's description of its 2009 rule suggests that physical take of an eagle will only be authorized if every avoidance measure has been exhausted. Removal of nests will still generally be permitted only in cases where the nest poses a threat to human health, or where the removal would protect eagles. Explanations of the rule on USFWS's website specify that take permits may be issued when "necessary for the protection of… other interests in any particular locality" (U.S. Fish and Wildlife Service 2009). The discussion expands the definition of such public and private interests to include utility infrastructure development and maintenance. The website states that due to concerns about population declines, permits for take of golden eagle are likely to be restricted throughout the eagle's range (U.S. Fish and Wildlife Service 2009). Considerations for issuing take permits include the health of the local and regional eagle populations, availability of suitable nesting and foraging habitat for any displaced eagles, and whether the take and associated mitigation provides a net benefit to eagles (74 FR 46836–46879). The website goes on to say that permits will be issued that "result in a reduction of ongoing take or a net take of zero" (U.S. Fish and Wildlife Service 2009).

In January 2011, USFWS issued the *Draft Eagle Conservation Plan Guidance* (draft Guidance) intended to assist parties to avoid, minimize, and mitigate adverse effects on bald and golden eagles. The draft Guidance calls for scientifically rigorous surveys, monitoring, assessment, and research designs proportionate to the risk to eagles. The draft Guidance describes a process by which wind energy developers can collect and analyze information that could lead to a programmatic permit to authorize unintentional take of eagles at wind energy facilities. USFWS recommends that ECPs be developed in five stages. Each stage builds on the prior stage, such that together the process is a progressive, increasingly intensive look at likely effects of the development and operation of a particular site and configuration on eagles. The Shiloh IV ECP follows that process. Additional guidance from USFWS and revisions to the draft Guidance is expected in the fall of 2012. Shiloh IV's ECP was prepared to be consistent with the draft Guidance.

1.3.2 State Regulations and Guidelines

California Endangered Species Act

California implemented the California Endangered Species Act (CESA) in 1984. The act prohibits the take of endangered and threatened species, but habitat destruction is not included in the state's definition of take. Under CESA, *take* is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include harm or harassment. The California Department of Fish and Game (DFG) administers CESA and authorizes take through either Section 2080.1 (for species listed under ESA and CESA) or Section 2081 agreements (except for species designated as fully protected).

California Fish and Game Code

Fully Protected Species

The California Fish and Game Code provides protection from take for a variety of species, referred to as *fully protected species*. Section 5050 lists fully protected amphibians and reptiles; Section 3515 lists fully protected fish; Section 3511 lists fully protected birds; and Section 4700 lists fully protected mammals. The California Fish and Game Code defines *take* as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." Except for take related to scientific research, all take of fully protected species is prohibited, and DFG cannot issue take permits for fully protected species.

Sections 3503 and 3503.5 (Protection of Birds and Raptors)

Section 3503 of the California Fish and Game Code prohibits the killing of birds and/or the destruction of bird nests. Section 3503.5 prohibits the killing of raptor species and/or the destruction of raptor nests. Typical violations include destruction of active bird and raptor nests as a result of tree removal and failure of nesting attempts (loss of eggs and/or young) as a result of disturbance of nesting pairs caused by nearby human activity. Consultation with DFG would be required if nesting birds would be affected by construction activities.

California Energy Commission Guidelines

Published by the California Energy Commission (CEC) and DFG (2007), the *California Guidelines for Reducing Impacts to Birds and Bats from Windplant Development* (CEC Guidelines) outline the generally accepted procedures for the permitting and study of wind energy developments in the state. The CEC Guidelines are intended to provide a strategy to reduce impacts on birds and bats from new wind energy developments or repowering of existing wind energy projects in California. The CEC Guidelines include recommendations for screening proposed sites; study design; impact assessment; and development of avoidance, minimization, and mitigation measures. Although following the CEC Guidelines is voluntary, for the most part they represent the current state of knowledge on wind-wildlife interactions and are generally accepted by industry and agencies as among the best available resources and frameworks for assessing potential impacts on birds and bats from wind energy projects in California. The CEC Guidelines describe four project categories used to determine recommended levels of pre-project study, reproduced below.

> **Category 1—Project Sites with Available Wind-Wildlife Data.** Some proposed projects have the advantage of an existing foundation of data on bird and bat use and potential impacts from nearby similar projects. For these Category 1 projects, a reduced study effort may be appropriate. Projects potentially falling into Category 1 might include infill development, repowering projects, and those near existing wind facilities for which there is little uncertainty as to the level of impacts. Consultation with the lead agency, USFWS, DFG, biologists with specific expertise, and other appropriate stakeholders (such as a conservation organization representative) is recommended when considering whether a project qualifies as Category 1. Factors to consider in determining whether or not data from an adjacent facility would allow a project to be classified as Category 1 include:
>
> - Whether the field data were collected using a credible sampling design
> - Where the data were collected in relation to the proposed site
> - Whether the existing data reflect comparable turbine type, layout, and habitat
> - Suitability for migratory species, physical features, and winds
> - Whether the data are scientifically defensible and still relevant
>
> Category 1 projects may not need a full year of pre-permitting studies to answer questions about potential collision risk because of the availability of existing data. Caution is warranted in extrapolating existing data to unstudied nearby sites. Slight topographical or habitat variations can make substantial differences in bird and bat site use and potential impacts. In addition, technological changes, including use of large turbines, variations in turbine design or layout, increased operating times, and use of different lighting, may require new or additional data gathering.

Category 2—Project Sites with Little Existing Information and No Indicators Of High Wildlife Impacts. Projects in Category 2 have no obvious "red flags" that emerge from the preliminary site assessment (for example, "red flags" might be known occurrences of special-status species or high levels of fatalities at nearby wind facilities) and no substantial body of information from nearby projects that could provide information for an impact assessment. Pre-permitting surveys should last a minimum of one year to document how birds and bats use a site during spring, summer, fall, and winter.

Category 3—Project Sites with High or Uncertain Potential for Wildlife Impacts. Projects with high levels of bird and/or bat use or considerable uncertainty regarding bird and bat use or risk will need more study than Category 2 projects to help understand and formulate ways to reduce the number of fatalities. Characteristics of a site that might put a proposed project in Category 3 are:

- Known avian migration stopover destinations such as water bodies within or immediately adjacent to the project
- Special-status species occurring on or adjacent to a proposed site
- High concentrations of wintering and/or breeding raptors
- Sites near or contiguous to wind projects that have experienced high bird or bat fatalities that cannot be avoided or minimized

Pre-permitting studies in excess of one year may be necessary for Category 3 projects when baseline information is lacking and when considerable annual and seasonal variation in bird and bat populations is suspected or when there is potential for declining or vulnerable species to occur at the site.

Category 4—Project Sites Inappropriate for Wind Development. Wind development should not be considered on land protected by local, state, or federal government as: designated wilderness areas, national parks or monuments, state parks, regional parks, and wildlife or nature preserves. Sites for which existing data indicate unacceptable risk of bird or bat fatalities might also be appropriately classified as Category 4, particularly if no feasible avoidance or mitigation measures are available to reduce impacts.

Based on the survey and monitoring work that has been conducted in the Montezuma Hills WRA and discussions with USFWS, Shiloh IV considers the proposed project site a Category 1 site.

1.4 Purpose of the Bird and Bat Conservation Strategy

Shiloh IV has prepared this BBCS to ensure that feasible avoidance and minimization measures are implemented into project design and operation; that the project remains in compliance with federal, state, and local requirements; and that mitigation for impacts that cannot be avoided or minimized be addressed through an appropriate program of compensatory mitigation. Many of the practices that have been adopted by the wind power industry are described in the CEC Guidelines (2007) and are incorporated in this BBCS.

Golden eagles, due to their regulatory status, population trends in some locations, and charismatic public image, have become a species of particular concern in the context of wind projects. Because several facets of golden eagle behavior and biology bring eagles into potential conflict with wind energy production, the ECP address eagles, and this BBCS addresses general avian and bat issues.

1.5 Corporate Policy

Shiloh IV is committed to implementing feasible measures to avoid and minimize avian and bat mortality associated with construction and operation of its wind energy projects. These measures include—but are not limited to—siting considerations; facility layout and turbine design; incorporation of safety features into appurtenant facilities (e.g., transmission lines, meteorological towers); identification of high-risk turbines; compensatory mitigation; and adaptive management measures in response to availability of new scientific data or new technological innovations that may contribute to reduction of mortality.

Chapter 2
Existing Conditions

2.1 Project Area and Vicinity

The project area is in an actively farmed area of Solano County supporting extensive wind farm development. In addition to wind energy, the primary land uses are grazing and dryland farming. The Sacramento and San Joaquin Rivers lie to the south; the Suisun Marsh lies to the west.

The predominant landform is a relatively uniform pattern of treeless hills with crest elevations of 100–272 feet above mean sea level, separated by narrow valleys and drainages. The valleys in the project area transition to sloped hillsides with relatively flat ridgelines. In this portion of the county, the topographic and meteorological conditions consistently produce strong, steady winds.

Dryland farming and livestock grazing are the dominant land uses in the project area. Approximately 3,059 acres (98%) of the project area is in wheat production or preparation for wheat production. Farmers in the Montezuma Hills typically use a 1- to 3-year crop rotation cycle, where grazing and fallow years follow planting and harvesting.

Depending on the crop pattern and their proximity to native habitats, agricultural lands (particularly fallow croplands) can provide relatively high-value foraging habitat for avian wildlife. Raptor species such as red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), barn owl (*Tyto alba*), and great horned owl (*Bubo virginianus*) use agricultural lands for foraging. Ground-feeding granivorous passerines such as savannah sparrow (*Passerculus sandwichensis*), western meadowlark (*Sturnella neglecta*), Brewer's blackbird (*Euphagus cyanocephalus*), and red-winged blackbird (*Agelaius phoeniceus*) also forage in the stubble and disked crop fields. While agricultural practices can make the area attractive foraging habitat, the routine disturbance associated with agricultural practices can also make the area unsuitable for nesting by groundnesting species and for terrestrial species such as California ground squirrel (*Spermophilus beecheyi*) and western burrowing owl (*Athene cunicularia hypugea*). Such species are often extirpated from cultivated areas or only remain in portions that escape cultivation, such as along fences or near wetlands and drainages.

Several groves of eucalyptus and other ornamental trees, encompassing approximately 13 acres, are present in the project area. These groves are typically found around residences or abandoned homesteads and were planted as windbreaks or for landscaping. Eucalyptus and other ornamental trees can provide roosting and nesting habitat for a variety of raptors, including golden eagles, as well as passerines, other birds, and bats.

2.2 Bird and Bat Use

A thorough inventory of diurnal bird abundance and behavior and bird and bat fatalities has been developed for the Montezuma Hills WRA through pre- and postconstruction studies conducted during the past two decades at multiple wind projects (Appendix A). Several raptor nest surveys have been conducted in and around the WRA. Several special-status species were observed during these surveys: Golden eagle (fully protected species), Swainson's hawk (state-listed as threatened), peregrine falcon (*Falco peregrinus*) (fully protected species), American white pelican (*Pelecanus erythrorhynchos*) (California species of special concern [SSP]), northern harrier (*Circus cyaneus*) (SSP), black swift (*Cypseloides niger*) (SSP), loggerhead shrike (*Lanius ludovicianus*) (SSP), and tricolored blackbird (*Agelaius tricolor*) (SSP). The cumulative observations from these surveys and several previous assessments conducted at nearby wind project sites are included in Appendix A.

Incidental observations of prey species for raptors were documented during the course of bird use surveys conducted for the Shiloh III project as well as during monitoring activities associated with other projects in the Montezuma Hills. These observations indicated a relatively sparse prey base—particularly California ground squirrels—in the Montezuma Hills WRA in general, largely as a result of agricultural practices that include routine tilling and cultivation (Kerlinger et al. 2009a:76).

2.2.1 Resident and Migratory Birds

Preconstruction surveys for avian species, conducted in accordance with CEC and DFG guidelines (primarily point counts at scattered and representative locations across the project area) have been conducted for several years in the project vicinity. Surveys conducted for the Shiloh III project between April 26, 2007, and April 25, 2008, included one observation site that overlapped a portion of the Shiloh IV project area. Additionally, Curry & Kerlinger conducted avian use and abundance surveys at four observation points within the proposed project area from January 17 to April 18, 2011 (Kerlinger et al. 2011). Over the last 10 years, several other preconstruction surveys have been conducted at adjacent (and now operating) wind projects (i.e., High Winds, Shiloh I, Shiloh II, and Solano Winds).

2.2.2 Raptor Nesting Surveys

In the Montezuma Hills, dominated by mostly treeless rolling hills, raptor nesting habitat is generally limited to small groups of nonnative eucalyptus trees. Exceptions are nesting habitat for northern harriers and short-eared owls (*Asio flammeus*), which nest on the ground in various grassland and marshland settings where tall grasses and reedbeds provide sufficient cover for their nests. In March 2007, Hunt et al. (2007) conducted a raptor nesting survey of the entire Montezuma Hills WRA (plus a 3-mile radius for all species and a 5-mile radius for golden eagles) using both aerial and ground-based surveys (results also summarized in Kerlinger et al. 2009a). In this 350-square-mile study area, the biologists documented 150 confirmed or likely raptor nests and confirmed 8 species to be breeding. The most common and ubiquitous species were red-tailed hawk, American kestrel, and great horned owl. Five special-status species were documented: golden eagle, Swainson’s hawk, northern harrier, white-tailed kite (*Elanus leucurus*), and short-eared owl. Barn owl was also documented to be nesting. The results of this study indicate species composition and relative abundances similar to those found in previous surveys conducted in the Montezuma Hills WRA since the late 1980s (Howell and DiDonato 1988; Orloff and Flannery 1992; Kerlinger et al. 2006a).

2.2.3 Resident and Migratory Bats

Twenty-seven species of bats are known to occur in California. Local mortality studies have identified four primary bat species in the area, all of which tend to migrate to warmer regions for the winter. Indicated priorities are designations developed by the Western Bat Working Group.

- Hoary bat (*Lasiurus cinereus*) (medium priority).

- Western red bat (*Lasiurus blossevillii*) (California species of special concern; high priority).
- Silver-haired bat (*Lasionycteris noctivagans*)(medium priority).
- Mexican free-tailed bat (*Tadariada brasiliensis*) (low priority).

Although these species are considered migratory, there is evidence to suggest that small numbers of each population remain year-round in the Bay Area, and likely in the Montezuma Hills WRA. All four species forage on flying insects in open airspace, often hundreds or even thousands of feet above ground level. Hoary bats are long-distance migrants, migrating into the Bay Area from a huge area, presumably including much of the northwestern United States and western Canada. Western red bats and Mexican free-tailed bats are regional migrants that breed primarily in the Central Valley of California and overwinter in the Bay Area and along the California coast. Very little is known about the migrations of silver-haired bats, except that this species is associated with forests and presumably migrates from the Sierra Nevada and Klamath mountains south into the Bay Area and along the California coast during winter months.

Three other bat species are likely to occur in the project area, but for demographic or behavioral reasons are not likely to be at high risk of turbine collision

- California myotis (*Myotis californicus*) (low priority).
- Yuma myotis (*Myotis yumanensis*) (low priority).
- Pallid bat (*Antrozous pallidus pacificus*) (California species of special concern; high priority).

Johnston et al. (2010) detected California myotis acoustically while surveying at the Shiloh I wind project. This species is a year-round resident of the Montezuma Hills WRA, although no fatalities have been observed at any of the wind energy sites in the area. California myotis is a relatively sedentary species and is not likely to migrate through the area. It is not expected to be at risk of turbine collision because it typically forages within a few meters of the ground or within 1 meter of the outsides of tree foliage, typically of oaks.

There are no known sizeable bat colonies and no known caves or large structures (e.g., bridges) in the project area that would support such a colony. The Montezuma Hills WRA does provide relatively plentiful small-scale roosting habitat in the form of barns, outbuildings, houses, a mature olive orchard, scattered stands of eucalyptus trees, ornamental trees, and some isolated native trees. Onsite drainages, cattail wetlands, and stock ponds, in addition to the Sacramento River to the south and Suisun Marsh to the west, are within foraging distance.

Of the four bat species that have been detected in postconstruction fatality studies, nearly all turbine-related fatalities have been hoary bats and Mexican free-tailed bats. Few western red bat or silver-haired bat fatalities have been observed at this WRA.

There are no data to indicate that any of the four identified species remain in the Montezuma Hills WRA during the winter, although bat fatalities were found in all other seasons. Mortality data for Montezuma Hills windfarms indicate an autumn period of intensified activity for all bat species recorded, with a decline in winter.

Chapter 3
Assessment of Potential Effects

Operation of wind plants can cause mortality of raptors and other birds through collision with turbine blades, and of bats through collision and barotrauma (sudden changes in air pressure created by blade movement). Extensive studies have been conducted in the Montezuma Hills WRA; data from those studies have been used to develop mortality projections for the Shiloh IV project. These studies were conducted in accordance with protocols set forth in *Studying Wind Energy/Bird Interactions: A Guidance Document—Metrics and Methods for Determining or Monitoring Potential Impacts on Birds at Existing and Proposed Wind Energy Sites* (Anderson et al. 1999) and the CEC Guidelines (California Energy Commission and California Department of Fish and Game 2007).

The National Wind Coordinating Committee, an organization funded by the U.S. Department of Energy's Wind and Water Technologies Program and made up of a collaborative of representatives from utilities, wind developers, environmental organizations, states, federal agencies, and consumer advocacy groups, (among others), published a paper in 2001 that summarized existing mortality studies and compared avian mortality from wind energy with other sources of avian mortality (Erickson et al. 2001). The paper concluded that current levels of mortality caused by wind plants do not appear to be causing significant population impacts on avian species, with the possible exception of golden eagle impacts at the Altamont Pass.

3.1 Mortality Estimates

Fatality data have been collected in the Montezuma Hills WRA since the early 1990s. Howell and Noone (1992) conducted a study to determine mortality rates at the enXco V project. The Wildlife Response and Reporting System, a long-running (more than 12 years), industry-regulated program of reporting and cataloging bird collisions, compiles data of incidentally observed occurrences. Current postconstruction monitoring data are available from five facility reports: a 1-year fatality study at the Solano Wind site (Burleson Consulting 2010), a 1-year study at the Shiloh II site (Kerlinger et al. 2010), a 3-year study at the Shiloh I site (Kerlinger et al. 2009b), a 2-year study at the High Winds site (Kerlinger et al. 2006b), and a 2-year autumn research study at the High Winds and Shiloh 1 project areas (Johnston et al. 2010, final report in preparation). Together, these studies provide multiple years of empirical fatality data collected throughout much of the Montezuma Hills WRA and surrounding the proposed project area.

Raptors constitute the category of birds of greatest concern in the context of wind turbine collision. In contrast, study results have indicated that waterfowl and waterbirds are subject to a low incidence of turbine-related fatalities. For example, 3 years of postconstruction fatality surveys at the nearby Shiloh I project documented only 6 waterfowl and 19 waterbird fatalities involving six species (Kerlinger et al. 2009b:69; also see for example Howell and Noone 1992)

Hoary bats and Mexican free-tailed bats appear to suffer the largest numbers of turbine collisions of any bird or bat species observed at the Montezuma Hills WRA (Appendix A). Although reported numbers of hoary bat fatalities are greater in the upper midwest and the east, hoary bat fatalities in the Pacific Northwest remain a concern (Kunz et al 2007). In contrast to hoary and Mexican free-tailed bat fatalities at the Montezuma Hills WRA, only a few western red and silver-haired bat fatalities have been reported there (Appendix A) and in the nearby Altamont Pass WRA (Smallwood and Thelander 2008).

3.1.1 General Avian and Bat Assessment

In view of the broadly consistent results of bird use surveys conducted for various projects throughout the Montezuma Hills WRA, a mortality estimate for the proposed Shiloh IV project was developed by compiling the postconstruction mortality rates documented at four other facilities in the Montezuma Hills WRA: High Winds, Shiloh I, Shiloh II, and Solano Wind. Because the studies were conducted under varying conditions, timeframes, and protocols, the estimates for the proposed project were developed using a broad analytic brush to encompass the full range of potential analytic variability.

To normalize the data across wind projects based on their size and energy output, this assessment was conducted using adjusted mortality estimates from four studies—2 years of postconstruction fatality monitoring at High Winds, 3 years at Shiloh I, and 1 year each at Shiloh II and Solano Wind. To ensure an objective assessment, the data were calculated in both MW/year and turbines/year. Average rates and weighted average rates were calculated for each metric (MW/year and turbines/year) based on the duration of postconstruction fatality monitoring.

The weighted averages assigned greater statistical importance to studies based on the duration of the study. This approach entailed multiplying the adjusted mortality rates (developed by applying searcher efficiency factors to documented fatalities) by the length of the study (in years). In other words, the High Winds rate was multiplied by 2, the Shiloh I rate was multiplied by 3, and the Shiloh II and Solano Wind rates were multiplied by 1. The sum of these rates was then divided by 7 to reflect each of the included study years. This operation was carried out using adjusted fatalities/MW/year (Table 2) and adjusted fatalities / turbine/year (Table3).

Table 2 shows estimates based on fatalities per MW per year for the four studies. Table 3 shows estimates based on fatalities per turbine per year for the four studies. The four studies' average and weighted average rates are used to estimate annual fatalities for the entire proposed project for both modes of evaluation—i.e., per MW and per turbine (Table 4). The proposed project estimates per MW and per turbine were arrived at by multiplying the four studies' average and weighted average estimated mortality rates by 100 MW (the nameplate capacity of the proposed project) and by 50 turbines (the maximum number of turbines for the proposed project), respectively.

Table 2. Adjusted Mortality Estimates (per MW per year) for Selected Species at Montezuma Hills WRA Wind Projects

Species/Group	High Winds (2-year average)	Shiloh I (3-year average)	Shiloh II (1 year)	Solano Wind (1 year)	Mortality Rate of Four Studies	
					Average	Weighted Average
Overall avian	1.36	6.96	1.51	0.34	2.543	3.737
Selected Raptors						
American kestrel	0.21	0.28	0.03	0.06	0.145	0.199
Red-tailed hawk	0.14	0.07	0.09	0.15	0.113	0.103
Northern harrier	0	0.01	—	—	0.003	0.004
Golden eagle	0.01	0.005	—	—	0.004	0.005
White-tailed kite	0.023	—	—	—	0.006	0.004
Peregrine falcon	—	0.005	—	—	0.001	0.003
Ferruginous hawk	0.01	0.01	—	—	0.005	0.007
Rough-legged hawk	0.01	—	—	—	0.003	0.002
Waterfowl	—	0.02	0.09	—	0.030	0.026
Waterbirds	0.06	0.18	0.22	—	0.110	0.162
Large birds	0.22	0.21	0.70[a]	0.15	0.190[b]	0.306
Medium birds	0.24	1.89	—	0.19	0.840[b]	0.924
Small birds	0.89	4.86	0.81	—	1.640	2.839
Overall bat	2.02	3.92	2.72	1.65	2.580	3.087
Western red bat	0.07	0.06	0.26	0.25	0.160	0.096

Sources: High Winds: Kerlinger et al. 2006b; Shiloh I: Kerlinger et al. 2009b; Shiloh II: Kerlinger et al. 2010; Solano Wind: Burleson Consulting 2010.

[a] Includes medium and large birds.

[b] Medium and large birds were combined in the Shiloh II study and are excluded from this calculation.

Table 3. Adjusted Mortality Estimates (per turbine per year) for Selected Species at Montezuma Hills WRA Wind Projects

Species/Group	High Winds (2-year average)	Shiloh I (3-year average)	Shiloh II (1 year)	Solano Wind (1 year)	Mortality Rate of Four Studies	
					Average	Weighted Average
Overall avian	2.448	10.44	3.02	0.67	4.145	6.316
Selected Raptors						
American kestrel	0.378	0.42	0.06	0.12	0.244	0.337
Red-tailed hawk	0.252	0.105	0.18	0.29	0.208	0.174
Northern harrier	0	0.015	0	0.00	0.004	0.007
Golden eagle	0.018	0.0075	0	0.00	0.006	0.009
White-tailed kite	0.0414	0	0	0.00	0.010	0.007
Peregrine falcon	0	0.0075	0	0.00	0.002	0.004
Ferruginous hawk	0.018	0.015	0	0.00	0.008	0.012
Rough-legged	0.018	0	0	0.00	0.005	0.003

Species/Group	High Winds (2-year average)	Shiloh I (3-year average)	Shiloh II (1 year)	Solano Wind (1 year)	Mortality Rate of Four Studies	
					Average	Weighted Average
hawk						
Waterfowl	0	0.03	0.18	0.00	0.053	0.044
Waterbirds	0.108	0.27	0.44	0.00	0.205	0.267
Large birds	0.396	0.315	1.4[a]	0.29	0.601[b]	0.503
Medium birds	0.432	2.835	0	0.37	0.910[b]	1.561
Small birds	1.602	7.29	1.62	0.00	2.628	4.744
Overall bat	3.636	5.88	5.44	3.24	4.548	5.160
Western red bat	0.126	0.09	0.52	0.49	0.307	0.160

Sources: High Winds: Kerlinger et al. 2006b; Shiloh I: Kerlinger et al. 2009b; Shiloh II: Kerlinger et al. 2010; Solano Wind: Burleson Consulting 2010.

[a] Includes medium and large birds.

[b] Medium and large birds were combined in the Shiloh II study and are excluded from this calculation.

Table 4. Projected Annual Fatalities at the Shiloh IV Wind Project

Species/Group	Total Estimated Fatalities (per MW)[a]		Total Estimated Fatalities (per turbine)[b]	
	Average	Weighted Average	Average	Weighted Average
Overall avian	254.25	373.67	207.23	315.81
Selected Raptors	0.00	0.00	0.00	0.00
American kestrel	14.50	19.95	12.23	16.87
Red-tailed hawk	11.25	10.30	10.34	8.69
Northern harrier	0.25	0.44	0.19	0.37
Golden eagle	0.38	0.54	0.32	0.45
White-tailed kite	0.58	0.43	0.52	0.36
Peregrine falcon	0.13	0.26	0.09	0.22
Ferruginous hawk	0.50	0.71	0.41	0.59
Rough-legged hawk	0.25	0.19	0.23	0.16
Waterfowl	2.75	2.60	2.63	2.18
Waterbirds	11.50	16.24	10.23	13.35
Large birds	19.33	30.60	30.01	25.13
Medium birds	58.00	92.36	45.46	78.05
Small birds	164.00	283.88	131.40	237.20
Overall bat	257.75	308.74	227.45	258.00
Western red bat	16.00	9.60	15.33	7.99

[a] Reflects total estimated annual fatalities for the entire proposed project, based on the average and weighted average mortality rates, respectively, per MW per year observed during all four studies. This estimate is based on estimated mortality rates shown in Table 2 and use of 50 2.0 MW turbines.

[b] Reflects total estimated annual fatalities for the entire proposed project, based on the average and weighted average mortality rates, respectively, per turbine per year observed during all four studies. This estimate is based on estimated mortality rates shown in Table 3 and use of 50 turbines.

Overall observations, unadjusted incidents, and adjusted incidents per MW/year for High Winds, Shiloh I, and Shiloh II for all species and observations for Shiloh III are presented in Appendix A. Examination of these fatality calculations and projections reveals that the bat species most commonly killed by interactions with wind turbines in the Montezuma Hills WRA are hoary bat and Mexican free-tailed bat. Among birds, fatalities are highest for red-winged blackbird, western meadowlark, American kestrel, horned lark, and red-tailed hawk.

The two bats are the species of greatest concern in terms of absolute fatality numbers. Hoary bats are generally solitary bats. They do not breed in California, but males at least can be found year-round, and the species' migratory habits funnel individuals from a broad region into or through the state. Overall, because they are relatively uncommon in the region (Findley and Jones 1964; Cryan 2003; Reid 2006), the relatively high fatality numbers are of concern regardless of whether they are expressed in absolute or relative terms (i.e., in relation to the species' overall abundance in the area). In contrast, the fatality numbers for the abundant and highly gregarious Mexican free-tailed bat (Zeiner et al. 1990; Bat Conservation International 2005), expressed in terms of relative abundance, appear much less significant than the numbers for hoary bats and the two raptor species (American kestrel and red-tailed hawk) with high mortality rates. Similarly, although the absolute fatality numbers are comparable or greater, the fatality rates for songbirds when expressed as a proportion of overall abundance also appear much lower than those for hoary bats and the two raptor species. Therefore, among species for which fatality rates are relatively high in the WRA, the potential for impacts that could affect local abundance is greatest for hoary bat, red-tailed hawk, and American kestrel.

Red-tailed hawks and American kestrels are among the most common and ubiquitous raptor species throughout California and North America (Smallwood and Bird 2002; Preston and Beane 2009), and they are also frequently among the most common raptor casualties at other wind farms (e.g., see Erickson et al. 2001, 2009; ICF International 2011b). Because of their overall abundance, even moderate site-specific fatality rates may not constitute substantial population-level impacts for these species. Nevertheless, recent evidence points to widespread declines of American kestrels across much of North America (Farmer et al. 2008; Bird 2009; Farmer and Smith 2009). Although the reasons for these declines are not yet clearly known and may be diverse (e.g., changes in forest cover, chemical contamination of prey species, West Nile virus, negative interactions with expanding populations of other raptor species, mortality at wind facilities), the geographic breadth of the apparent declines clearly warrants concern for this species.

H. T. Harvey and Associates, during a 2-year study of night-migrating bird and bat movement patterns, reported two Swainson's hawk fatalities—one in August 2009 and the other in September 2010. Because these fatalities were not discovered in connection with postconstruction mortality surveys, they have not been incorporated into mortality estimates in this BBCS.

Chapter 4
Conservation Approach

4.1 Conservation Measures

Shiloh IV has adopted an array of conservation measures as part of its permitting and environmental compliance processes for the proposed project. The EIR prepared for the proposed project specified a number of mitigation measures that would address avian and bat mortality; this BBCS' conservation approach builds on these and other commitments developed through the environmental compliance process. These conservation measures are summarized below by category: Design and Construction, Operations and Monitoring, and Offsite Mitigation. Additional conservation and mitigation measures for eagles can be found in the ECP.

4.1.1 Design and Construction

CM-1: Conduct preconstruction surveys

A qualified biologist will conduct preconstruction surveys of all potential raptor nesting habitat within 0.25 mile of construction areas within 30 days prior to construction. A 500-foot no-disturbance buffer will be created around active raptor nests during the breeding season or until young have fledged.

In addition, biologists will conduct burrowing owl surveys in accordance with guidelines set forth in DFG's *Staff Report on Burrowing Owl Mitigation* (California Department of Fish and Game 1995), which specifies preconstruction surveys and standard measures to avoid or relocate owls as well as guidance for compensatory mitigation for loss of habitat.

Biologists will also conduct preconstruction surveys for sensitive biological resources. Although current agricultural practices likely preclude use by ground-nesting birds, disturbance of such species is prohibited under the MBTA. If any such nests are detected, protective buffers will be established in consultation with USFWS until the nests are no longer active.

CM-2: Site turbines to avoid high-risk landscape features

Shiloh IV will site turbines to avoid features of the landscape known to attract raptors and waterbirds (e.g., water and foraging habitat) to the extent feasible. The distance of the lowest point of the turbine rotor (i.e., the tip of any blade at the 6:00 position) will be no less than 29 meters (95 feet) from the ground surface. This design characteristic addresses the finding that roughly 74% of all bird observations (54% of raptor observations) occurred at heights lower than 30 meters (Kerlinger et al. 2009a).

CM-3: Establish a no-disturbance buffer around potential raptor nesting habitat

If nesting raptors are identified in areas susceptible to disturbance from construction activities, the relevant jurisdictional agencies will be consulted for the specific buffer zone to be maintained for that nest. Factors to be considered include intervening topography, roads, development, type of work, visual screening from the nest, and nearby noise sources). Buffers will not apply to construction-related traffic using existing roads that are not limited to project-specific use (e.g., county roads, highways, farm roads). If no nests are observed during the preconstruction survey but nesting occurs following the start of construction, it will be assumed that the individuals are acclimated to the level of ongoing disturbance.

Using the results of the preconstruction surveys as well as information from previous survey efforts, the project will be designed to maintain a 500-foot setback from groves of mature trees that can provide nesting habitat for raptors, including golden eagles.

Buffer zones of 250 feet will be established around occupied burrowing owl burrows during the breeding season (February 1–August 31); buffer zones of 160 feet will be established during the nonbreeding season. In the event that construction must occur during the burrowing owl nesting season within 250 feet of likely nest burrows, passive relocation of owls and burrow closures will be implemented immediately prior to the beginning of the breeding season (February 1) to encourage owls to relocate more than 250 feet from the work area. A qualified biologist will implement the passive relocation and burrow closures in accordance with guidelines prepared by the California Burrowing Owl Consortium (1993) and through coordination with DFG. In the event that owls cannot be successfully relocated away from the established buffer zones, a qualified biologist will actively monitor the burrowing owls for signs of disturbance related to construction activities. If the burrowing owls exhibit any behavior that could put nesting success at risk, Shiloh IV will immediately cease construction activities within the buffer zone and will contact DFG for further consultation.

CM-4: Retain nest trees

Shiloh IV will retain any trees with active or suspected raptor nests. Any trees (without nests) that cannot be avoided must be replaced with similar native trees of comparable size, unless otherwise requested in writing by the landowner and approved by the County.

CM-5: Incorporate avian-safe practices into design of overhead power lines and other project features

Shiloh IV will incorporate avian-safe design characteristics for any overhead power lines. These include following avian-safe practices as outlined in *Suggested Practices for Avian Protection on Power Lines* (Avian Powerline Interaction Committee 1994, 2006): using insulated jumper wires; covering all exposed terminals at the substation (e.g., pot heads, lightning arresters, transformer bushings) with wildlife boots or other insulating materials; using nonconductive materials on riser poles; spacing energized wires a safe distance apart; installing perch discouragers when appropriate on crossarms; using conductor wire no smaller than 4/0 to ensure visibility; and installing bird flight diverters on all overhead lines to further reduce the risk of avian collisions. In addition, the overhead 230 kV transmission line will be installed in accordance with Avian Power Line Interaction Committee requirements.

Where feasible, permanent meteorological towers will be freestanding to reduce the potential for avian collisions. Where freestanding meteorological towers are not feasible, guy wires will be marked with recommended bird deterrent devices (i.e., daytime visual markers) to prevent diurnally moving species from colliding with them.

CM-6: Incorporate features to discourage increased prey base

Site preparation will entail moving rock piles away from wind turbines; turbine foundations will be designed and constructed to prevent under-burrowing by small mammals.

At the completion of project construction, Shiloh IV will prepare road edges such that agricultural activities can be conducted immediately adjacent to the road surface. This preparation will entail clearing excess gravel and soil from the shoulder, feathering road edges for runoff control, and replacing topsoil to support farming operations to the same grade as the roadway or adjacent drainage channel. In areas where topography precludes this approach, the road edges will be smoothed and compacted. 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.

CM-7: Install appropriate lighting

Turbines and meteorological towers will be lighted only to the extent required for compliance with Federal Aviation Administration requirements. Other project lighting will be focused downward and minimized to limit skyward illumination. This measure will reduce the risk of bats and night-migrating birds being attracted into flight paths that could lead them to collisions with wind turbines.

CM-8: Provide training for construction and project personnel

A qualified biologist will conduct a preconstruction (*tailboard*) education session at the project site prior to construction. Specific information will focus on the distribution, general behavior, and ecology of special-status species that could occur in the project area; the protection afforded to such species by the MBTA, BGEPA, ESA, and CESA; the procedures for reporting contacts with listed and proposed species; and the importance of following all the applicant-proposed measures. The tailboard session will include discussion and overview of the general constraints associated with biological resources in the project area and the timing and processes required for project implementation. Employees will be informed that they are not authorized to handle or otherwise move any special-status species that they may encounter. Employees will participate in the education program prior to engaging in fieldwork. Shiloh IV will maintain appropriate records to ensure that employees have attended the education program prior to working in the project area.

4.1.2 Operations and Monitoring

CM-9: Conduct postconstruction mortality monitoring and bird use surveys

Monitoring Requirements

Qualified biologists will conduct annual bird and bat mortality monitoring surveys to validate the risk assessment and to document actual fatalities associated with wind turbines and other project-related activities and facilities (e.g., meteorological towers, overhead power lines). These studies will be conducted in accordance with standardized guidelines as set forth in the CEC Guidelines (2007) for a minimum of 3 years following the first delivery of power. The biologists will conduct bird use surveys—consistent with protocols observed during the preconstruction use surveys—concurrently with mortality monitoring surveys.

The biologists and Shiloh IV will prepare an annual report documenting the results of each year's monitoring efforts. The report will be submitted to USFWS, DFG, the County, and the Technical Advisory Committee (TAC) within 90 days after the end of each calendar year, unless additional time has been approved by the County. Monitoring data will also be submitted to the Biogeographic Information and Observation System Program in accordance with the CEC Guidelines.

Shiloh IV will report any discovered injured or dead golden eagles for the life of the project.

Monitoring Protocols

Annual postconstruction monitoring will be conducted for 3 years from the initiation of power delivery, with the possibility of extending the monitoring period if results warrant. There are three major field components of the monitoring program.

- Avian use surveys to determine the seasonal and annual variations in relative abundance and species use patterns.
- Carcass surveys to search for the bodies of birds and bats killed by turbines or power transmission structures.
- Carcass detection probability and removal monitoring for bias correction.

Avian Use Surveys

Postconstruction monitoring will include avian use surveys of the project area to estimate relative abundance and relative use of the project area. Information describing the relative abundance of raptor species in the project area is crucial to interpreting the results of carcass surveys and to guide adaptive management of the facility. Observation stations will be established based on topography and turbine configuration and will be stratified to cover all major habitat types and geographies in the project area in accordance with the CEC Guidelines (2007). CEC recommendations for the number of sample sites are flexible, depending on specific location attributes and areas of special concern. The number of stations selected will be based on the number of stations required to adequately sample the habitat types and topographies present in the project area.

Surveys will consist of two 30-minute sessions per day (one in the morning, one in the afternoon) at each observation point once per week for a minimum of 1 year. A qualified observer will survey a 360° viewshed at each location, recording the number of individuals of each species detected out to the maximum distance possible based on visibility at each station and weather conditions on any given day. To avoid nonrepresentative days, observations will not be conducted on days with outlying weather conditions. Observers will make note of any raptor prey species detected from the observation station and any unusual raptor behavior observed. The need to extend avian use surveys beyond the first year will be evaluated in light of the first year of mortality data.

Carcass Surveys

Monitored Turbines

The project will comprise up to 50 turbines, each with a ground to rotor-tip height of approximately 130 meters. The CEC Guidelines recommend that the width of the search area should equal the maximum rotor tip height; in this case, 65.5 meters from the base of the turbines. However, the search area used for the Shiloh I and II projects extended out 105 meters from each turbine's base (Kerlinger et al. 2009b, 2010). Accordingly, to ensure comparability with recent datasets from neighboring projects, the proposed protocol exceeds the CEC Guidelines by adopting the 105-meter-radius search area.

The CEC Guidelines suggest searching 30% of the turbines in most cases. However, more recent practices entail searching at least 50% of turbines. Differences in fatality patterns among individual turbines and seasonal changes in fatality patterns at the same turbine can result from small differences in habitats and topography, changes in micro-scale bird and bat use patterns, and random processes. Accordingly, turbine sampling will use an appropriate design for postconstruction monitoring to ensure meaningful and scientifically valid representation of project-wide conditions. For example, one subset of turbines could be sampled continuously through the 3-year monitoring period as a reference set to account for broad annual variations in bird use. A second subset could be selected randomly and rotated each year to ensure that local variations in mortality rates are captured and that the entire project area is adequately evaluated.

Search Interval

The CEC Guidelines (2007) recommend a minimum 2-week search interval, which was the standard applied during earlier projects in the Montezuma Hills WRA (e.g., Kerlinger et al. 2006b); however, a 7-day search interval has been the standard applied in the Montezuma Hills WRA in more recent assessments (Curry & Kerlinger 2008; Kerlinger et al., 2009b, 2010). Accordingly, the Shiloh IV survey effort will adopt a 7-day search interval.

Searches

A clean sweep survey will be conducted over the entire search area to locate and remove any preexisting bird and bat carcasses the day prior to the start of standardized searches at each turbine. Surveyors will walk circular transects under each turbine to a distance of 105 meters from the base of the turbine. Circular transects will be spaced 5 meters apart from the base of the turbine out to a distance of 35 meters, and spaced 10 meters apart thereafter out to 105 meters, resulting in 14 concentric transects for each turbine. Surveyors will use a belt-transect technique, visually searching the ground for any avian or bat fatalities out to 5 meters on either side. Transect locations may be adjusted to adapt to visibility effects of vegetation height and topography. Searchers will verify the accuracy of their transect spacing through periodic confirmation with a laser rangefinder.

Each turbine will be surveyed on the same day each week, but the order in which turbines are searched on a given day will be scheduled to ensure that each turbine is searched at varying times of day throughout each season to avoid time-of-day biases.

Fatalities

Fatalities comprise partial or intact carcasses and collections of feathers that meet the diagnostic criteria of a fatality. Data will be collected describing the condition and location of the find, and the identity of the nearest structure will be recorded. Locations will be documented using handheld global positioning system (GPS) units. Photographs will be taken of the carcass as it was found and to indicate its location relative to nearby turbines or other structures. All carcass remnants will be collected and placed in plastic ziplock bags and frozen for future use during bias correction surveys, release to USFWS, research use, or donation to the USFWS National Eagle Repository, as appropriate.

Any avian or bat carcasses found onsite incidentally by surveyors or onsite staff will be recorded as incidental finds and handled in the same manner as the regular search carcasses. Injured birds will be reported as fatalities unless they have been successfully rehabilitated and released. All bird deaths will be reported to the Wildlife Response and Reporting System database.

Each time an area is searched, data will be recorded regarding weather conditions; groundcover classification by height and type; turbine functionality; search area access issues; and any incidental observations of birds, bats, and raptor prey species.

Bias Correction Surveys

The number of fatalities detected during the carcass surveys is not equal to the actual number of fatalities at a turbine or project. Carcasses can be missed by surveyors (searcher efficiency) or can be removed from the search area during the interval between deposition and the survey (carcass removal), resulting in a downward bias of the annual estimate. Bias correction monitoring provides estimates of these biases, the level of which can be used to estimate the true total number of turbine-related fatalities that occur each year.

Searcher efficiency may be influenced by vegetation, topography, and searcher-specific variability. In addition to directly biasing the fatality estimate, searcher efficiency can bias the estimation of scavenger removal rates because scavenger removal studies rely on searchers, are influenced by their biases, and exert quasi-experimental influences on estimators.

Scavenger Removal Estimates

Some fatalities cannot be detected because scavengers or other factors remove them. Carcass removal trials will therefore be conducted to determine the rate at which carcasses are removed from the survey area. Accordingly, independent scavenger removal trials will be conducted once per season using 20 birds—10 small birds and 10 medium to large birds—and 20 bats. Carcasses will be placed across the project area at randomly selected bearings and distances from turbines. Each carcass will be marked with green electrical tape on one leg to distinguish it from searcher-efficiency trial birds and bats and actual turbine fatalities. Upon placement in the field, the carcasses will be checked daily for 7 days and every 2 days thereafter for an additional 7 days.

During each check, the carcass will be classified into one of the following categories.

- Intact (whole, unscavenged).
- Scavenged (signs of scavenging present, dismemberment, or feather spot remaining).
- Feather spot (the carcass was scavenged and removed, but more than 10 feathers remained).
- Removed (not enough remains of carcass to be considered a fatality, hereby defined as at least five tail feathers or two primaries within at least 5 meters of each other, or a total of 10 feathers in standardized carcass search).

Searcher Efficiency Estimates

Searcher efficiency trials will be conducted to estimate the proportion of carcasses missed during carcass searches. Searcher efficiency trials will be conducted four times per year, once during each season. Trials will be conducted on dates when carcass surveys are scheduled and searchers will be "blind" to the fact that trials are being conducted.

During each trial, a total of 20 birds—10 small birds and 10 medium to large birds—and 20 bats will be placed in the field. Carcasses will be marked to distinguish them from actual mortalities and placed in the field early in the morning prior to surveyor arrival. Carcasses will be placed at random distances and bearings from turbines. Turbines will be selected such that all major habitat types and topographies are represented. At the end of each trial day, the supervisor will contact the surveyors to determine how many of the placed carcasses were detected. The supervisor will then give the surveyors the locations of any remaining carcasses so they can be immediately retrieved.

Reporting, Collaboration, and Information Sharing

Shiloh IV will prepare an annual report documenting the results of each year's monitoring efforts. The report will be submitted to USFWS, DFG, and the TAC within 90 days after the end of each complete year of monitoring.

Shiloh IV will also report discovered injured or dead golden eagles for the life of the project.

Data Application

Results will be used by Shiloh IV, USFWS, and DFG to determine the effectiveness of mitigation measures, and to determine which, if any, turbines produce disproportionately high levels of mortality. The results will inform the appropriateness of mitigation measures implemented by Shiloh IV for the benefit of future wind energy projects.

4.1.3 Offsite Mitigation

CM-10: Provide offsite compensatory mitigation

Shiloh IV will ensure that offsite mitigation habitat is provided in an amount equal to or greater than the total rotor-swept area of the project (i.e., 84 acres). The mitigation habitat will be acquired through the purchase of conservation credits in an approved mitigation bank, in fee title, or through conservation easement, and will be suitable to support breeding and foraging habitat for raptors, including American kestrels, red-tailed hawks, and golden eagles. Suitable nest trees will be protected; if none are available, they will be planted. Alternatively, the applicant may contribute an in-lieu fee to the Solano Land Trust or other conservation entity approved by Solano County in consultation with DFG and USFWS.

4.2 Adaptive Management Framework

The body of knowledge concerning the interaction of wind energy generation with birds and bats is continually growing. Accordingly, pursuing an adaptive management strategy to adjust to results of monitoring, new technology, and new behavioral information is crucial to ensuring that impacts are minimized to the greatest extent feasible. The first step in the adaptive management process is the validation of the risk assessment that was developed prior to project implementation.

If the actual levels of mortality exceed the estimates developed in the risk assessment, adaptive management measures should be implemented. However, because the precise distribution and implications of such exceedances are impossible to predict, it is not reasonable to tie specific adaptive management measures to specific biological triggers. Rather, this BBCS presents a suite of possible actions from which an appropriate response, in consultation with the wildlife agencies, can be selected to best address the specific conditions on the ground.

4.2.1 Validation of Risk Assessment

Validation of the risk assessment entails measuring the results of the postconstruction avian and bat mortality monitoring surveys against the estimated mortality rates developed in this BBCS. Because of the extensive work that has been done at existing wind projects in the Montezuma Hills WRA, it is anticipated that actual mortality rates will fall within expected parameters. However, if mortality exceeds estimates, additional mitigation may be warranted.

4.2.2 Biological Triggers

Specific biological triggers that would indicate the need for adaptive management actions are listed below.

- Discovery of mortality of birds or bats that substantially exceeds (i.e., greater than 20%) the estimated mortality estimates.
- Discovery of *take* of other species not anticipated.
- Scientific research demonstrating that population-level effects on eagles or other special-status birds or bats are a result of the local project.

4.2.3 Possible Adaptive Management Actions

A variety of potential management actions and other advanced conservation measures and mitigation options may be appropriate if additional mitigation is deemed necessary to address avian and bat mortality. Some of these are discussed below. Some of these techniques are experimental.

Visual Modifications

USFWS recommends testing measures to reduce *motion smear*—the blurring of turbine blades because of their 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. More research is needed to assess the efficacy of such techniques.

Anti-Perching Measures

Anti-perching devices can be installed on poles within 1 mile of project facilities (with landowner permission) to discourage bird use of the area.

Contribution to Research Efforts

Shiloh IV could contribute funding to support research and evaluation of new technologies that could help to reduce turbine-related mortality as well as research to increase the understanding of bird-turbine interactions; similarly, Shiloh IV could deploy experimental technologies (if appropriate innovations become available) at its facilities to test their efficacy in reducing mortality.

Onsite Hazard Reduction

Shiloh IV will work closely with USFWS if mortality rates for a migratory species of concern exceed estimated rates. Additional onsite hazard reduction techniques, including operational adjustments, could be discussed and implemented if such efforts have been demonstrated to be effective avoidance or minimization techniques.

Offsite Hazard Reduction

Shiloh IV could contribute funds to enable utilities to install safety features (e.g., anti-electrocution retrofits, bird diverters on power lines) in other areas where bird mortality is of concern. This is described in more detail in Shiloh IV's ECP.

Contribution to Other Conservation Efforts

Shiloh IV could contribute funding to support the conservation and rehabilitation of birds and bats. This could include direct contributions to organizations such as the U.C. Davis Raptor Center or Bat Conservation International.

The California Raptor Center is affiliated with the UC Davis School of Veterinary Medicine. The Center's programs focus on raptor education, raptor health care and rehabilitation, and raptor research. The Raptor Center receives more than 200 injured or ill raptors annually. About 60% are rehabilitated and returned to the wild. In a typical year, the four raptor species most commonly brought in for care are barn owl (96 admissions in 2006), American kestrel (20 admissions), red-tailed hawk (19 admissions), and Swainson's hawk (15 admissions) (UC Davis School of Veterinary Medicine 2011). The Center relies on donations of time and resources to provide resident raptor care and feeding, underwrite education programs, provide rehabilitation medical supplies and medication, and maintain the Center and facilities.

4.3 Summary

Shiloh IV will adhere to the conservation measures and conservation approach described above. The design and construction measures are expected to help avoid direct effects during construction and long-term operations. Operational monitoring will determine the magnitude of the actual effects on birds and bats. Offsite mitigation will provide unimpaired foraging habitat for bats and birds. The adaptive management program will help to ensure that the project operates within the levels anticipated and will provide a framework for additional management actions should they prove necessary. With implementation of these measures—and particularly the offsite mitigation—mortality of avian and bat species would be avoided, minimized, and mitigated to the extent possible.

Chapter 5
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Appendix A
List of Bird Species Observed in the Montezuma Hills

Appendix A. List of Bird Species Observed in the Montezuma Hills

	High Winds[a]			Shiloh I[b]			Shiloh II[c]			Shiloh III[d]
Species	Observed	Incidents	Adjusted Incidents MW/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed
American coot		3	0.01137		10	0.1	1			12
American crow*	201			34			3			18
American goldfinch*	15			0	1	0.03				148
American kestrel*	748	65	0.25591	340	27	0.28	291	1	0.03	318
American pipit	1,241	7	0.01137	230	9	0.28	262			340
American robin*	7						1			1
American white pelican	67			120			298			117
American wigeon										8
Anna's hummingbird*	2			0						
Ash-throated flycatcher										1
Bank swallow*	1									
Barn owl		5	0.01137		2	0.02				
Barn swallow*	294			78			122			883
Black-crowned night heron					1	0				
Black-headed grosbeak					1	0.03				
Black-necked stilt										8
Black phoebe*	8			1						8
Black rail								2	0.08	
Black swift										3
Black-throated gray warbler					4	0.13				
Brewer's blackbird*	677	7	0.01137		15	0.16	138	2	0.06	2,851
Burrowing owl*	1			2						15
California quail*	1			0						
Canada goose*	72			58			557			98
Cattle egret							10			
Chipping sparrow	73			0						
Chukar					4	0.04				2
Cinnamon teal*	1			0			2			3
Cliff swallow*	346			227			247			324
Common goldeneye							6			
Common moorhen		1	0.00569		1	0.01				
Common raven*	760			203			642			457
Common yellowthroat		3	0.00569							
Cooper's hawk*	1						1			
Dark-eyed junco, slate					1	0.03				126
Double-crested cormorant		2	0.00569							2
Dunlin								1	0.04	
Empidonax species		3	0.00569							
European starling*	128	20	0.03412		6	0.19	925	2	0.08	1,740
Ferruginous hawk	9	2	0.00569	0	2	0.01	19			18
Gadwall							2			
Golden-crowned kinglet					1	0.03				
Golden-crowned sparrow					1	0.03				
Golden eagle*	283	2	0.00569	30	1	0	17			31
Goose sp.					1	0				

Appendix A. Continued

	High Winds[a]			Shiloh I[b]			Shiloh II[c]			Shiloh III[d]
Species	Observed	Incidents	Adjusted Incidents MW/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed
Grasshopper sparrow*	1									
Great blue heron										1
Great egret*	11			8			53			8
Greater yellowlegs							2			4
Great-horned owl	0			4	4	0.02				12
Hammond's flycatcher					1	0.03				
Herring gull										1
Horned lark*	2,729	57	0.09668	398	21	0.66	1,427	3	0.12	1,703
House finch*	88				1	0.03	25			88
House sparrow					1	0.03				
Killdeer*	238			171	4	0.04	254			273
Lark sparrow										2
Lesser goldfinch										40
Lesser scaup										10
Lesser yellowlegs	2			0						
Lincoln's sparrow		3	0.00569		2	0.06				10
Loggerhead shrike*	141			167			93			220
Long-billed curlew	139			0			186	1	0.03	2,121
Macgillivray's warbler					2	0.06				
Mallard*	15			30	5	0.02	521	3	0.09	159
Marsh wren							2			
Merlin	1			1	1	0.01	2			1
Mourning dove*	193	7	0.01137	35	26	0.27	169	3	0.09	786
Northern flicker*	23	7	0.01137	14	2	0.02	17			29
Northern harrier*	171			184	2	0.01	187			83
Northern mockingbird*	36			1	1	0.01	3			11
Northern pintail							2			
Northern shoveler							21			
Nuttall's woodpecker*	3									
Orange-crowned warbler		3	0.00569		1	0.03				
Osprey	0			1						1
Pacific slope flycatcher					3	0.09				
Peacock	4			0						
Peregrine falcon					1	0				1
Prairie falcon	9			11			9			16
Red-shouldered hawk										
Red-tailed hawk*	770	42	0.10237	689	15	0.07		3	0.09	552
Red-winged blackbird*	781	47	0.07962		42	1.32	4,631	5	0.19	2,078
Ring-necked pheasant*	12	3	0.01137	8	8	0.04	5			11
Rock dove*	408	7	0.01137		9	0.09	93	1	0.03	682
Rough-legged hawk	95	2	0.00569							24
Ruby-crowned kinglet		7	0.01137		1	0.03				
Savannah sparrow	15				7	0.22	1,887			998
Say's phoebe	40			13			9			32
Scrub-jay*	95			0						1

Appendix A. Continued

	High Winds[a]			Shiloh I[b]			Shiloh II[c]			Shiloh III[d]
Species	Observed	Incidents	Adjusted Incidents MW/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed
Short-eared owl	1									
Snow goose							60			254
Snowy egret*	10						4			
Song sparrow*	22			0						1
Sora		10	0.01706		1	0.01		1	0.04	
Swainson's hawk	4			27			25			33
Swainson's thrush					1	0.03				
Townsend's warbler		10	0.01706		3	0.09				
Tree swallow*	13	3	0.00569	10	4	0.13	275	1	0.04	146
Tri-colored blackbird*	18				2	0.06				6
Tundra swan							172			
Turkey vulture*	1,789	5	0.01137	854	2	0.01	446			1,199
Unidentified bird		20	0.03412		1	0				
Unidentified blackbird		3	0.00569							
Unidentified duck							194			
Unidentified grebe								1	0.03	
Unidentified gull				1			20			86
Unidentified hawk				1			72			
Unidentified hummingbird							2			1
Unidentified passerine					14	0.44				
Unidentified sparrow					3	0.09	3			100
Unidentified swallow						0.03	223			183
Unidentified warbler		10	0.01706							
Unidentified waterfowl							5			
Varied thrush								1	0.04	1
Violet-green swallow*	51									
Virginia rail		10	0.01706		2	0.02				
Warbling vireo		7	0.01137		3	0.09				
Western flycatcher								1	0.04	
Western gull										1
Western kingbird*	23			0			6			23
Western meadowlark*	1,185	10	0.01706	531	76	0.79	1,315	8	0.24	3,531
Western tanager								1	0.04	
Western wood-pewee		3	0.00569							
Whimbrel	23			0						
White-crowned sparrow*	45			0	2	0.06	1			140
White-tailed kite*	3	7	0.01706	91			24			6
White-throated swift		7	0.01137		2	0.06				
Willet	1									
Wilson's warbler		3	0.00569		7	0.22		1	0	
Yellow-billed magpie	1			0						3
Yellow-breasted chat					1	0.03				
Yellow-rumped warbler	1	7	0.01137	0			3			38
Yellow warbler					4	0.13		1	0.04	
Mixed blackbirds					2	0.06	55,309	1	0.04	18,796

Appendix A. Continued

	High Winds[a]			Shiloh I[b]			Shiloh II[c]			Shiloh III[d]
Species	Observed	Incidents	Adjusted Incidents MW/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed	Incidents	Adjusted Incidents Mw/yr	Observed
Hoary bat		331	0.35259		64	1.9		8	0.68	
Mexican free-tailed bat		256	0.27298		63	1.87		21	1.79	
Silver-haired bat		11	0.01137		3	0.09				
Western red bat		21	0.02275		2	0.06		3	0.26	

Source: Curry & Kerlinger, LLC 2011.

Notes: * indicates that the species may nest in the project area or its vicinity.

Boldface indicates special-status species.

Observed indicates total individuals counted during avian use surveys.

Incidents reflects total unadjusted fatalities during the study period.

Adjusted Incidents/MW/yr includes adjustment factors to account for searcher efficiency variables. The adjustment factors account for apparent disparities in some ratios of incidents to incidents/MW/yr.

[a] High Winds avian use surveys were conducted 8/17/2000–8/16/2001. Postconstruction mortality data were collected 8/2003–7/2005.

[b] Shiloh I avian use surveys were conducted in 2004. Postconstruction mortality data were collected 4/10/2006–4/11/2009.

[c] Shiloh II avian use surveys were conducted 11/12/2005–6/2/2006. Postconstruction mortality data were collected 4/27, 2009–4/24/2010.

[d] Shiloh III avian use surveys were conducted 4/24/2007–4/24/2008.

Appendix C

Bayesian Eagle Risk Analysis for Shiloh IV

Appendix C

Bayesian Eagle Risk Analysis for Shiloh IV

C.1 Background

The Service uses explicit models in a Bayesian statistical inference framework to estimate eagle fatalities at a wind facility while accounting for uncertainty. The analysis presented below follows the Service's Eagle Conservation Plan Guidance version 2 (ECP Guidance, USFWS 2013); a more detailed background on the Service's model and modeling framework are presented in Appendix D of the Technical Appendices of the ECP Guidance.

The basic Service fatality prediction model is based on the assumption that there is a predictable relationship between pre-construction eagle exposure (λ) and subsequent annual fatalities resulting from collisions with wind turbines (F), such that:

$$F = \varepsilon \lambda C$$

Where C is the probability of a collision given a minute of eagle flight within the hazardous area (see Service definition in ECP Guidance Technical Appendices), and ε is the expansion factor, a constant that describes the total area and time within a project footprint that is potentially hazardous to eagles; this is used to expand the estimated fatality rate into the annual number of predicted fatalities. One advantage of using a Bayesian modeling framework is the ability to incorporate known information directly into the model fitting by defining an appropriate prior probability distribution (or simply "prior"). The Service has defined prior distributions for both eagle exposure and collision probability based on the best available data. The exposure prior is updated with the pre-construction (or, in the case of Shiloh IV, pre-repowering construction) eagle use data collected at the site (which will overwhelm any influence of the prior with adequate sampling) and the collision probability will be updated with post-construction fatality if the project becomes operational. The expansion term represents the hazardous area (dependent on turbine number and size).

C.1.1 Shiloh IV

We calculated eagle risk at Shiloh IV under four scenarios. It should be noted that all scenarios assume that the observers detected 100% of eagle flight minutes below 200-m within a 1-mile (1.6 km) radius plot for each count.

- Model Scenario 1 was calculated for all daylight hours
- Model Scenario 2 calculated both the low and high end of the range of operational daylight hours provided by the applicant (note: we assumed zero risk during non-operational daylight hours)
- Model Scenario 3 modeled both a 600-hour (November-December) and a 900-hour (June–July) curtailment scenario for both the low range and the high range of operational daylight hours from Model Scenario 2.
- Pre-repower–modeled the risk of the old pre-repower turbine layout assuming the same eagle use of the site as recorded in 2007 and 2008 except we used all daylight hours because the

operational hours were unlikely to be the same for the smaller old generation turbines and the new repowered turbines given the difference in size.

Note: Although our ECP Guidance (Service 2013) recommends eagle data be collected by point counts with fixed-radius circular plots of 800-m, we made an exception for Shiloh IV. Our model typically assumes eagles are only detectable within an 800-m radius of the observer. In this instance we accepted the assumption that observers could detect eagles out to one mile because, 1) the eagle observational data available for our analysis were collected prior to development of our guidance and assumed an unlimited detectability radius , 2) the availability of post construction data from neighboring wind farms in the Montezuma Hills WRA also supports the assumption of eagle detectability beyond 800 m at this location, 3) the open terrain at Montezuma Hills WRA. The open terrain in conjunction with the potential to readily identify golden eagles beyond 800 m (by combination of plumage, size, shape, flight style, behavior, etc.), makes for an unobscured environment from witch to detect the species and identify it out to one mile under most conditions.

C.1.2 Exposure

The Service defines a prior for eagle exposure (*Gamma* (0.97, 2.76)) based on the exposure rates across a range of sites (USFWS 2012). The prior is then updated with the eagle flight minutes observed and the total area and time covered by observation surveys to get the posterior distribution for exposure that is then used in the fatality model (USFWS 2013). In this case,

$$\boldsymbol{Posterior\ \lambda \sim Gamma(0.97 + 48, 2.76 + 601.11)}, \textbf{ therefore}$$

$$\boldsymbol{Posterior\ \lambda \sim Gamma(48.97\ , 603.87\ ).}$$

Observation surveys recorded 48 eagle minutes over 601.11 hr-km^2 of observations (this is the product of the area and time observed). Note, unless strata are specified, exposure rate is assumed to be uniform across the space and time of the project footprint. In this case the observation data were not collected in such a way that allow for spatial or temporal stratification, therefore the model is assuming the data represent the range of exposure throughout a typical year.

C.1.3 Collision

The Service defines the collision probability as *Beta* (1.19, 176.66) based on information from projects presented in Whitfield (2009).

$$\boldsymbol{Prior\ C \sim Beta(1.2, 176.7)}$$

C.1.4 Expansion

This is the product of the total hazardous area ($A = \pi r^2$, where r is the turbine rotor radius and A is summed across all turbines) and daylight hours.

Note: the daylight hours can be modified to reflect operational daylight hours (daylight hours when turbines are spinning) if supporting data are available. We adjusted operational daylight hours using the method described above to calculate expansion factors for each model run presented in Model Scenario's 1-4.

For Shiloh IV Model Scenario 1, ε is

$$\varepsilon = (50 \times (\pi \times 0.04625^2)) \times 4452.414 = 1496.03$$

The units for ε are hr·km^2.

We modified the daylight hours to reflect the range operational hours considered in the several model scenario's we analyzed.

C.1.5 Estimating fatalities

Site Data for all model scenarios

Input		
Location	**Latitude**	**Longitude**
	38.1174	-121.8044
	Value	**Notes**
Number of Turbines	50	2.0 MW
Turbine Rotor Radius (km)	0.04625	92.5-m diameter
Count Duration (hr)	0.5	30-min counts
Eagle Minutes	48	
Number of Counts	148	
Count Area (km^2)	8.136647	1-mile circular plot*1
	Mean	**SD**
Exposure Prior	0.352	0.357
Exposure Posterior	0.081	0.012

So the fatality estimate is a product of

$$\boldsymbol{Fatalities = Posterior\ \lambda \times Prior\ C \times \varepsilon}$$

Model Scenario 1: All daylight hours

We calculate predicted fatalities using simulation runs that draw from the exposure and collision distributions and insert the drawn values into the model. This results in a distribution of predicted fatalities:

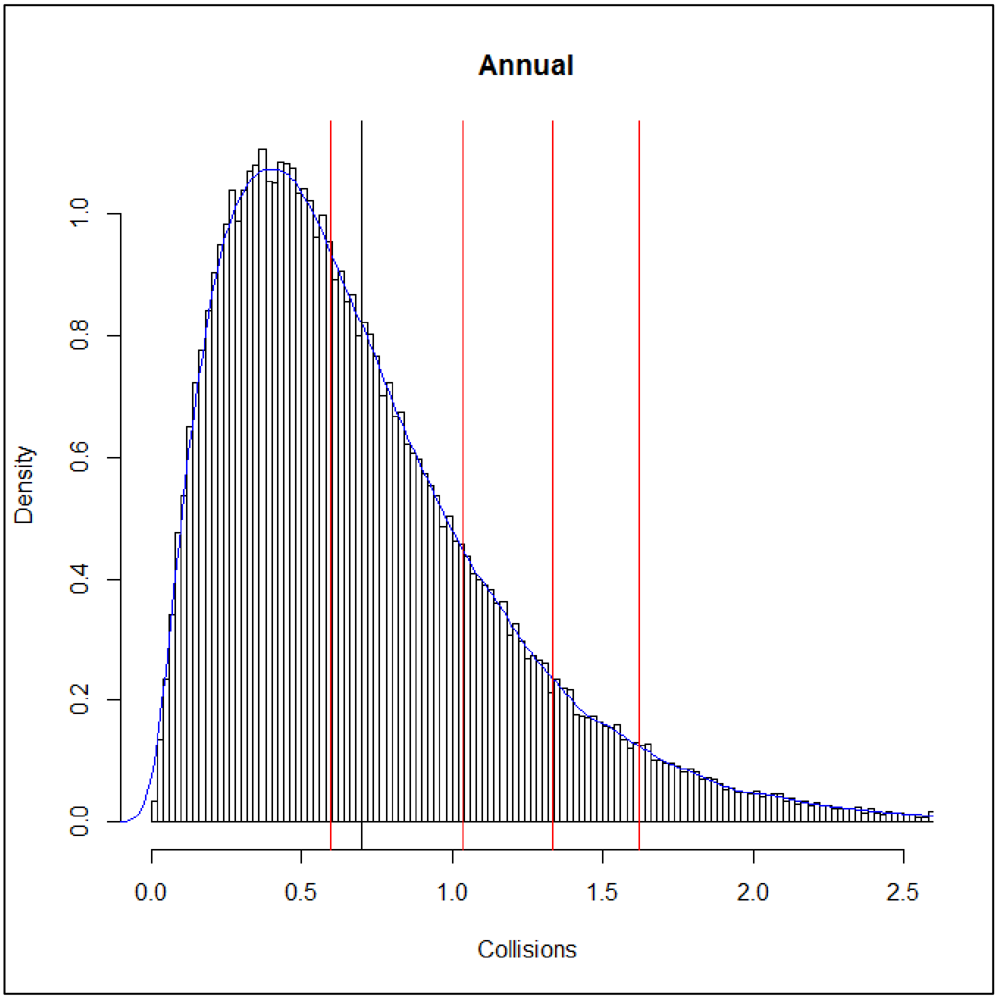

Figure C-1. Annual predicted fatalities for Model Scenario 1, assuming Shiloh IV would be operational during all day light hours. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.7 (indicated by the blue reference line) and a standard deviation of 0.47. Moving from right to left, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates at Shiloh IV.

Table C – 1. Annual Predicted Fatalities for Model Scenario 1

Model Scenario 1: All Daylight Hours						
4452.414 Daylight Hours						
	Mean	SD	CI50	CI80	CI90	CI95
All Daylight Hours	0.7	0.47	0.6	1.04	1.33	1.61

Model Scenario 2: Operational Daylight Hours

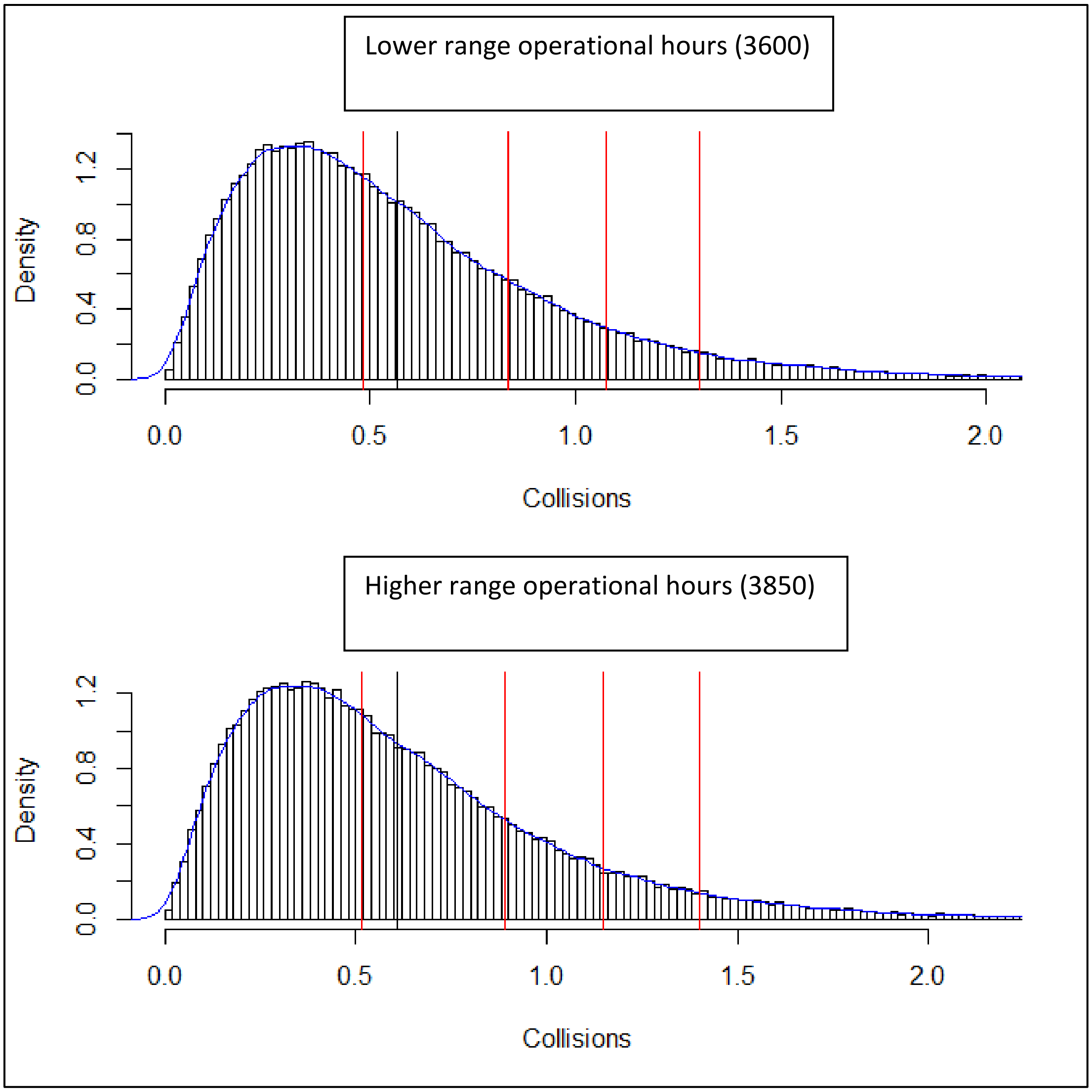

Figure C-2. Calculated predicted range of fatalities for Model Scenario 2. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.7 (indicated by the blue reference line) and a standard deviation of 0.39 (low operational hours) and 0.41 (high operational hours). Moving from right to left, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates at Shiloh IV.

Table C-2. Annual Predicted Fatalities for Model Scenario 2

Model Scenario 2: Operational Daylight Hours.						
Operational Hours	**Mean**	**SD**	**CI50**	**CI80**	**CI90**	**CI95**
Low (3,600 hours)	0.57	0.39	0.48	0.84	**1.08**	1.31
High (3,850 hours)	0.61	0.41	0.52	0.89	**1.16**	1.4

Model Scenario 3: Reduced Operations (curtailment)

To evaluate the potential to reduce annual take predictions using seasonal curtailment (reduced operations), we first examined eagle flight minutes per month using the available observational data. As Figure C-3 indicates, two high use periods were identified, one in mid-summer and another in early winter.

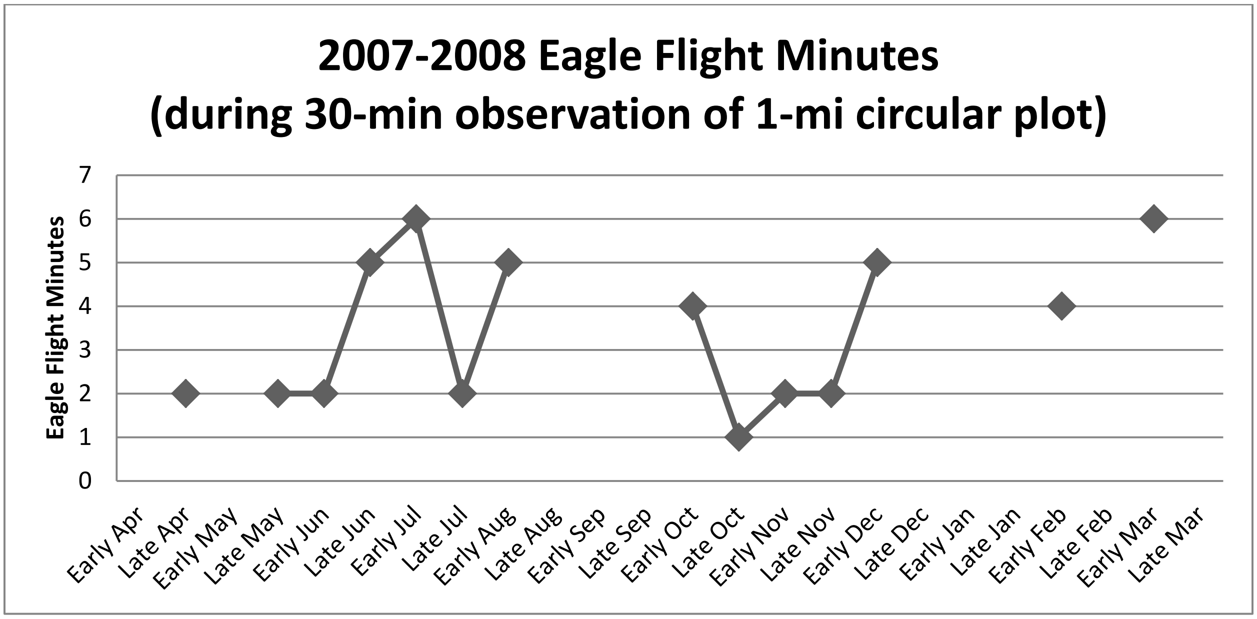

Figure C-3. Golden Eagle flight minutes observed each month at the Shiloh IV Wind Project, LLC, 2007–2008.

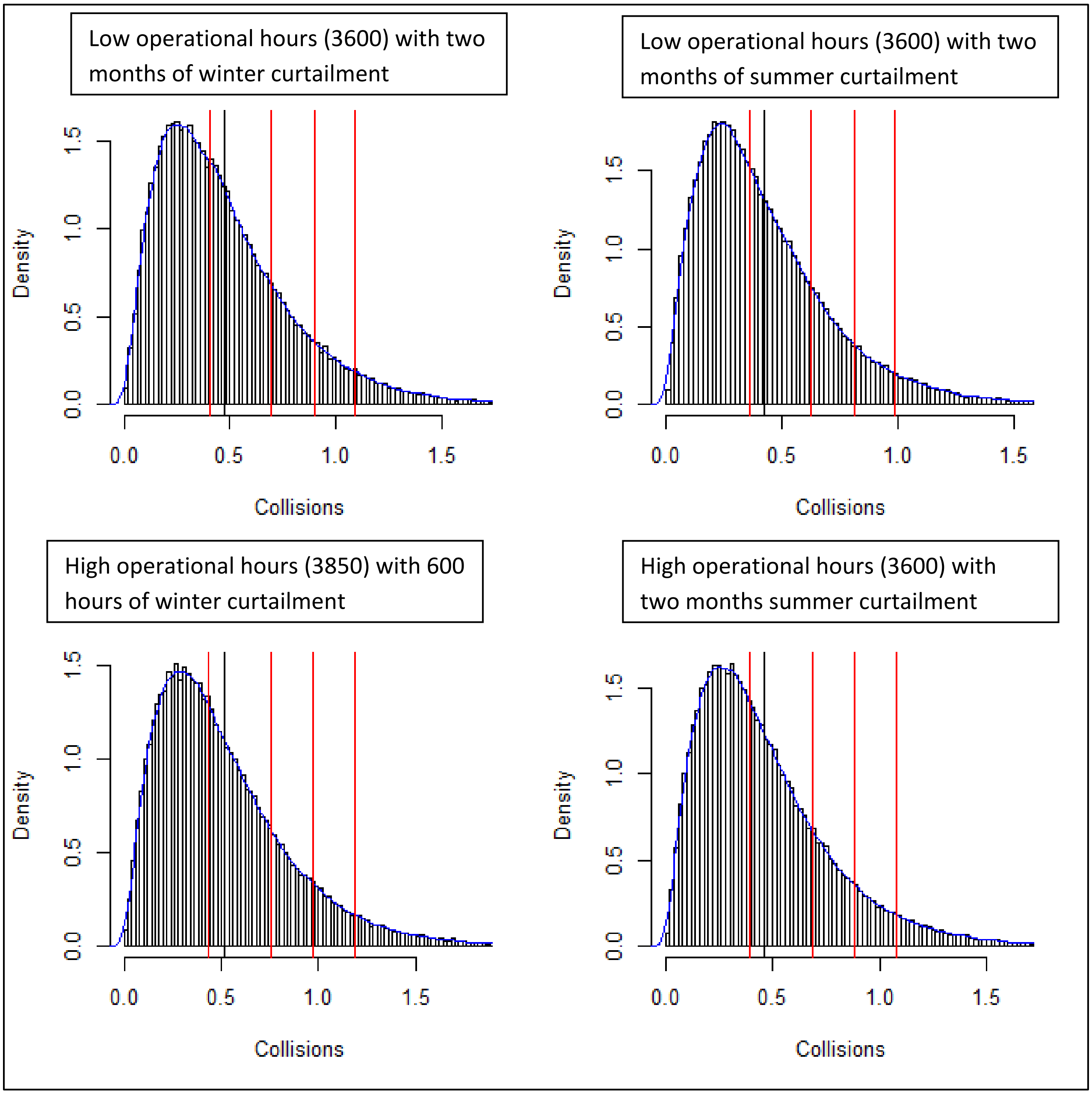

Figure C-4. Calculated predicted range of eagle fatalities for Model Scenario 3. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.7 (indicated by the blue reference line) and a standard deviations for each run is presented in Table C-3). Moving from right to left, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for each model run's annual predicted golden eagle collision rates at Shiloh IV.

Table C-3. Annual predicted eagle fatalities for Model Scenario 3 presenting a range of reduced operations/curtailment options and their associated annual predicted eagle take rates. Each scenario represents approximately two months of curtailment (900 hours in the summer; 600 hours curtailment in the winter). Low and High operational hours reflect the range of operational daylight hours provided by Shiloh IV.

Table C-3. Model Scenario 3: Reduced Operations (curtailment) Range of Options

	daylight operational hours	*Mean*	*SD*	*CI50*	*CI80*	*CI90*	*CI95*
Summer Curtailment							
Low Operational Hrs	2700	0.43	0.29	0.36	0.63	0.81	0.98
High Operational Hrs	2950	0.46	0.31	0.39	0.68	0.88	1.07
Winter Curtailment							
Low Operational Hrs	3000	0.47	0.32	0.4	0.7	0.89	1.09
High Operational Hrs	3250	0.51	0.35	0.44	0.76	0.97	1.18

Model Scenario 4: Pre-Repowering

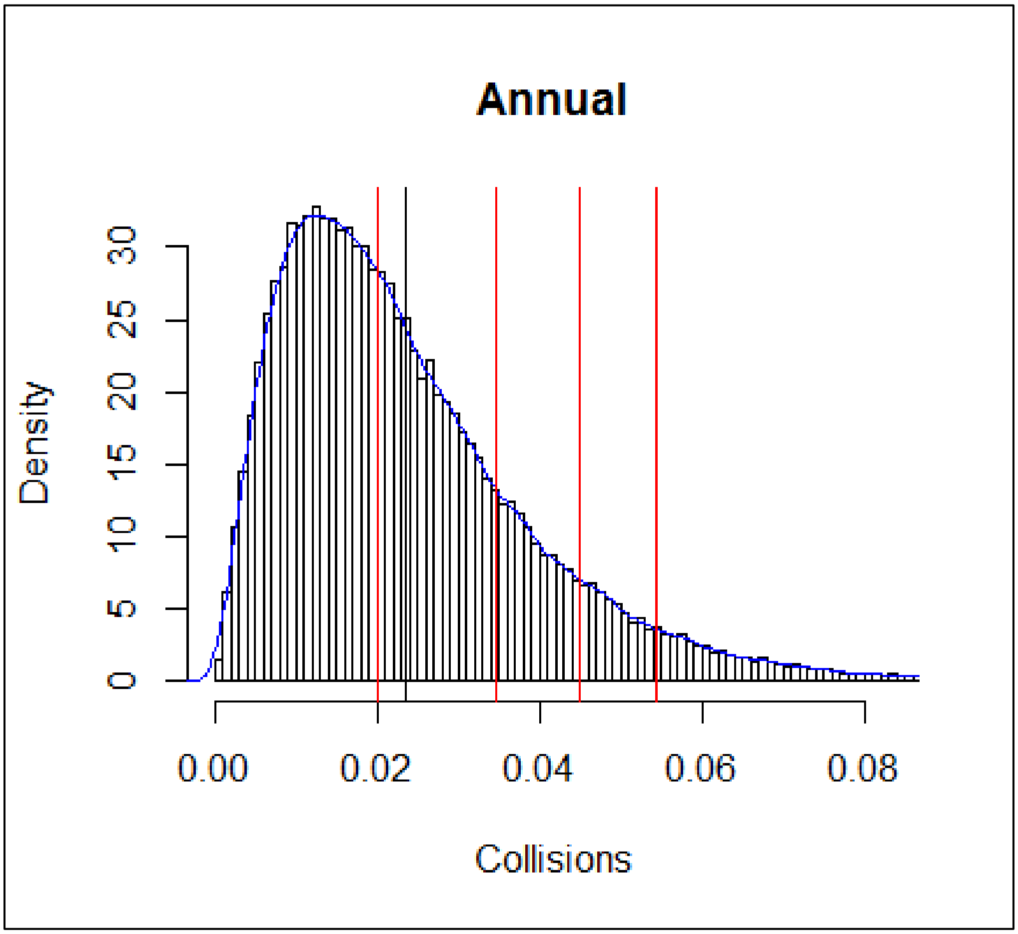

Figure C-5. Calculated annual fatality rates for the portion of the Shiloh IV pre-repower for the 230 old generation turbines that were removed. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.7 (indicated by the blue reference line) and a standard deviation of 0.016. Moving from right to left, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for each model run's annual predicted golden eagle collision rates at Shiloh IV.

Table C-4. Calculated Predicted Fatalities Pre-Repower (For the 230 Old Generation Turbines that qere Removed)

Annual Predicted Fatalities:						
Model Scenario 4 (Pre-Repower Hazardous Area, new collision prior)						
0.011 km2 Hazardous Area (0.0085 km rotor radius)						
	Mean	**SD**	**CI50**	**CI80**	**CI90**	**CI95**
All Daylight Hours	0.024	0.016	0.02	0.035	0.045	0.054

C.2 Discussion

The Service's eagle risk model is meant to describe the relationship between pre-construction eagle use and the fatalities that occur post-construction. In the case of Shiloh IV, the "pre-construction" data is really pre-repowering data rather than true pre-construction data. There were turbines active on site when the eagle use data used in the model were collected. However, given that the surveys do reflect eagle use previous to the action of interest (the repowering of Shiloh IV), it seems reasonable to use the pre-repower use data. However, it would not be appropriate to compare the exposure from this site (or later the update collision probability) to preconstruction data or the collision probabilities from other sites (including adjacent sites) unless true pre-construction use can be extrapolated for Shiloh IV or an equivalent post-construction use can be estimated for the sites to be compared.

The difference in size of the newer and older turbines complicates the relationship between the pre-repowering eagle use data and either true pre-construction use or post-construction use.

- The 230 old smaller turbines had 17 m rotor diameter for a total of **0.011 hazardous km^2**.
- The 50 newer, larger turbines have a rotor diameter of 92.5 m for a total **0.336 hazardous km^2**.

The eagle use data for Shiloh IV were collected during observations of 1-mile radius plots. The Service recommends 800-m plots (USFWS 2012) due to concerns of observer detection rates decreasing over distances of 800-m. In this case, the distance to the observed eagle was not recorded so we were not able to check whether detection rates may have varied with distance. The inherit assumption in using 1-mile radius plots as the 'observed area' in the model as presented is that the observers detected all eagles flying up-to and below 200-m above ground level that entered the observation area within the designated observation time. Given the available data supporting that eagle use and take risk is relatively low in the Montezuma Hills WRA, in this case, we accepted the assumption that eagles were detectable within a to 1-mile radius.

R Code with Data Inputs for Bayesian Eagle Risk Analysis:

```
# Model run with the wind data provided from Shiloh IV
# and then again assuming curtailment for 2 months in the fall

## actual dates for fall curtailment not specified, one scenario:
# Season Days DayLtHr cRange
# Fall 60.00 705.0117 09/02-10/31

# Daylight hours for the 2 months with the most daylight hours Jun+Jul 892.4907
# Daylight hours for the 2 months with the fewest daylight hours Dec+Nov          599.6499
#
# run 2 curtailment options 600 hrs and 900 hr to capture the approximate range of
# 2-month shutdown of all turbines on the site
## Operational hours data from Shiloh IV:
# EDF has data available on the average number of hours turbines can be predicted to operate
# based on the Shiloh IV meteorological tower data. It can be calculated by predicting the
# number of hours in which the mean wind speed is predicted to be >3m/s, which is the
# cut-in speed for the Repower 2.0MW turbines on the site.
# So, for example, between 6am-7pm, the data indicates
# approximately 3,600-3,850 hours of potential operation.
# This is less than the standard model input used
# which is approximately 4,450 hours.
#

## Shiloh IV Collision Model (4 May 2013)
#####
# Source required functions
# source("C:/workspace/projects/Eagles/Eagles_sync/R/DayLen.R")
# source("C:/workspace/projects/Eagles/Eagles_sync/R/FatalFcns.R")
# source("C:/workspace/projects/Eagles/Eagles_sync/R/RVSmry.R")
```

```
##### Use DayLength function to calculate daylight hours

LatLng<-c(38.1174,-121.8044)

## approximated the daylight hours that would be associated
## with a Fall shutdown of turbines, but realized that the data are unclear
## about the best time to apply the curtailment and so it made more sense
## to look at the impact of curtailment hours more generally (see above)

#Season<-c("Rest"="9/1","Fall"="10/31")
#DayLtHr<-DayLen(LatLng[2],LatLng[1],Type=Season,Labels=names(Season))

## We'll run the monthly daylight hour breakdown for reference
DayLtHr_Monthly<-DayLen(LatLng[2],LatLng[1],Type="Monthly",Labels=names(Season))

colnames(DayLtHr_Monthly)[1]<-"Season"

DayLtHr_Monthly$AveDayLen<-with(DayLtHr_Monthly,DayLtHr/Days)

print(DayLtHr_Monthly)

# Now we'll run the annual daylight hours for the model run
## (though note that these will be reduced to reflect operational time)

DayLtHr<-DayLen(LatLng[2],LatLng[1],Type="Annual",Labels=names(Season))

colnames(DayLtHr)[1]<-"Season"
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)
print(DayLtHr)
##### Project Data & Model Inputs
```

```
cProject<-"Shiloh IV" #project ID to associate with model outputs

nTurbine<-c(50) #number of turbines #50 2-MW turbines

HazRadKm<-c(92.5/2/1000) #radius of hazardous area around each turbine
#usually rotor radius (in kilometers)
HzKM2<-sum(nTurbine*pi*HazRadKm^2)

CntHr<-c(30/60) # count duration (in hours)

# Days=c(365.25) # days to extrapolate a strata to (prediction)
# should total 1 year for annual collision fatality estimate

#LtHrPerDay=c(12) # avg daylight hours per day for "Days" (previous line)
#LtHrPerDay=c(DayLtHr$AveDayLen)

## Create the "ExpSvy" data frame
# this includes the Eagle Minutes observed, number of counts conducted,
# and the area observed at each observation point

### Scenario 1, standard run
# ExpSvy<-data.frame(row.names=c("Annual"),
# EMin=c(48),
# nCnt=c(148), # 2 obs pts x 1 per wk x 52 wks = 104 30 min counts
# CntKM2=c(pi*(1.60934)^2), # survey area was 1-mi circular plot
# DayLtHr=c(DayLtHr$DayLtHr)
# )
### Scenario 2, operational daylight hours (daylight hours adjusted by operational time)
# ExpSvy<-data.frame(row.names=c("AnnualMinOp","AnnualMaxOp"),
# EMin=c(48),
# nCnt=c(148), # 2 obs pts x 1 per wk x 52 wks = 104 30 min counts
```

```
# CntKM2=c(pi*(1.60934)^2), # survey area was 1-mi circular plot
# DayLtHr=c(3600,3850)
# )
# ### Scenario 3, curtailment alternative (daylight hours adjusted by operational time
# and reduced by a set number of curtailment hours, 300 or 900 hrs

ExpSvy<-data.frame(row.names=c("600,low OpHrs","900,low OpHrs","600,high
OpHrs","900,high OpHrs"),
 EMin=c(48),
 nCnt=c(148), # 2 obs pts x 1 per wk x 52 wks = 104 30 min counts
 CntKM2=c(pi*(1.60934)^2), # survey area was 1-mi circular plot
 DayLtHr=c(3600-600,3600-900, 3850-600,3850-900)

# ### Scenario 4, Old turbines (pre-repower)
##############################
## Calculation of the hazardous area associated with the old-generation turbines

# nTurbineOld<-c(50)
# HazRadKmOld<-c(17/2/1000)
# HzKM2Old<-sum(nTurbine*pi*HazRadKmOld^2)
# HzKM2<-HzKM2Old
###Kenetech KCS-56 - 100 kW: Rated power: 100 kW, Diameter: 17 m, Rotor speed: 72 U/min
##############################

# ExpSvy<-data.frame(row.names=c("Annual"),
# EMin=c(48),
# nCnt=c(148), # 2 obs pts x 1 per wk x 52 wks = 104 30 min counts
# CntKM2=c(pi*(1.60934)^2), # survey area was 1-mi circular plot
# DayLtHr=c(DayLtHr$DayLtHr)
# )
AddTot<-FALSE #Add strata for total (TRUE) or not (FALSE)
```

Appendix D

Shiloh IV Programmatic Eagle Take Permit Resource Equivalency Analysis Summary

Appendix D.

Shiloh IV Programmatic Eagle Take Permit Resource Equivalency Analysis Summary

D.1 Overview

This appendix provides the Resource Equivalency Analysis (REA) developed by the Service to calculate the compensatory mitigation owed for the annual loss of golden eagles caused by the Shiloh IV Wind Project as analyzed in the EA. Our ECP Guidance (Service 2013) explains that if conservation measures and ACPs do not remove the potential for take, and the projected take exceeds calculated thresholds for the species or management population affected, compensatory mitigation is required to offset predicted take and ensure that permit issuance will result in no-net-loss to eagle populations. This REA results in an estimates of the number of high-risk electric power poles that would need to be retrofitted per eagle taken based on the inputs provided.

The Service's REA is based on a modeling approach used in natural resource damage assessment as a way to ensure that environmental impacts are mitigated. It is a tool used to account for environmental debits and credits with respect to eagle fatalities and mitigation. Additional information on the model can be found in our ECP Guidance (Appendix G. *Examples Using Resource Equivalency Analysis to Estimate Compensatory Mitigation for the Take of Golden and Bald Eagles from Wind Energy Development*) (Service 2013). The REA includes spreadsheets with information on the lifespan of eagles, age of reproduction, number of years females reproduce (i.e., lifespan on reproduction), productivity, age distribution of birds killed, productivity of mitigation (i.e., assumed as 0.0036 eagle electrocutions/pole as estimated by Lehman et al. 2010), and a discount rate (i.e., the rate used in calculating the present value of expected yearly benefits and costs – 3%). This information is used to help calculate direct losses, indirect losses, fledging success, generational impacts, debits, productivity of mitigation, and credits owed. A copy of our REA spreadsheet tool is available on our eagle web page at: http://www.fws.gov/cno/conservation/MigratoryBirds/EaglePermits.html.

However, for use of the REA for Shiloh IV, there was one primary input value that changed over the course of the analysis: annual permitted take estimate. The numbers used for three scenarios were the applicant's take estimate (0.5 eagle per year), the Service's take estimate (0.89 eagle per year), and a curtailment take estimate (0.68 eagle per year). The only other numbers changed in the model inputs are permit year, start year of take, and start year for reproduction; these were assumed to all occur in 2013. Based on these annual fatality estimates, the Service was able to calculate the total debit in bird-years associated with a 5-year permit, the relative productivity of the mitigation (assuming the pole retrofits provide 10 years of benefits to eagles), and the credits owed to ensure there is no net loss to the population (the debit divided by the productivity of the mitigation).

D.1.1 Model Results Assuming 0.5 Eagle/Year

Total Debit: 5-year Permitted Take of Golden Eagle

Start Year of Take:	2013
Debit Present Value Bird-Years	2.93
Year	*Present Value Bird-Years*
2013	2.93
2014	2.85
2015	2.76
2016	2.68
2017	2.60
Total Present Value Bird-Years	**13.83**

**Relative Productivity of Mitigation:
Retrofitting High-Risk Power Poles for Avoided Loss of Golden Eagle**

Year	*Present Value Bird-Years/Pole*
2012	0.021
2013	0.020
2014	0.020
2015	0.019
2016	0.019
2017	0.018
2018	0.018
2019	0.017
2020	0.017
2021	0.016
Total Present Value Bird-Years	**0.185**

**Credit Owed for a 5-Year Permitted Take of Golden Eagle
(assuming 10 years of avoided loss from retrofitted poles)**

Total Debit	13.83	Present Value Bird-Years
÷ Relative Productivity of Lethal Electric Pole Retrofitting	0.19	Avoided loss of PV bird-years/pole
= Credit owed	74.57	Poles to be retrofitted to achieve no net loss of golden eagle

D.1.2 Model Results Assuming 0.89 Eagle/Year

Total Debit: 5-year Permitted Take of Golden Eagle

Start Year of Take:	2013
Debit Present Value Bird-Years	5.22
Year	*Present Value Bird-Years*
2013	5.22
2014	5.07
2015	4.92
2016	4.78
2017	4.64
Total Present Value Bird-Years	**24.61**

Relative Productivity of Mitigation:
Retrofitting High-Risk Power Poles for Avoided Loss of Golden Eagle

Year	*Present Value Bird-Years/Pole*
2012	0.021
2013	0.020
2014	0.020
2015	0.019
2016	0.019
2017	0.018
2018	0.018
2019	0.017
2020	0.017
2021	0.016
Total Present Value Bird-Years	**0.185**

Credit Owed for a 5-Year Permitted Take of Golden Eagle
(assuming 10 years of avoided loss from retrofitted poles)

Total Debit	24.61	Present Value Bird-Years
÷ Relative Productivity of Lethal Electric Pole Retrofitting	0.19	Avoided loss of present value bird-years/pole
= Credit owed	132.73	Poles to be retrofitted to achieve no net loss of golden eagle

D.1.3 Model Results Assuming 0.68 Eagle/Year

Total Debit: 5-year Permitted Take of Golden Eagle

Start Year of Take:	2013
Debit Present Value Bird-Years	3.99
Year	***Present Value Bird-Years***
2013	3.99
2014	3.87
2015	3.76
2016	3.65
2017	3.54
Total Present Value Bird-Years	**18.81**

Relative Productivity of Mitigation:
Retrofitting High-Risk Power Poles for Avoided Loss of Golden Eagle

Year	*Present Value Bird-Years/Pole*
2012	0.021
2013	0.020
2014	0.020
2015	0.019
2016	0.019
2017	0.018
2018	0.018
2019	0.017
2020	0.017
2021	0.016
Total Present Value Bird-Years	**0.185**

Credit Owed for a 5-Year Permitted Take of GOEA
(assuming 10 years of avoided loss from retrofitted poles)

Total Debit	18.81	Present Value Bird-Years
÷ Relative Productivity of Lethal Electric Pole Retrofitting	0.19	Avoided loss of present value bird-years/pole
= Credit owed	101.41	Poles to be retrofitted to achieve no net loss of golden eagle

D.2 Summary

The REA indicates that 75 poles would need to be retrofitted under the applicant's estimate, 133 with the Service's estimate and 101 with the reduced take estimate, assuming a 5-year permit, 10 years of benefit from the electric pole retrofits, and that all mitigation is provided in year 1.