Attachment 3

Final Eagle Conservation Plan for the Shiloh IV Wind Project

FINAL

EAGLE CONSERVATION PLAN FOR THE SHILOH IV WIND PROJECT

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Contents

Tables and Figures

Tables **Page**

Figures **Follows Page**

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draft Guidance	Draft Eagle Conservation Plan Guidance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 EDF Renewable Energy (EDF-RE), an EDF EN Company, has developed the Shiloh IV Wind Project (project) (Figure 1-1), a commercial wind energy facility in Solano County, California, that delivers renewable energy to the Pacific Gas and Electric Company (PG&E)/California Independent System Operator power grid. The project contributes to meeting California's Renewable Portfolio Standard goals and helps 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, was constructed in 2012, and became operational late in 2012.

Issuance of a programmatic eagle take permit by the USFWS is a federal action, and is therefore subject to the National Environmental Policy Act (NEPA). The USFWS prepared a Draft Environmental Assessment (EA) evaluating the effects of issuing an eagle permit, including an alternative to implement the Draft ECP prepared by Shiloh IV. The DEA was noticed in the federal register on September 27, 2013 and the USFWS solicited comments for a 45 day public comment period (subsequently extended due to a shutdown of the federal government). This ECP was updated to be consistent with the USFWS Selected Alternative (Alternative 3) in the Final EA for issuance of the 5-year programmatic eagle take permit. Additionally, this Final ECP also provides updates clarifying that the project is now operational and updates consistent with what are expected to be the permit conditions.

1.1 Corporate Policy

EDF-RE, 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 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 has installed 50 new RePower MM92 wind turbines (Table 1-1) in the approximately 3,513-acre project area (Figure 1-2). The project has an installed capacity of 100 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 were constructed in the project area, or existing roads were improved to accommodate project requirements.

The power generated by the turbines is conveyed to a 230 kilovolt (kV) substation (built on an existing pad) by an electrical power collection system that was installed as part of the project. The system comprises pad-mounted transformers, buried cables, and junction boxes. The pad-mounted transformers are connected to each turbine by buried power cables. Junction boxes—part of the buried cable system—house cable splices and allow access to the cables. The cables are 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, was expanded by 8,000 square feet.

The project required 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 was 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 followed existing elevation contours to the degree possible; moreover, the project was designed to avoid wetlands, low-lying drainage areas, and residences throughout the project area.

The existing 230 turbines that were part of the enXco V wind project have been decommissioned in compliance with the permit for that 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 designated as a WRA by Solano County in its 1987 Wind Turbine Siting Plan because of favorable

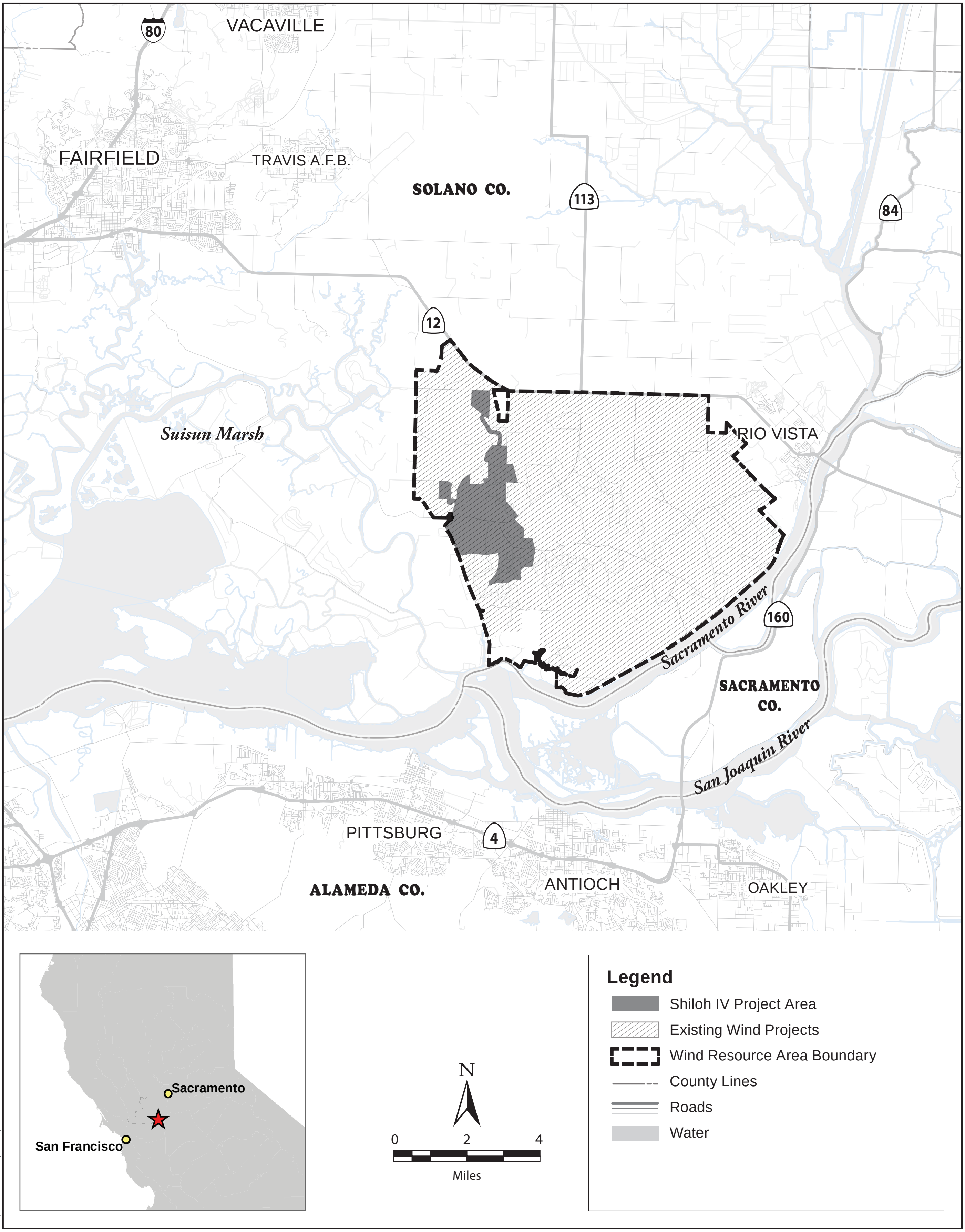

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Figure 1-1
Shiloh IV Project Location

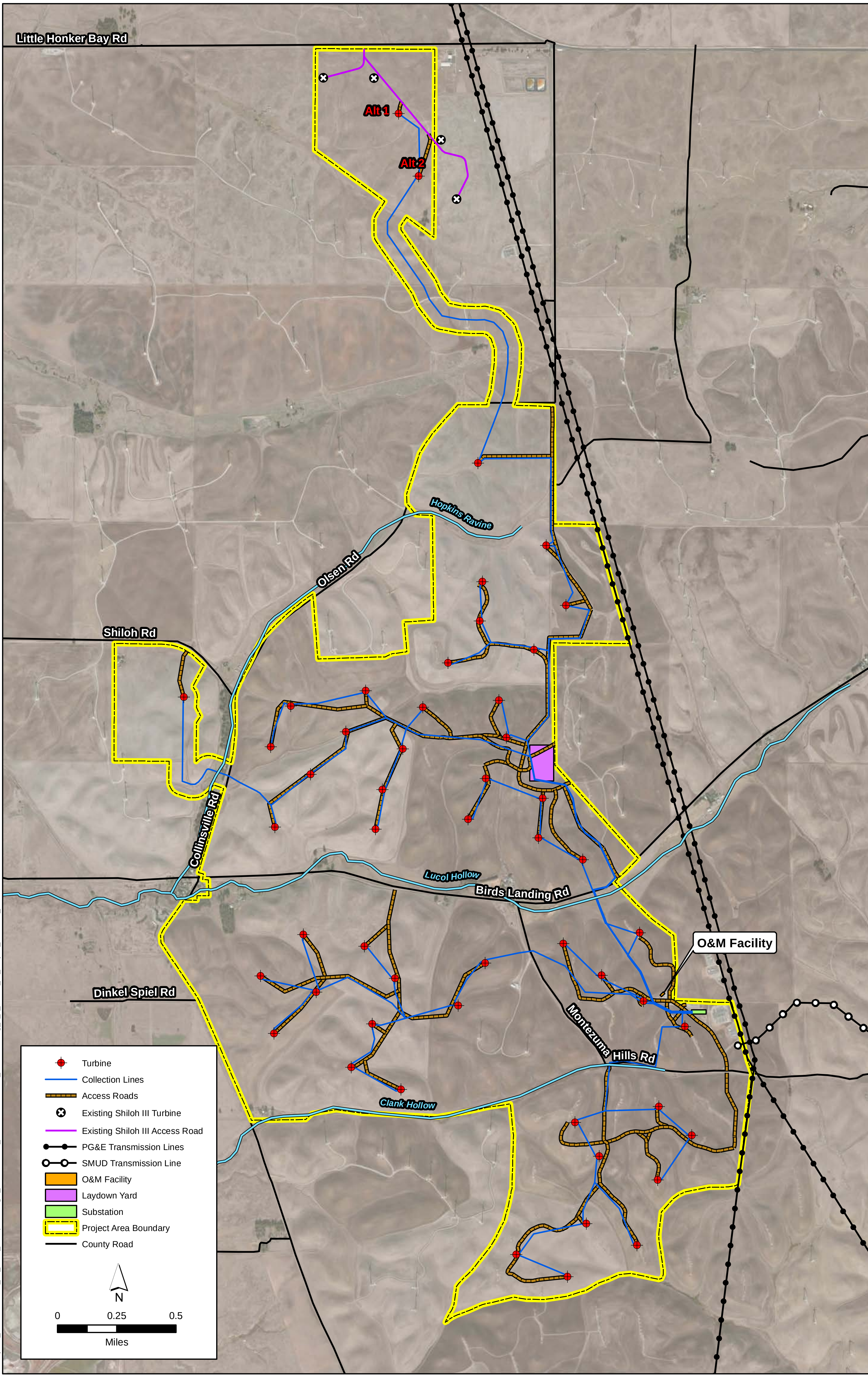

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Figure 1-2
Shiloh IV Wind Project Features

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	Constructed in 2012; in operation
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	Constructed in 2012; in operation
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 are located on parcels which previously contained 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

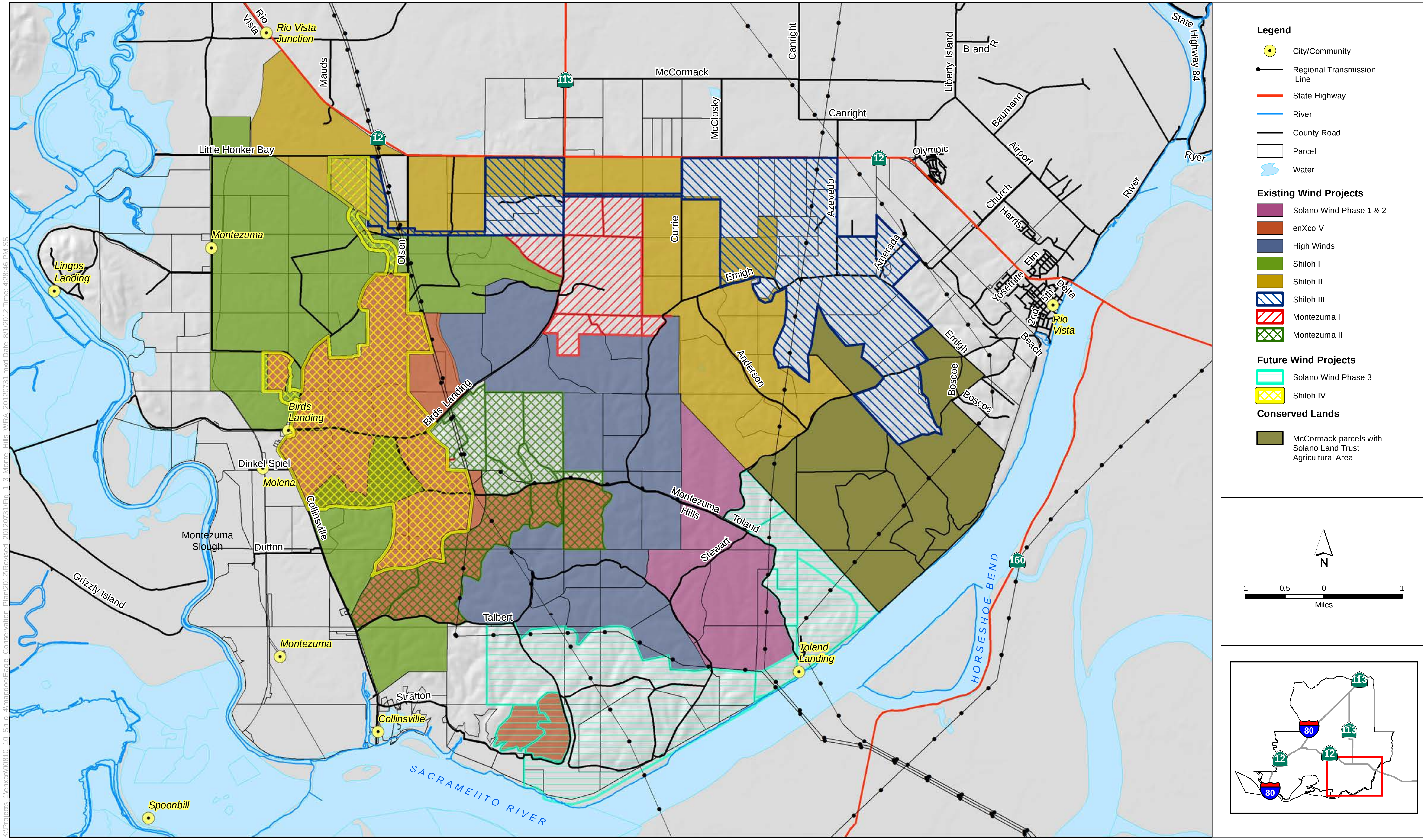


Figure 1-3
Montezuma Hills Wind Resource Area

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. The USFWS also issued revised Eagle Conservation Plan Guidance in 2013.

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 also prepared 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 2012c).

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 now in the operational 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 operational 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.

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

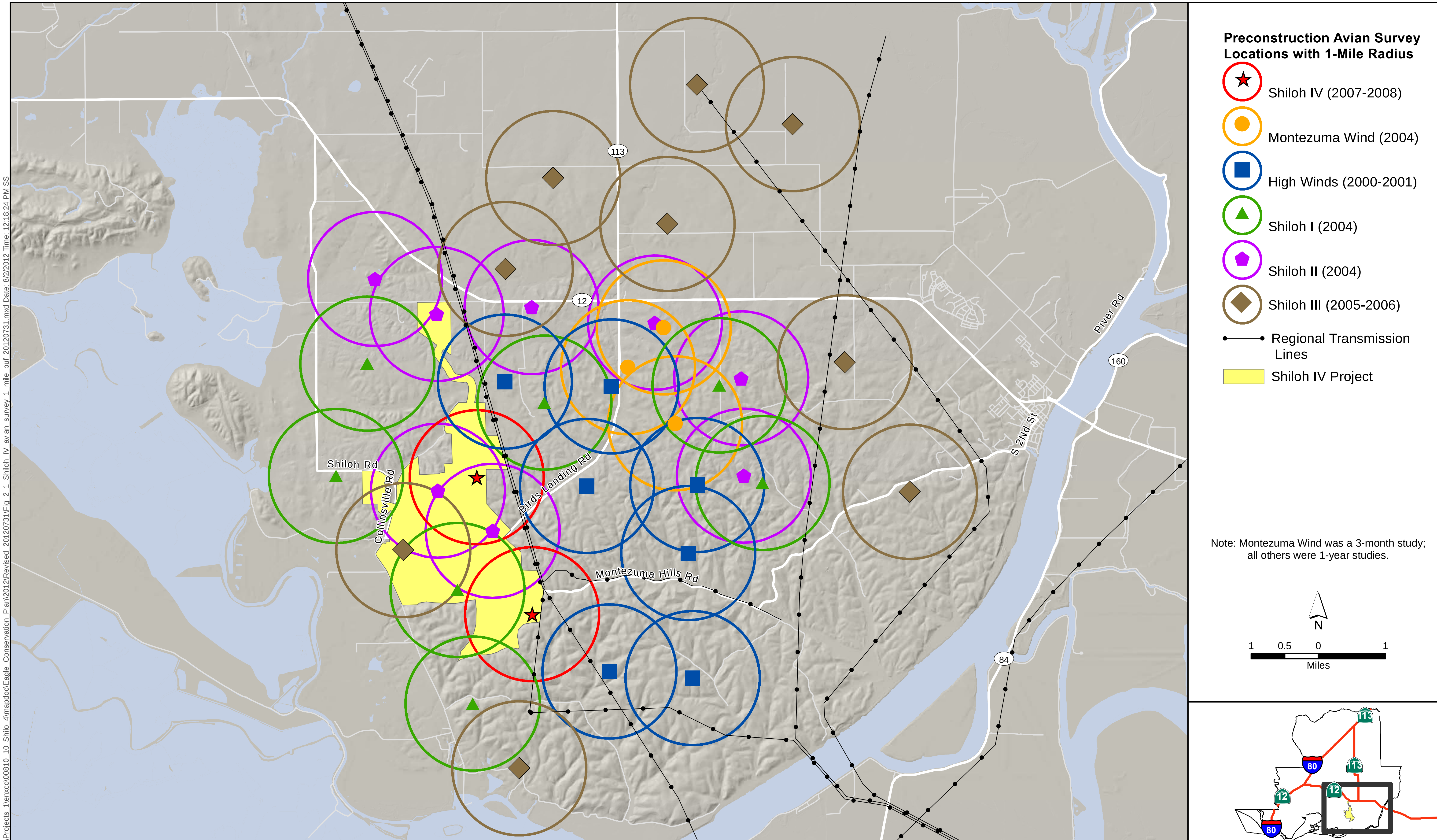
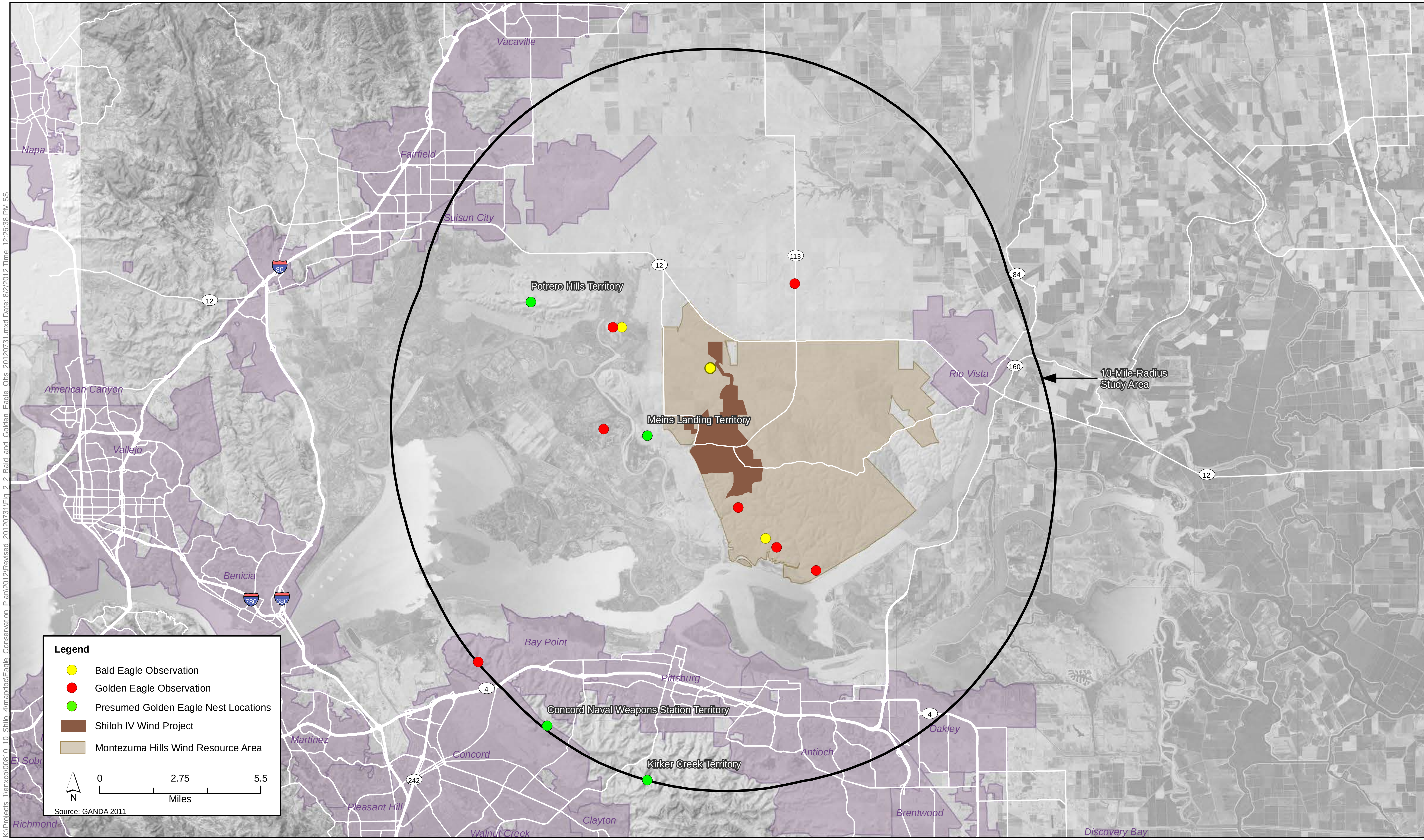


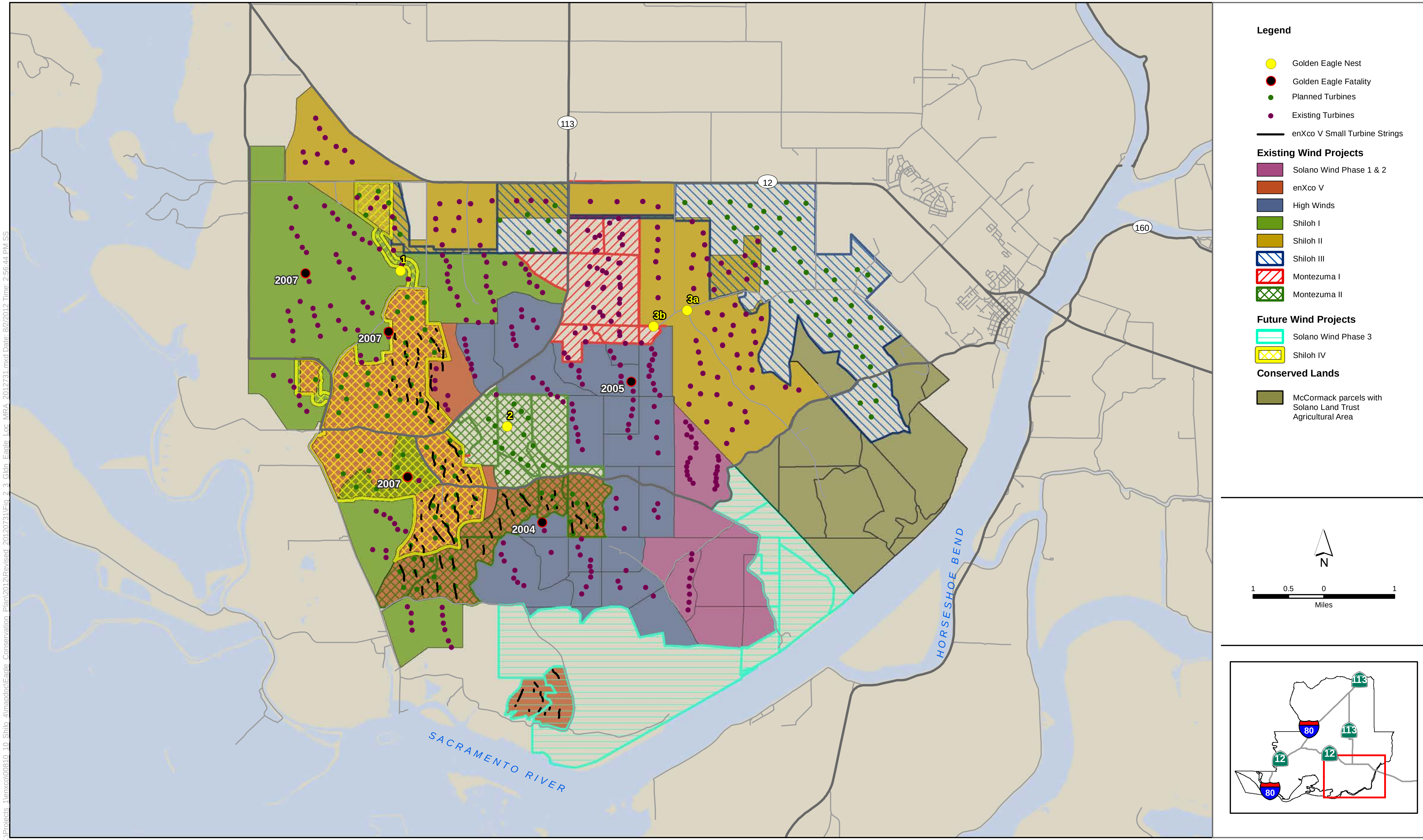
Figure 2-1
Regional Avian Surveys — Montezuma Hills Wind Resource Area



K:\Projects_1\enxco\00810_10 Shilo 4\mapdoc\Eagle_Conservation_Plan\2012\Revised_20120731\Fig_2_2_Bald_and_Golden_Eagle_Obs_20120731.mxd Date: 8/2/2012 Time: 12:26:38 PM SS

ICF INTERNATIONAL

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



ICF INTERNATIONAL

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

To assess the level of risk anticipated by the project we examined actual fatality data from several adjacent operational projects in the Montezuma Hills WRA. Overall, there does not appear to be 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. USFWS also developed a collision rate estimate using their Bayesian model as described in the Draft and Final EA.

Results

The monitoring data indicate that a total of eight golden eagles have been found as of 2012 (five detected during standardized mortality monitoring and three detected incidentally by operations and maintenance personnel at enXco V) between January 2005 and February 2012 in the Montezuma Hills WRA. 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 2012c.

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. USFWS' estimate which is based in part on eagle use of the project area and incorporates uncertainty, was higher at 0.89 eagles per year.

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 a standardized approach to characterize risk and 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. This is further supported by USFWS's risk analysis. Repowering is likely to reduce the risk associated with current conditions and mitigation will help ensure that residual impacts are offset.

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. USFWS conservatively estimated 0.89 eagles per year.

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 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), or 960 eagles identified within BCR 32 by USFWS (U.S. Fish and Wildlife Service 2011), 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. USFWS similarly concluded in the Final EA that there are cumulative impacts on the population.

4.2 Construction-Related Avoidance and Minimization Measures

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

AMM-1: Conduct preconstruction surveys

A qualified biologist conducted 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 sited 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) is higher 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

Shiloh IV committed to establishing a 1-mile no disturbance buffer during construction around active golden eagle nests during the breeding season or until young had fledged. Preconstruction surveys were conducted in March 2012 (see AMM-1) and no nesting eagles were detected in the region.

AMM-4: Retain nest trees

Shiloh IV has committed to the retention of 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.

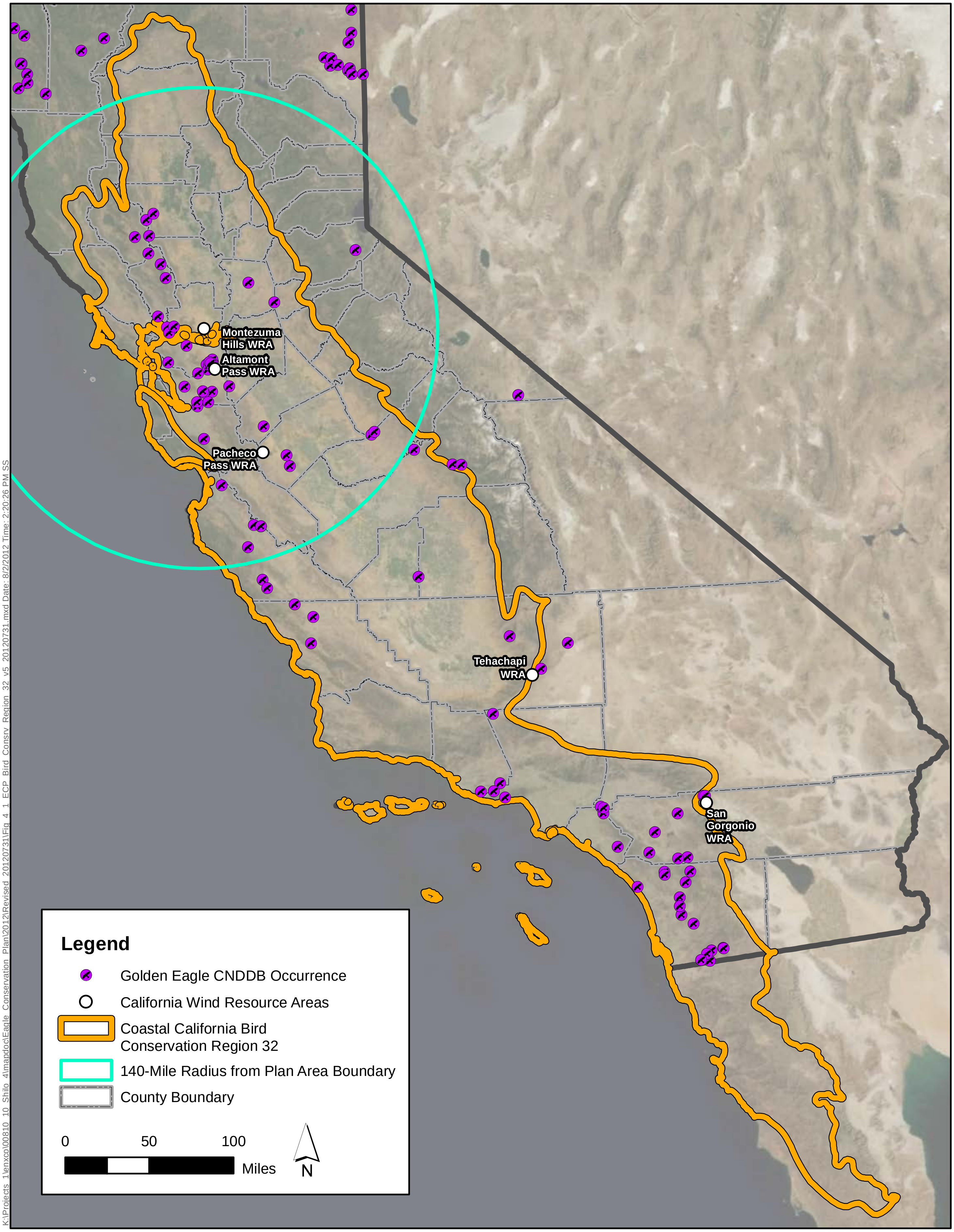


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Figure 4-1
Coastal California Bird conservation Region 32

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

Shiloh IV incorporated avian-safe design characteristics into 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 was installed in accordance with Avian Power Line Interaction Committee (1994, 2006) requirements.

Permanent meteorological towers were constructed to be freestanding to reduce the potential for avian collisions.

AMM-6: Incorporate features to discourage increased prey base

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

At the completion of project construction, Shiloh IV prepared road edges such that agricultural activities can be conducted immediately adjacent to the road surface. This preparation entailed 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 were smoothed and compacted. These measures were 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 conducted a preconstruction (*tailboard*) education session at the project site prior to and during construction. Specific information focused 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 included 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 were informed that they are not authorized to handle or otherwise move any special-status species that they may encounter. Employees participated in the education program prior to engaging in fieldwork. Shiloh IV maintained a training log to ensure that employees attended the education program prior to working in the project area.

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

Shiloh IV is coordinating 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 is requiring that construction, 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.” (50 CFR 22.3)

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 knowledgeable individuals at USFWS to help devise experimental ACPs. 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.

4.3.1 Approach for Developing and Evaluating Eagle ACPs

The process of developing ACPs for wind energy facilities has been hampered by the lack of standardized scientific study of potential ACPs. USFWS 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 experimental ACPs would be scientifically evaluated for their effectiveness, 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.

Despite the current lack of formally approved ACPs, there may be other conservation measures based on the best available scientific information that should be applied as a condition on programmatic eagle take permits for wind-energy facilities. USFWS and the project operator will identify site-specific and possibly turbine-specific factors that may pose risks to eagles, and agree on the experimental ACPs to avoid and minimize those risks. Unless the USFWS determines that there is a reasonable scientific basis to implement the experimental ACPs up front (or it is otherwise advantageous to the developer to do so), USFWS recommends that such measures be deferred until such time as there is eagle take at the facility or USFWS determines that the circumstances and evidence surrounding the take or risk of take suggest the experimental ACPs might be warranted.

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

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

Step	Experimental Advanced Conservation Measures	Threshold or Trigger
Step I	Initiate consultation with the USFWS to illuminate appropriate conservation measures to minimize likelihood of existing take. Mortality monitoring for eagles, using approved protocol for 1-3 years based on USFWS requirements.	One eagle taken.
Step II	Initiate advanced conservation measures involving visual and/or auditory deterrence procedures and consultation with the USFWS 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 up to 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	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 USFWS. Initiate consultation with the USFWS 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 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 USFWS, 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 USFWS 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 USFWS, 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 experimental 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 or survival 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. Nine 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, the USFWS modeled level of estimated eagle take, and subsequent discussions with USFWS staff, the compensatory mitigation required by the USFWS for the project is 133 poles for the 5-year permit term. Shiloh IV will contract directly with PG&E to retrofit 133 poles within one year of permit issuance near Lake San Antonio, Monterey California. Additional pole retrofits, if necessary to offset eagle take in the future, may be completed through the National Fish and Wildlife Foundations' (NFWF's) Bald and Golden Eagle Protection Act account, under a contract with a utility, and/or other mechanisms, if they become available in the future.

The mitigation proposed above is intended to compensate for the unavoidable take of 0.89 eagles per year during the permit term. If the levels of take are less than anticipated, USFWS will apply any excess mitigation to subsequent permit renewals. Similarly, if the levels of take are more than anticipated, Shiloh IV will work with PG&E to identify additional poles that can be retrofitted to offset the impact. These retrofits will be at a location approved by USFWS and will be provided within 1 year of the impact.

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 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 poles. Shiloh IV will retrofit 133 poles to cover the first 5-year permit term, and will make subsequent contributions in future 5-year periods, as described above in Mitigation Measure 1, as necessary, 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 is likely to 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.

Lastly, the USFWS utilizes a Resource Equivalency Analysis (REA) as a tool to estimate the compensatory mitigation for the take of eagles. The REA takes into account the current understanding of eagle life history factors, the effectiveness of retrofitting poles, the expected annual take, and the timing of the implementation of the pole retrofits. The USFWS completed an REA for the Shiloh IV project and determined that 133 pole retrofits would be required to offset the USFWS' predicted take from the project (i.e., the USFWS Bayesian model estimated take), in order to achieve no net loss to the population. Shiloh IV believes that the USFWS' estimate of eagle fatalities under the Bayesian model may be higher than what actually occur and therefore, the REA may actually over-mitigate, if the actual fatalities are less than predicted. In any case, this information further supports the discussion of project-level and population level effects below.

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 experimental 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

Moffat's equilibrium 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 133 poles in year 1, which is the total proposed mitigation for the first 5-year permit term. Consequently, the mitigation action in year 1 could prevent the electrocution of multiple 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). Additionally, the USFWS' REA indicates that 133 poles is sufficient to ensure no-net-loss to the population, assuming the USFWS' estimated rate of fatalities (which itself may be an overestimation). In view of the model results and the REA, ICF concludes that the proposed level of mitigation is sufficient to produce an increase in long-term steady-state abundance. The USFWS REA ensures that the retrofits are sufficient to result in no net loss to the population.

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 eagles in the Montezuma Hills WRA between 2004 and 2012 (ICF 2011a:Appendix B), including several located by operational staff after the intensive monitoring efforts had been completed. 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, as evidenced through previous reports.

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 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. Experimental 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 became operational in December 2012 and began postconstruction monitoring for avian and bat fatalities in March 2013, consistent with the requirements of local land use approvals and requirements issued by Solano County. The monitoring is required for a period of 3 years beginning at the start of commercial operations. The County required monitoring is currently in progress and will be completed in January 2016. The components of this monitoring are described in Section 5.1 below.

5.1 Monitoring (Years 1–3 of Operation)

Qualified biologists are conducting 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 are being conducted in accordance with standardized guidelines as set forth in the CEC Guidelines (2007), and supplemented with additional County requirements, for 3 years following the first delivery of power. The biologists are conducting 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, are being conducted for 3 years from the initiation of commercial operation. 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 includes 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 have been established on the basis of topography and turbine configuration and have been 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 was based on the number necessary to adequately sample the habitat types and topographies present in the project area.

Surveys consist of one 30-minute session per day (one in the morning, one in the afternoon) at each observation point once per week during December, January, February and July, and twice per week for a minimum of 1 year. A qualified observer surveys 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 are not conducted on days with outlying weather conditions. Observers 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 comprises 50 turbines, each with a ground to rotor tip height of 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 other recent monitoring in the Montezuma Hills 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 protocol required by the County 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 uses 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 has adopted a 7-day search interval, which exceeds the CEC Guidelines, and is consistent with the County requirements.

Searches

A clean sweep survey was 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 walk circular transects under each turbine to a distance of 105 meters from the base of the turbine. Circular transects are spaced 5 meters apart from the base of the turbine out to a distance of 30 meters, and spaced 10 meters apart thereafter out to 105 meters, resulting in 14 concentric transects for each turbine. Surveyors use a belt-transect technique, visually searching the ground for any avian or bat fatalities out to 5 meters on either side. Transect locations are adjusted to adapt to visibility effects of vegetation height and topography. Searchers verify the accuracy of their transect spacing through periodic confirmation with a laser rangefinder.

Each turbine is surveyed on the same day each week to the extent feasible, but the order in which turbines are searched on a given day is 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 is collected which describes the condition and location of the find, and the identity of the nearest structure. Locations are documented using handheld global positioning system (GPS) units. Photographs are taken of the carcass as it was found and to indicate its location relative to nearby turbines or other structures. All carcass remnants are collected and placed in plastic ziploc 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 are recorded as incidental finds and handled in the same manner as the regular search carcasses. Injured birds are reported as fatalities unless they have been successfully rehabilitated and released. All bird deaths are reported to the Wildlife Response and Reporting System database.

Each time an area is searched, data is 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 potential 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 are therefore conducted to determine the rate at which carcasses are removed from the survey area. Accordingly, independent scavenger removal trials are conducted once per season using 20 birds—10 small birds and 10 medium to large birds—and 20 bats (native species are used if available). Carcasses are placed across the project area at randomly selected bearings and distances from turbines. Each carcass is 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 are checked daily for 14 days.

During each check, the carcass is 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 (a "feather spot," 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 are conducted to estimate the proportion of carcasses missed during carcass searches. Searcher efficiency trials are conducted four times per year, once during each season. Trials are conducted on dates when carcass surveys are scheduled and searchers are "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 are placed in the field. Carcasses are marked to distinguish them from actual mortalities and placed in the field early in the morning prior to surveyor arrival. Carcasses are placed at random distances and bearings from turbines. Turbines are selected such that all major habitat types and topographies are represented. At the end of each trial day, the supervisor contacts the surveyors to determine how many of the placed carcasses were detected. The supervisor then gives 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 USFWS, DFG, and Solano County 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 Eagle Monitoring (Year 1 after Permit Issuance)

As described above, Shiloh IV is required by Solano County to conduct fatality monitoring for all birds and bats beginning at the start of commercial operations. The programmatic eagle take permit will be issued after the start of this required monitoring, but not before it ends. While County required monitoring entails monitoring 50% of the turbines for all species in a given year, USFWS is requiring monitoring of 100% of the turbines for eagles for at least one year. The USFWS objective is to validate their risk estimate and ensure that eagle takes are detected. The primary parameters determining the accuracy and precision of an estimate of total turbine-related fatalities are as follows:

- The proportion of turbines searched
- The maximum search radius
- The frequency of searches
- Spacing of transects

- Bias correction

Shiloh IV would therefore complete additional monitoring beginning at permit issuance, using a protocol designed specifically to detect eagle fatalities on the remaining 50% of turbines (if the permit is issued prior to completion of the County required monitoring), or on all turbines (if the permit is issued after completion of the County required monitoring). Although this monitoring effort is focused on eagles, if during the course of monitoring EDF's surveyors find other birds, those will be recorded and reported.

5.2.1 Monitored Turbines

All turbines will be monitored for eagle fatalities for 1 year following permit issuance. Turbines selected for eagle monitoring will include any turbines not already monitored as part of the County required monitoring.

5.2.2 Search Radius

The maximum search radius has been a subject of debate for many years. Some researchers are now using an additional "adjustment term" to account for carcasses that land outside the search radius, with the rationale for the cutoff based on a statistical model that fits a regression curve to the proportion of carcasses found in various distance categories related to the size of the turbine. However, a recent study by Hull and Muir (2010) determined the fall zone for various combinations of bird size and turbine height based on Monte-Carlo simulations and ballistics theory. Based on these results, 95% of all large birds at large turbines will fall within a radius of 116.5 meters of the turbine hub. For the majority of turbines in the Montezuma Hills Wind Resource Area, a maximum search radius of 117 meters will result in over 99% of eagle carcasses landing within the maximum search radius. Therefore, a search radius of 120 meters is proposed.

5.2.3 Search Interval

The frequency of searches or search interval is a critical parameter when estimating the total number of avian fatalities, particularly for smaller birds. However, there is abundant evidence suggesting that larger birds, and eagles in particular, are unlikely to be removed by scavengers and remain highly detectable for long periods of time. For example, a study conducted in the Altamont Pass Wind Resource Area in 2010, involving placement of carcasses of various sizes and a double blind search protocol resulted in an estimate of overall detection probability (including both components of detection probability usually referred to as searcher efficiency and scavenger removal rate) for golden eagles of 93% (95% credible interval 83-98) at 30 days and 81% (95% credible interval 62-94) at 60 days (ICF International 2013). In addition, records from the APWRA also indicate that golden eagle carcasses can, in fact, persist for up to 9 years. There are at least 10 examples of eagle carcass parts being discovered that, based upon the location, age, and body parts found, were determined to have been residual parts of an eagle carcass first detected 1, 2, 3, and up to 9 years earlier.

Ten years of research conducted by Curry & Kerlinger in the Montezuma Hills Wind Resource Area strongly suggest that a 30-day interval between searches is a robust means of surveying for large bird carcasses. This is because scavengers are unlikely to remove large bird carcasses completely and carcasses are easily detected. Evidence of an eagle carcass persists beyond 30 days. Further, the size of eagle carcasses makes them relatively easy for searchers to find. Even if a carcass is missed the first month, there is strong evidence that carcasses are detectable many months, perhaps years, after a fatality occurs (Curry, personal communication). This provides the opportunity for a searcher to find carcasses months after an incident. This is further substantiated by other research on detection probabilities in searched and unsearched areas (Huso, 2014).

Finally, because the law requires immediate collection and reporting of all eagle carcasses, carcasses that are found by operations and maintenance personnel are removed from the search area and thus are not available to be detected by search crews of the monitoring team. From the 2005 through 2011 bird years in the Altamont Pass WRA, the proportion of carcasses found by O&M personnel at monitored turbines prior to the monitoring team being able to conduct a search ranged from 8 to 38%, with the average being 22 percent. This is a high number, given that O&M personnel are not specifically conducting searches, and further indicates that detection probabilities for golden eagle carcasses are very high.

Therefore, a search interval of 60 days is highly likely to find all golden eagle fatalities at monitored turbines. The data presented above indicates that O&M personnel can also play a significant role in monitoring eagle fatalities at turbines. Despite the information presented above, the USFWS is requiring a search interval of 30 days for the first year of monitoring. Shiloh IV will implement a 30 day search interval for the first year of monitoring as required by the USFWS. If additional years of monitoring are necessary, the search interval may be increased to 60 days based on evidence of carcass persistence as described above.

5.2.4 Transect Spacing

The proper spacing of transects is directly related to the distance at which a carcass can be detected. The detection distance is a function of several parameters, including topography, vegetation composition and height, and the size of the carcass being searched for. Relative to most other species, the distance between transects can generally be greatly expanded when the objective is detection of eagle carcasses only and topography and vegetation height do not impede visibility. Where topography and vegetation height do result in a condition where visibility is impaired, standard minimum transect spacing must be observed. Transect spacing will be in concentric circles at 20, 60, and 100 m, with searchers searching on 20 m of each side of transects. This spacing will be adequate when vegetation height is 15 cm (6 inches) or less. When vegetation is taller than 6 inches, transect spacing will be reduced so that transects occur every 10, 30, 50, 70, 90, and 110 m from turbine bases, with searchers searching on 10 m of each side of transects. Laser range finders will be used to determine transect locations and maintain spacing.

5.2.5 Bias Correction

Despite its size, there is a low probability that the carcass of an eagle killed at a Shiloh IV turbine may be overlooked by searchers. This might be the case for carcasses in tall vegetation or for those removed by scavengers before searchers have conducted searches. To take these possibilities into account, focused searcher efficiency and carcass persistence trials will be conducted as part of eagle monitoring.

As explained above, transect spacing for searches will depend on vegetation height. In short vegetation (i.e., vegetation height <15 cm), circular transects will be spaced at 20 m, 60 m, and 100 m from turbines, with searchers searching 20 m to each side of transects. In tall vegetation (i.e., vegetation height >15 cm), circular transects will be spaced at 10 m, 30 m, 50 m, 70 m, 90 m, and 110 m from turbines, with searchers searching 10 m to each side of transects.

Given the two vegetation-height/transect-spacing classes, searcher efficiency and carcass persistence will be tested in each using a minimum sample of 10 large bird carcasses (total of 20 carcasses to be placed). Huso et al. (2012) recommended a minimum sample size of 10 carcasses for measuring each factor or factor combination that may affect a mortality estimate.

Turkey Vulture will be the preferred carcass for trials because its large size and weight (66 cm, 1.8 kg; Sibley 2000) most closely approximate those of a Golden Eagle (76 cm, 4.5 kg). Other species to be used in trials will include Red-tailed Hawk (48 cm, 1.1 kg), Great Horned Owl (56 cm, 1.4 kg), and other such large birds for which detectability would be lower than for eagles because their carcasses are more cryptically colored and smaller. Trial carcasses will be marked with black filament tied to a leg so that the marking does not make the carcass more visible, yet it can be determined upon examination that the find is a trial carcass and not a fatality.

A trial will consist of placing a carcass at a predetermined, random distance and bearing from a specific turbine early in the morning before a scheduled search. The project field manager, who will not be one of the searchers, will determine the turbine and placement location using a random number generator. Two trial carcasses will be placed each month, with the placement of trial carcasses terminating when the 10-sample target has been reached in each vegetation-height class. Trial carcasses will be dispersed throughout the wind farm so as not to encourage scavenging, as recommended by Strickland et al. 2011.

Following the methods of Warren-Hicks et al. (2013), trial carcasses will be left in the field for up to 60 days to determine the carcass persistence rate. They will be checked every day for the first week, every three days for the next two weeks, and then every seven days until all carcasses are removed or the end of the trial period is reached.

Trials will be blind (i.e., searchers will not know that they were being tested), and each trial carcass will be used to measure the searcher efficiency and carcass persistance rates. The first morning's search will be the searcher efficiency trial, graded on whether searchers found the carcass or not. At the end of fieldwork that day, searchers will report results to the field manager, who will then check a trial carcass not found to determine whether it was missed or whether a scavenger had removed it before the search commenced. If he cannot find the carcass, then the trial will be excluded from the searcher efficiency rate calculation, but it will be used to calibrate the carcass persistence rate. If searchers missed the carcass, they will have another opportunity to find it if the carcass persists until the next round of searches.

To give an idea of the searcher efficiency and carcass persistence rates likely to result, we report the following. Over 9 field seasons at Shiloh projects in the MHWRA, Curry & Kerlinger has run 71 searcher efficiency/carcass persistence trials with large birds (46 Red-tailed Hawks, 23 Turkey Vultures, and 2 Great Horned Owls), of which 50 were in placed in short vegetation (<15 cm in height) and 21 in tall vegetation (>15 cm in height). Using the Fatality Estimator of Huso et al. (2012) to calculate searcher efficiency and carcass persistence, the searcher efficiency rate in short vegetation was found to be 0.98 (0.94, 1.00), while that in tall vegetation was found to be 0.90 (0.76, 1.00). Carcass persistence in short vegetation was found to be 26.3 (18.8, 47.3) days, while that in tall vegetation was found to be 52.3 (24.5, >100) days, based on 14-day trials. By comparing the new trial findings with the previously found rates for large birds, we will be able to determine the probability that an eagle may have been missed during the eagle fatality surveys.

5.2.6 Reporting

Shiloh IV will prepare a report documenting the results of the eagle fatality monitoring efforts. The report will be submitted to the USFWS within 90 days after the end of monitoring. USFWS will be notified within 24 hours upon positive identification of an eagle injury or fatality.

5.2.7 Summary

Based on the considerations provided above, Shiloh IV will implement an eagle monitoring protocol designed to ensure a high detection of all eagle carcasses. While all birds and bats encountered will be recorded, the focus of eagle monitoring will be on the detection of any eagle carcasses. With this goal, the protocol will entail searches of 100% of turbines at least once every 30 days in a search plot with radius of up to 120 meters. Transect spacing will be a standard of 10-20 meters depending on vegetation height so that 100% of the area will be surveyed. A report will be provided to the USFWS within 90 days after the end of the monitoring period.

Subsequent monitoring protocols, if determined to be necessary as a result of future eagle takes, and if required under the Stepwise Table, may be modified from the one-year protocol described herein, through consultation with the USFWS. Such modifications would be specific to the goals of the monitoring, but may include sampling a subset of turbines, modifications to the search radius and/or search transect spacing, and/or other factors determined to be necessary in the future.

5.3 ACP Effectiveness Monitoring (As Necessary After Permit Issuance)

Under the stepwise approach to implementation of the experimental ACPs, additional monitoring may be required during the permit term(s) 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 County required monitoring, and/or the supplemental eagle specific monitoring, protocols 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 experimental ACPs). The data collected and intensity of monitoring could be varied over time as steps are reached, in consultation with the USFWS, and as necessary to evaluate experimental ACPs.

5.4 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 of incidental finds made by O&M staff will be included in annual monitoring reports.

Chapter 6
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Curry, Richard. Telephone conversation with Brad Norton – Project Director at ICF International. Discussion regarding Curry and Kerlinger's monitoring of persistence rates based on fatality monitoring of Kennetech turbines in the Altamont Pass Wind Resource Area. May 22, 2014.