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Bird and Bat Conservation Strategy for the Palen Solar Electric Generating System

Prepared for

Palen Solar Holdings, LLC

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1.0 INTRODUCTION

The Palen Solar Electric Generating System (PSEGS) consists of two solar power electrical generating facilities with a combined net capacity of 500 megawatts. Each facility includes a central power tower, with associated electrical generating equipment, surrounded by a heliostat array that reflects sunlight to a receiver at the top of the tower. PSEGS is located on approximately 3,794 acres (15.35 square kilometers [km^2]) of federal land and is currently under review by the Bureau of Land Management (BLM) and the California Energy Commission (CEC).

The purpose of this Bird and Bat Conservation Strategy (BBCS) is to:

- Describe the use of the site by avian and bat species prior to project construction, as determined by pre-construction surveys
- Describe the monitoring program that is tailored to identify potential avian impacts associated with the facility
- Develop performance standards to guide a decision making framework
- Describe the formation and roles of a technical advisory committee
- Describe the adaptive management program, including the identification of deterrent methods that may be employed to reduce avian injury and mortality
- Satisfy CEC Condition of Certification BIO-16b.

This BBCS details the on-site and off-site surveys to be conducted and the data analysis and reporting processes that will be implemented by PSH in collaboration with representatives of the US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), CEC, and BLM (collectively, the Technical Advisory Committee or "TAC"; see Section 8.0). The monitoring proposed in this plan complies with CEC Condition of Certification BIO-16b, is adaptive in nature, and will be ultimately guided by the TAC in response to the results of the initial surveys conducted. The TAC may recommend modifications to the BLM Authorized Officer (AO) and CEC Compliance Project Manager (CPM) for the survey protocols and to recommend adaptive management responses, if necessary, based on analysis of the survey data. Although impacts to bats are not expected to result from project construction or operation, all bat mortalities detected ancillary to study objectives will be recorded by field survey personnel and operations staff and reported to the TAC as described in this plan.

PSEGS incorporates practical design, construction, and operational measures to avoid or minimize potential avian impacts, including the mitigation measures identified by the CEC in its Presiding Member's Proposed Decision for the PSEGS (CEC 2013) and by BLM in the Final Supplemental Environmental Impact Statement (BLM 2014) and Right-of-Way (ROW) Grants that will be issued for the facility prior to its construction. Substantial resources have been committed toward the development and implementation of avoidance, minimization, and mitigation actions to benefit the conservation of avian resources, including the development of this plan.

1.1 Strategy Goals

This BBCS has the following goals:

1. **Identify Collision Risks:** Risks will be identified by monitoring and identifying avian mortality and injury associated with facility structure collisions.
2. **Identify Solar Flux Risks:** Risks from flux will be assessed by monitoring and identifying avian mortality and injury associated with solar flux generated by the facility.
3. **Identify Patterns of Avian Use at the Facility:** Patterns of avian use will be assessed by conducting on-site and off-site surveys to document avian species composition on-site and off-site, compare abundance in representative habitats on-site and off-site, and document changes in avian use in these areas over time.
4. **Provide a Framework for Management and Response to Risks:** Provide a management and decision framework, including performance standards, a TAC, and the processes by which potential adaptive management measures will be identified, implemented, and modified.

1.2 Strategy Objectives

As outlined in CEC Condition of Certification BIO-16b, this BBCS has the following specific objectives:

1. Survey and monitor on-site and off-site avian use and behavior to document species composition on- and off-site, compare on-site and off-site rates of avian and bat use, document changes in avian and bat use over time, and evaluate the general behavior of birds in and near the facility.
2. Implement an on-site and off-site (if feasible) avian and bat mortality and injury monitoring program to identify the extent of potential avian or bat mortality or injury from collisions with facility structures or from elevated levels of solar flux that may be encountered within the facility airspace, including:
    a. assessing levels of collision-related mortality and injury with heliostats, perimeter fences and power tower structures;
    b. calculating rates of solar flux-related avian mortality and injury, if any;
    c. documenting seasonal, temporal, and weather-related patterns associated with collision- or solar flux-related mortality and injury, if any;
    d. documenting flight spatial patterns that may be associated with collision- or flux-related mortality and injury, if any; and
    e. documenting spatial patterns that may be associated with avoidance of the facility.

3. Identify specific conservation measures and/or programs to minimize impacts and evaluate the effectiveness of those measures.
4. Implement an adaptive management and decision-making framework for reviewing, characterizing, and responding to quantitative survey and monitoring results. Include performance standards in the decision-making framework to determine the effectiveness of adaptive management and/or deterrent methods.
5. Inclusion of performance standards in the decision-making framework to direct the distribution of the mitigation funds required by CEC Condition of Certification BIO-16a towards programs that benefit the types of avian species being impacted. *[Proposed by applicant/owner to be included in CEC Condition BIO-16b as of the date of this draft.]*

1.3 Project Background and Facility Description

Palen Solar Holdings, LLC (PSH) proposes to construct, operate, maintain, and decommission an approximately 500-megawatt (MW) solar energy generating facility, the PSEGS, in Riverside County, California (Figure 1). The technology utilized for PSEGS will be BrightSource Energy, Inc.'s thermal power tower technology, wherein heliostats reflect solar energy onto a steam generator at the top of the tower. The Palen Solar Power Project (PSPP), a solar trough facility originally targeted for the PSEGS site, was licensed by the CEC in 2010 (CEC 2010a; Figure 2). Two alternatives were approved: Alternatives 2 and 3. The footprints were slightly different, with Alternative 3 fully developed on BLM land and Alternative 2 allowing development on both BLM land and certain private parcels. A Record of Decision (ROD) was never issued by the BLM, and the PSPP was never constructed. PSH took ownership of the PSPP in June 2012. PSH filed an Amendment Petition to CEC for the proposed PSEGS in December 2012 (PSH 2012). PSH submitted a Plan of Development, Revision 2 (POD), to the BLM in support of an application for a ROW Grant on February 8, 2013. BLM is conducting a concurrent process to issue a ROD to PSH for approximately 5,200 acres (21.04 km^2) of public lands.

The PSEGS will have a nominal output of 500 MW and will consist of two adjacent and independent solar plants of approximately 250 MW each (Figure 2). While both solar plants will share common facilities, each will have a dedicated tower, solar field/heliostat array, and a dedicated non-reheat Rankine-cycle steam turbine generator/power block. The total solar power tower structure height is approximately 750 feet (ft; 227 meters [m]), including the solar receiver steam generator (SRSG) located in the top 130 ft (40 m). The final site layout will be completed during detailed design but is expected to consist of approximately 85,000 heliostats in each solar field.

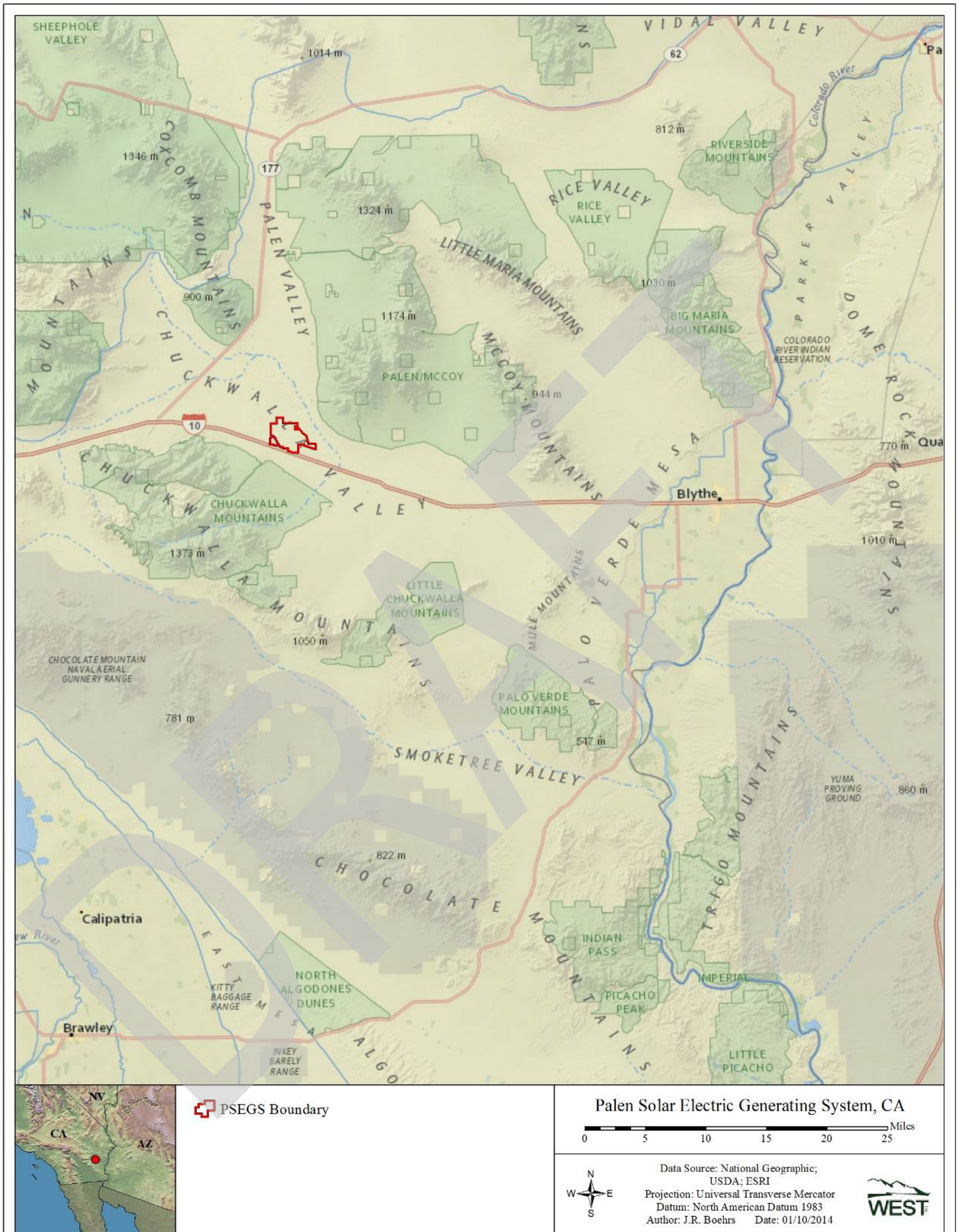

Figure 1. Location of the Palen Solar Electric Generating System.

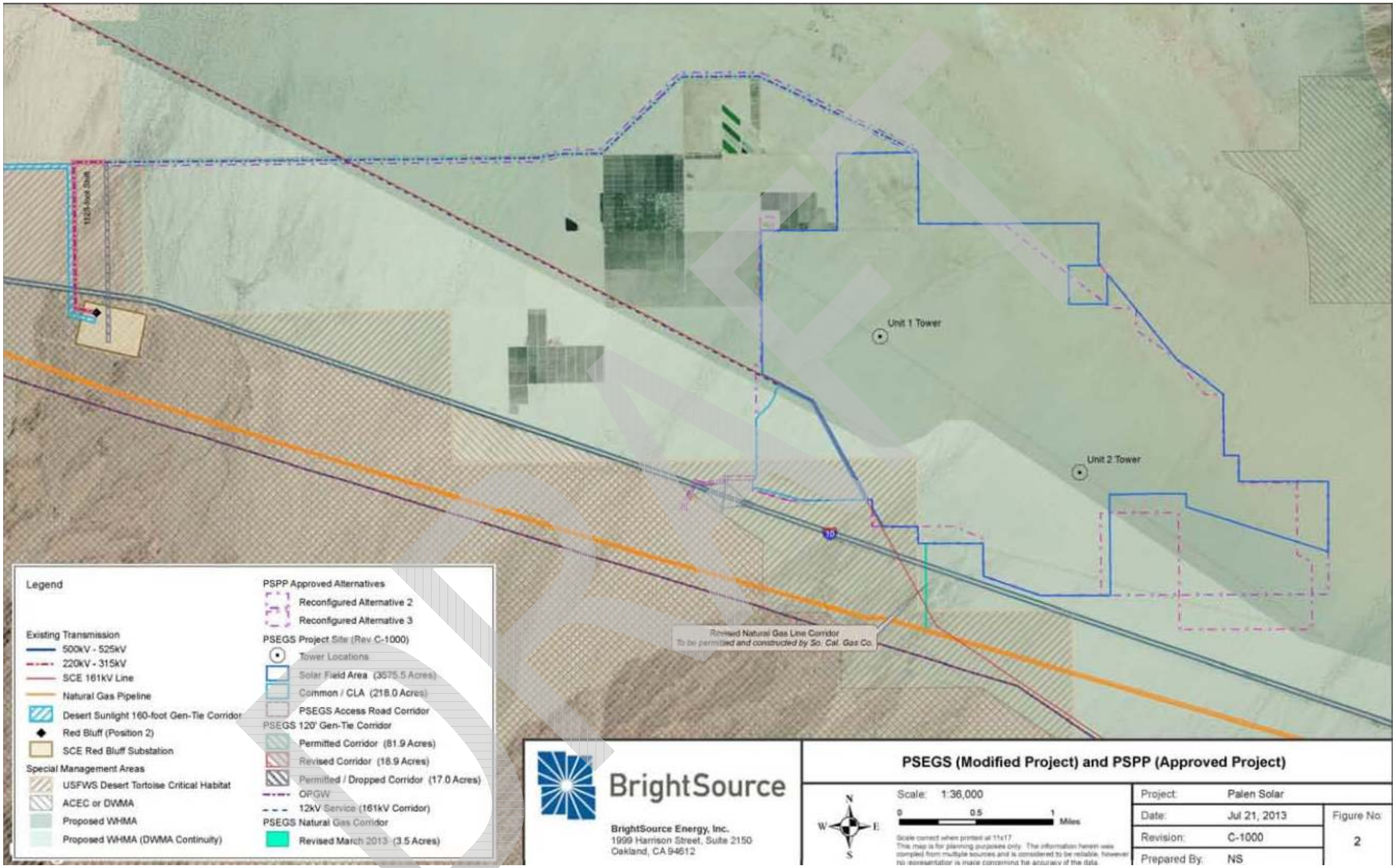

Figure 2. Overview of the original Palen Solar Power Project and the current proposed Palen Solar Electric Generating System.

1.4 Key Avian and Bat Laws, Regulations, Authorizations

The project is subject to all relevant federal, state, and local statutes, regulations, and plans as described in the Environmental Impact Statement and Commission Decision. The key federal, state, and local agency approvals, reviews, and permitting requirements for avian and bat species are presented in Table 1.

Table 1. Key avian and bat laws, regulations, and authorizations.

Authorization	Agency Authority	Statutory Reference
Federal		
National Environmental Policy Act (NEPA) Compliance to Grant Right-of-Way	Bureau of Land Management (BLM)	NEPA (Public Law [PL] 91-190, 42 United States Code [USC] 4321−4347, January 1, 1970, as amended by PL 94-52, July 3, 1975, PL 94-83, August 9, 1975, and PL 97-258, §4[b], Sept. 13, 1982)
Endangered Species Act (ESA) Compliance	US Fish and Wildlife Service (USFWS)	Endangered Species Act (PL 93-205, as amended by PL 100-478 [16 USC 1531 et seq.]); 50 Code of Federal Regulations (CFR) 402
Migratory Bird Treaty Act (MBTA)	USFWS	16 USC 703–711; 50 CFR 21 Subchapter B
Bald and Golden Eagle Protection Act (BGEPA)	USFWS	16 USC 668−668(d)
State		
Commission Decision	California Energy Commission (CEC)	California Endangered Species Act (CESA) of 1984, Fish and Game Code §§ 2050-2098

The regulatory framework for protecting birds includes the Endangered Species Act of 1973, as amended (ESA 1973), the Migratory Bird Treaty Act (MBTA 1918), the Bald and Golden Eagle Protection Act (BGEPA) of 1940, and Executive Order (EO) 13186. This BBCS has been developed to meet BLM and USFWS requirements for addressing these federal statutes.

The MBTA prohibits the "take" of migratory birds. With respect to the MBTA, take means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempts to do so. The MBTA does not include provisions for allowing unauthorized take. However, the USFWS does not usually take action under the MBTA if good faith efforts have been made to minimize impacts to migratory birds. This project affords substantial design measures to avoid and minimize the likelihood of take, but if take occurs, it will be reported to the USFWS and the TAC and further efforts may be made to mitigate risk to birds and bats, as described in Section 8.0 Monitoring and Adaptive Management Process.

The BGEPA prohibits take of bald and golden eagles. Take under the BGEPA is defined as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, disturb, or otherwise harm eagles, their nests, or their eggs. Under the BGEPA, "disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle; 2) decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. However, on September 11, 2009 (*Federal Register,* 50 Code of Federal Regulations [CFR] 13 and 22), the USFWS set in place rules establishing two new permit types: 1) take of bald (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) that is associated with, but not the purpose of, the activity; and 2) purposeful take of eagle nests that pose a threat to human or eagle safety. The USFWS recommends that project proponents prepare a BBCS to avoid, minimize, and mitigate project-related impacts to birds and bats and specifically golden eagles to ensure no-net-loss to the golden eagle population. Pursuant to BLM IM 2010-156, the BLM will coordinate with the USFWS to ensure that the BBCS meets specific requirements.

2.0 EXISTING CONDITIONS

2.1 Environmental Setting

The PSEGS site is located within the Chuckwalla Valley and is bordered by the Chuckwalla Mountains to the south, the Coxcomb Mountains to the north, and by the Palen Mountains to the northeast (Figure 1). The Palen Dry Lake lies immediately to the north of the site. The topography of the PSEGS is generally flat with no significant terrain features. Elevations within the site range from approximately 134 m (440 ft) above mean sea level in the northeast of the site to approximately 207 m (680 ft) in the southwest. According to vegetation mapping conducted for the site by AECOM (EDAW AECOM 2009), the dominant vegetative cover type within the PSEGS footprint is Sonoran Creosote Scrub (Figure 3). Several dry desert washes with sparse to moderately dense areas of Desert Dry Wash Woodland are present within and adjacent to the PSEGS (Figure 3). Immediately adjacent to the northwest boundary of the PSEGS is a privately-owned date palm plantation, approximately 530 acres (215 hectares [ha]) in size. Within the privately-owned lands to the northwest of the site are three agricultural ponds, each less than 2.5 acres (1.0 ha) in size.

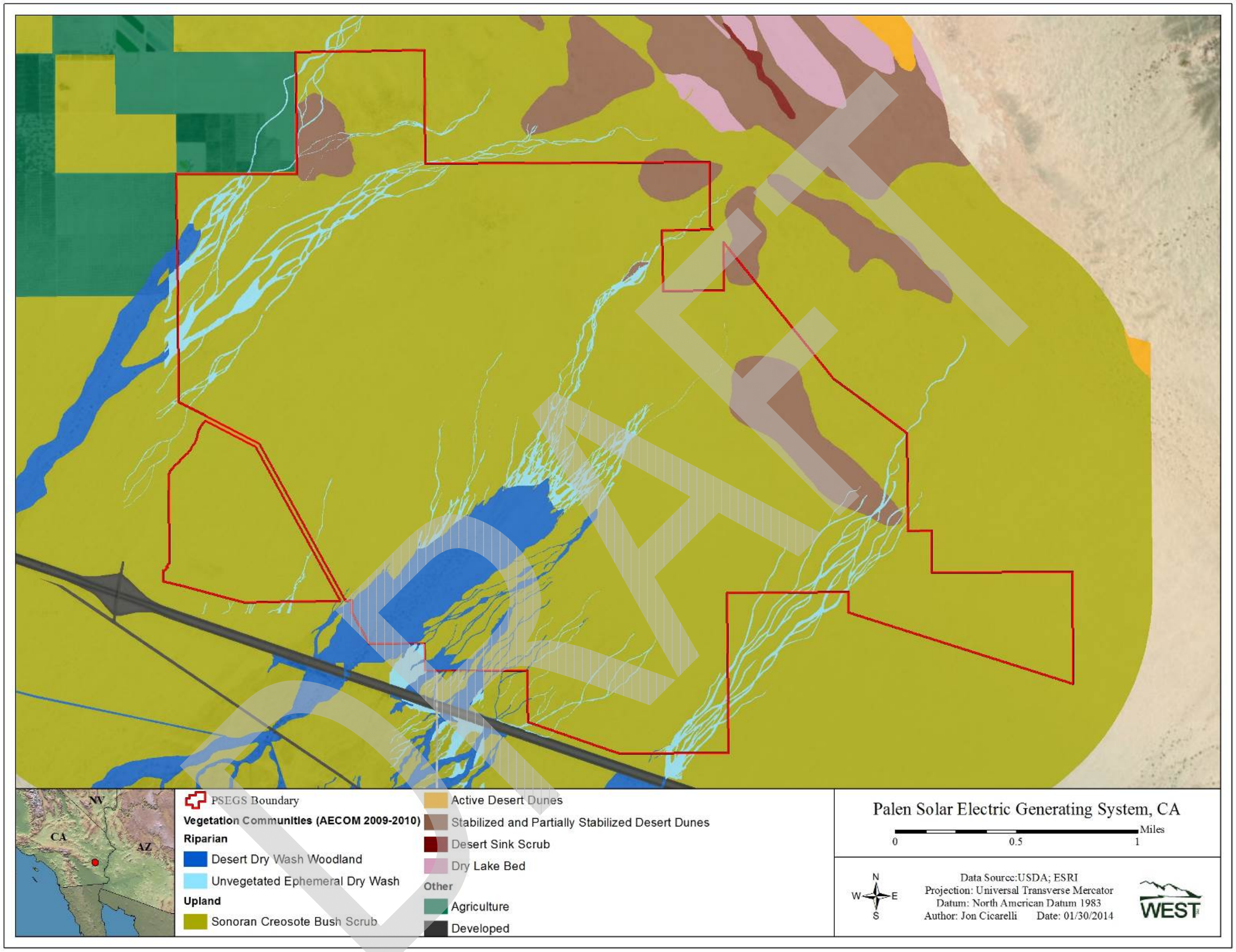

Figure 3. Vegetative cover types of the Palen Solar Electric Generating System.

2.2 Monitoring and Surveying to Date

In response to concerns about impacts to wildlife resulting from the development of the PSEGS, a variety of field studies and literature reviews were conducted. In 2009-2010, AECOM conducted baseline avian and bat studies in support of the original PSPP, which was licensed by the CEC in 2010. In the spring of 2013, baseline studies were initiated for the current PSEGS. These studies included multiple types of avian use surveys including bird use surveys focused on raptors and vultures, shorebirds/waterfowl surveys at agricultural ponds in the project vicinity, small bird count surveys, radar surveys to document passage of nocturnal migrants, and mist nest surveys. Surveys for bats included both acoustic surveys and surveys for roosting habitat. Surveys completed at the PSEGS, as well as spring 2014 surveys currently ongoing at the PSEGS are listed in Table 2 and a brief summary of study methods and results are included in the sections below. Currently, only results of the spring and fall 2013 studies are available and summarized below. Results of the spring 2014 surveys currently underway at the PSEGS will be included in subsequent versions of this BBCS.

Table 2. Pre-construction field survey efforts.

Study	Taxa	Survey Dates	Survey Effort
Bird Use Count Surveys			
	Large birds		
	including		8 hrs/survey
BBI 2013a	Raptors,	April 8– May 4, 2013	6 stations; 762 hrs
BBI 2013b	Vultures	May 5 – June 1, 2013	6 stations; 192 hrs
Levenstein et al. 2014		August 20 – December 13, 2013	6 stations; 3,234 hrs
WEST, Inc.		March 24 – June 13, 2014 (ongoing)	2 stations
Small Bird Count Surveys			
	Small birds		
			10 min/survey
EDAW and BBI 2009		April 12 – May 8, 2009	48 stations; 1,920 min
BBI 2013a		April 8 – May 4, 2013	120 stations; 4,790 min
BBI 2013b		May 5 – June 29, 2013	186 stations; 12,960 min
Levenstein et al. 2014		August 19 – November 14, 2013	150 stations; 19,390 min
WEST, Inc.		March 24 – June 13, 2014 (ongoing)	77 stations
Mist Net Surveys			
	Small birds		
			12, 12x2.6m nets/survey
BBI 2013a		April 11 – May 4, 2013	502.7 mist net hours
BBI 2013b		May 9 – June 14, 2013	1,322.4 mist net hours
Levenstein et al. 2014		September 18 – October 30, 2013	1,080 mist net hours
Gila Woodpecker Surveys			
	Gila		
BBI 2013b	woodpecker		Concurrent with SBCs
		April 8 – May 4, 2013	120 stations; 4,790 min
		May 5 – June 29, 2013	186 stations; 12,960 min

Table 2. Pre-construction field survey efforts.

Study	Taxa	Survey Dates	Survey Effort
Elf Owl Surveys			
BBI 2013b	Elf owl	May 18 – June 15, 2013	143 callback stations 63 listening stations 10 – 14 min/station
Habitat Evaluation for Elf Owl and Gila Woodpecker			
BBI 2013b	Gila woodpecker and elf owl	July 2 – July 19, 2013	29, 50-meter radius Habitat Suitability stations
Golden Eagle Nest Surveys			
BBI 2013c	Golden eagles	March 20 – April 15, 2013; May 24 – August 3,2013	Surveys by air and ground as per USFWS Guidelines
WEST, Inc.		April – August, 2014 (ongoing)	Surveys by air and ground as per USFWS Guidelines
Golden Eagle Prey Abundance Surveys			
BBI 2013b	Lagomorphs	April 8 – May 4, 2013 May 5 – June 29, 2013	Concurrent with SBCs 579.69 km of transects 120 stations 186 stations
Golden Eagle Camera Trap and Visual Surveys			
BBI 2013d	Golden eagles	January 23 – February 27, 2013	Camera trap surveys at bait stations and surveys by ground
Burrowing Owl Surveys			
EDAW AECOM 2009	Burrowing owls	March 10 – June 14, 2009	per CBOC 1993 Protocol Guidelines and concurrent with desert tortoise survey
Karl 2013		April 7 – June 26, 2013	per CDFG 2012 Protocol Guidelines
Agricultural Pond Surveys			
Levenstein et al. 2014	Shorebirds/ Waterbirds/ Waterfowl	August 19 – December 10, 2013	3 stations 106 hours
WEST, Inc.		March – June 2014 (ongoing)	
Nocturnal Radar Surveys			
Levenstein and Nations 2014	Nocturnal migrants	August 19 – October 31, 2013	1, 3 km radius station 600 hours
WEST, Inc.		March – June 2014 (ongoing)	

Table 2. Pre-construction field survey efforts.

Study	Taxa	Survey Dates	Survey Effort
Acoustic Bat Surveys			
Brown and Rainey 2013, 2014	Bats	May 11 – 14, 2013	12 survey locations in spring 2013; 989 bat call minutes
		October 7 – December 14, 2013	4 stations in fall/winter 2013; 11,638 bat call minutes
Bat Roost Surveys			
AECOM 2009	Bats	March 2009	Targeted visual surveys
Karl 2013		May 11 – 14, 2013 October 7 – December 14, 2013	Analysis of acoustic information to determine potential presence of species with various roosting habits

2.2.1 Bird Use Count Surveys

2.2.1.1 Methods

Bird use count (BUC) surveys were conducted by Bloom Biological Incorporated (BBI) during the spring (April 8 – May 4; BBI 2013a) and summer (May 5 – June 1; BBI 2013b) of 2013 and by Western EcoSystems Technology, Inc. (WEST) during the fall of 2013 (August 20 – December 13; Levenstein et al. 2014). The objective of the BUC surveys was to estimate the spatial and temporal use of the PSEGS by medium to large birds, particularly vultures and diurnal raptors (i.e., kites, accipiters, buteos, harriers, eagles, falcons and osprey [*Pandion haliaetus*]). Point counts using circular plots (similar to those described by Reynolds et al. 1980, Bibby et al. 1992) were conducted at six BUC observations points established throughout the PSEGS site and surrounding 0.6-mile (1.0-km) buffer, with two of the observation points (points 3 and 5) located within 200 m (626 ft) of the proposed solar collection towers for the PSEGS (Figure 4). Each survey plot was an 800-m (2,625-ft) radius circle centered on the point. From April 8 to May 4, and from August 20 – December 13, surveys at each observation point were conducted for approximately eight continuous hours per day (between approximately 6:00 am and 7:00 pm), four days per week. From May 5 to June 1, surveys at each observation point were conducted for approximately eight continuous hours per day (between approximately 6:00 am and 7:00 pm), one day per week.

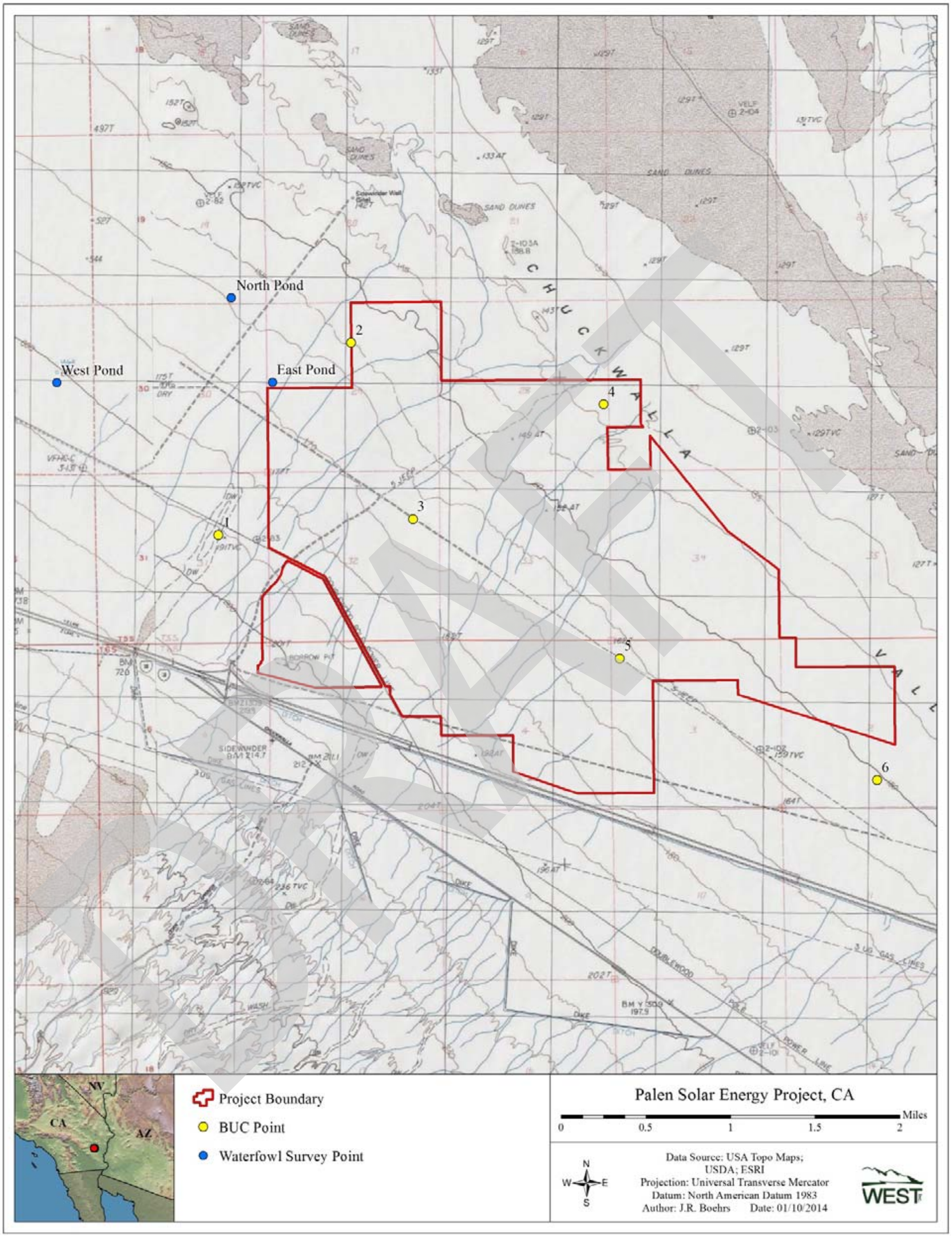

Figure 4. Location of bird use count (BUC) survey points and shorebird/waterfowl survey points at the Palen Solar Electric Generating System.

Survey methods were consistent with those used by the Hawk Migration Association of North America (HMANA), with observers continuously scanning the sky and surrounding areas for target species within the survey area. Observations of birds beyond 800-m radius were recorded, but were not included in statistical analyses. For each observation, the following data were recorded: observation number, start and end time of each observation, species or best possible identification, number of individuals, sex and age class (if possible), altitude above ground level (AGL) when first observed, highest and lowest altitude AGL, distance from plot center when first detected, closest distance, general flight direction, activity (behavior), and habitat(s). Flight or movement paths for all raptors and vultures were mapped onto US Geological Survey (USGS) base maps, given corresponding observation numbers, and digitized using ArcGIS software. Additionally, for each golden eagle observed, data were recorded every minute that the bird was within view, as recommended in the USFWS Eagle Conservation Plan Guidance (USFWS 2013a).

2.2.1.2 Results

Spring 2013

During the spring of 2013 (April 8 – May 4), a total of 96 BUC surveys were conducted. During this time, 4,399 birds were recorded, and 58 unique bird species were identified (Table 3). Turkey vulture (*Cathartes aura*; 1,701 observations) was by far the most abundant species observed, accounting for 38.7% of overall observations. A total of 2,734 focal birds (all raptors and other birds larger than an American crow [*Corvus brachyrhynchos*]) representing 14 unique species, were recorded, accounting for 62.2% of overall bird observations. Among the bird types that associate with water, waterbirds (27 observations) and shorebirds (four observations) accounted for less than 0.01% of the observations.

Summer 2013

During the summer of 2013 (May 5 – June 1), a total of 24 BUC surveys were conducted. During this time, 2,492 birds were recorded, and 52 unique bird species were identified (Table 3). Horned lark (*Eremophila alpestris*; 424 observations) was the most abundant species observed, accounting for 17.0% of overall observations. A total of 837 focal birds (all raptors and other birds larger than an American crow) representing eight unique species, were recorded, accounting for 33.6% of overall bird observations. The most commonly observed focal species was turkey vulture (382 observations). Among the bird types that associate with water, waterbirds (two observations) accounted for less than 0.01% of the observations.

Fall 2013

During the fall (August 20 – December 13, 2013) a total of 414 BUC surveys were conducted. During this time, 16,808 birds in 1,475 separate groups were recorded, and 75 unique bird species were identified (Table 3). Turkey vulture (107,989 observations in 1,960 separate groups) was by far the most abundant species observed, accounting for 93.6% of overall observations. A total of 1,587 individual diurnal raptors, representing 14 unique species, were recorded, accounting for 1.4% of overall bird observations. Among the bird types that associate with water, waterbirds accounted for 0.9% of total observations, waterfowl accounted for 0.8%, shorebirds accounted for 0.4%, and gulls/terns accounted for 0.4%.

Table 3. Number of observations (unlimited viewshed) and mean bird use (number of birds/observer-hour/survey[a]) for each diurnal raptor and vulture species during spring, summer, and fall bird use count surveys at the Palen Solar Electric Generating System, April 8 – May 4, May 5 – June 1, and August 20 - December 13, 2013.

	Spring 2013		Summer 2013		Fall 2013	
Species	**# Obs.**	**Mean Use**	**# Obs.**	**Mean Use**	**# Obs.**	**Mean Use[b]**
American kestrel	8	0.01	0	0.00	54	<0.01
Cooper's hawk	10	0.01	0	0.00	134	0.01
ferruginous hawk	1	<0.01	0	0.00	9	<0.01
golden eagle	0	0.00	1	0.01	8	<0.01
merlin	0	0.00	0	0.00	1	<0.01
northern harrier	20	0.02	0	0.00	142	0.02
osprey	0	0.00	0	0.00	109	<0.01
peregrine falcon	0	0.00	0	0.00	2	0
prairie falcon	39	0.04	25	0.10	158	0.03
red-shouldered hawk	2	<0.01	0	0.00	3	<0.01
red-tailed hawk	125	0.10	28	0.05	488	0.05
sharp-shinned hawk	4	<0.01	0	0.00	59	<0.01
Swainson's hawk	107	0.08	15	0.07	236	0.02
turkey vulture	1,701	0.95	382	0.60	107,989	1.74
unidentified accipiter	2	<0.01	0	0.00	7	<0.01
unidentified buteo	0	0.00	0	0.00	2	<0.01
unidentified falcon	2	<0.01	0	0.00	4	<0.01
unidentified hawk	19	0.01	3	0.01	28	<0.01
unidentified raptor	0	0.00	0	0.00	141	<0.01
zone-tailed hawk	0	0.00	0	0.00	2	<0.01
Total Observations	**2,065**		**454**		**109,576**	
Total Identified Species	**10**		**5**		**20**	
Observation Hours	**762**		**192**		**3,234**	

[a] 800-meter (m) radius plot
[b] For use values of other species, please see Appendix A.

After standardizing the fall BUC survey data to include only observations seen within 800 m from the observer and scaling mean use to the number of birds recorded per observer-hour, overall diurnal raptor use at the PSEGS was 0.18 birds/observer-hour/survey plot. The diurnal raptor species with the greatest use included red-tailed hawk (*Buteo jamaicensis*; 0.05 birds/observer-hour/survey), prairie falcon (*Falco mexicanus*; 0.03), Swainson's hawk (*Buteo swainsoni*; 0.02), northern harrier (*Circus cyaneus*; 0.02), and Cooper's hawk (*Accipiter cooperii*; 0.01). Overall use by turkey vultures was 1.74 birds/observer-hour/survey. Diurnal raptor subtypes were generally most commonly observed flying below 35 m (115 ft); however, osprey were more frequently observed flying between 35 and 70 m (115 and 230 ft) and eagles were most commonly observed flying between 105 and 140 m (345 and 459 ft). Vultures were most commonly observed flying between 35 and 105 m, while water-dependent species were most frequently observed flying below 35 m or above 280 m (919 ft). Use by diurnal raptors was greatest at points 1 and 2, while use by vultures was greatest at points 1 and 6. Use by water-dependent bird types was consistently higher at point 2.

2.2.1.3 Conclusions

The majority of the project site supports desert scrub vegetation and does not contain the appropriate topography to funnel migrating birds through the PSEGS. The site lacks a major ridgeline, water bodies, and large stands of mature trees. There are small agricultural ponds and a very small lake (Lake Tamarisk) associated with a golf course nearby, but the closest major water body is the Salton Sea, which is 34 miles (55 km) southwest of the site, and the irrigated agriculture fields near Blythe are approximately 30 miles (48 km) to the southeast. The results of BUC/migration counts by BBI and WEST indicate that the PSEGS site is not part of a major migratory pathway for diurnally migrating raptor species, although there was a relatively substantial movement of turkey vultures through the area.

An average of approximately 0.20 raptor observations/hour (excluding turkey vultures) were made during the three seasons of migration counts, which is considered low raptor use when compared to similar studies conducted for other renewable energy projects. Springtime raptor use estimates from other renewable energy facilities in California range from approximately 0.25 birds/hour at Tehachapi Pass to approximately five birds/hour at Altamont Pass (Erickson et al. 2009); fall raptor use estimates from other wind energy facilities in California range from approximately 0.25 birds/hour at San Gorgonio to approximately 9.5 birds/hour at Diablo Winds (Erickson et al. 2009). In 2013, BBI produced a report (BBI 2013e) in which an effort was made to compare avian survey data collected at PSEGS with data collected at the sites of other nearby proposed solar facilities. The closest project site to the PSEGS site where comparable spring raptor use counts have been conducted was at the proposed Rio Mesa Solar Electric Generating Facility (RMSEGF) project site approximately 28 miles (45 km) east-southeast of the PSEGS.

Results from fixed-point surveys with an unlimited radius survey conducted in the spring 2012 season at the RMSEGF site and at the PSEGS Project site in spring 2013 were used for a comparison between the two Projects. Results from the Rio Mesa 2012 surveys are displayed in Table 4, along with results for all detections from the PSEGS Project site that occurred at any distance from the station during spring 2013 fixed-point (BUC) surveys. These data provide the strongest basis for a comparison of raptor and other large bird abundances between the PSEGS Project site and another site within the region because similar methods were followed for surveys at both sites. However, the survey results from the RMSEGF encompass a substantial period of the early spring (i.e., February 21 through April 8) during which surveys were not conducted at the PSEGS Project site and this may be a cause for some differences in abundance values between the sites for a given species.

Turkey vultures accounted for approximately 96.1% of the observations made during the spring, summer, and fall 2013 raptor counts at the proposed PSEGS site (Appendix B). Red-tailed hawk accounted for approximately 0.01% of the observations made, while Swainson's hawk and prairie falcon each accounted for <0.01% of the observations made during the 2013 raptor counts at the proposed PSEGS site (Appendix B). The vast majority of birds observed during the 2013 BUCs were recorded at heights either below or above the area of greatest risk relative to solar flux at the Project site (see Section 3.0 below) Based solely on use and time spent within heights considered to be associated with greatest risk relative to solar flux, turkey vulture would have the greatest risk of entering the solar flux zone.

Table 4. Raptors and vultures per hour observed at the proposed Palen Solar Energy Generating System during spring 2013 and at the proposed Rio Mesa Solar Electric Generating Facility during spring 2012.

	Individuals/hour	
Common Name	**Palen 2013**	**Rio Mesa 2012**
turkey vulture	2.232	2.964
osprey	0.000	0.014
northern harrier	0.026	0.023
sharp-shinned hawk	0.005	0.005
Cooper's hawk	0.013	0.012
red-shouldered hawk	0.003	0.000
Swainson's hawk	0.140	0.030
red-tailed hawk	0.164	0.198
ferruginous hawk	0.001	0.001
golden eagle	0.000	0.000
American kestrel	0.010	0.037
merlin	0.000	0.001
peregrine falcon	0.000	0.004
prairie falcon	0.051	0.022
unidentified falcon	0.003	0.000

2.2.2 Small Bird Count Surveys

2.2.2.1 Methods

To date, three seasons of small bird count (SBC) surveys have been conducted at the PSEGS, or its precursor, the PSPP. A fourth season (spring 2014) is currently underway at the PSEGS. At the original PSPP, SBC surveys were conducted by EDAW and BBI (2009) in the spring of 2009. At the current PSEGS, SBC surveys were conducted by BBI during the spring of 2013 (April 9 – June 29; BBI 2013a) and by WEST during the fall of 2013 (August 19 – November 14; Levenstein et al. 2014). The objective of the SBC surveys was to characterize use by migrant and resident birds, particularly songbirds, within the site and surrounding area during the spring and fall migration periods. While data collection methods and survey point locations were generally consistent between survey year and seasons, the number of overall survey points varied somewhat. In 2009, a total of 48 points, located along six transects, were surveyed between April 12 and May 8 (Figure 5). During the spring, summer, and fall of 2013, points were located along 14 transects, established throughout the PSEGS site and surrounding 1.0-mile (1.6-km) buffer (Figure 6).

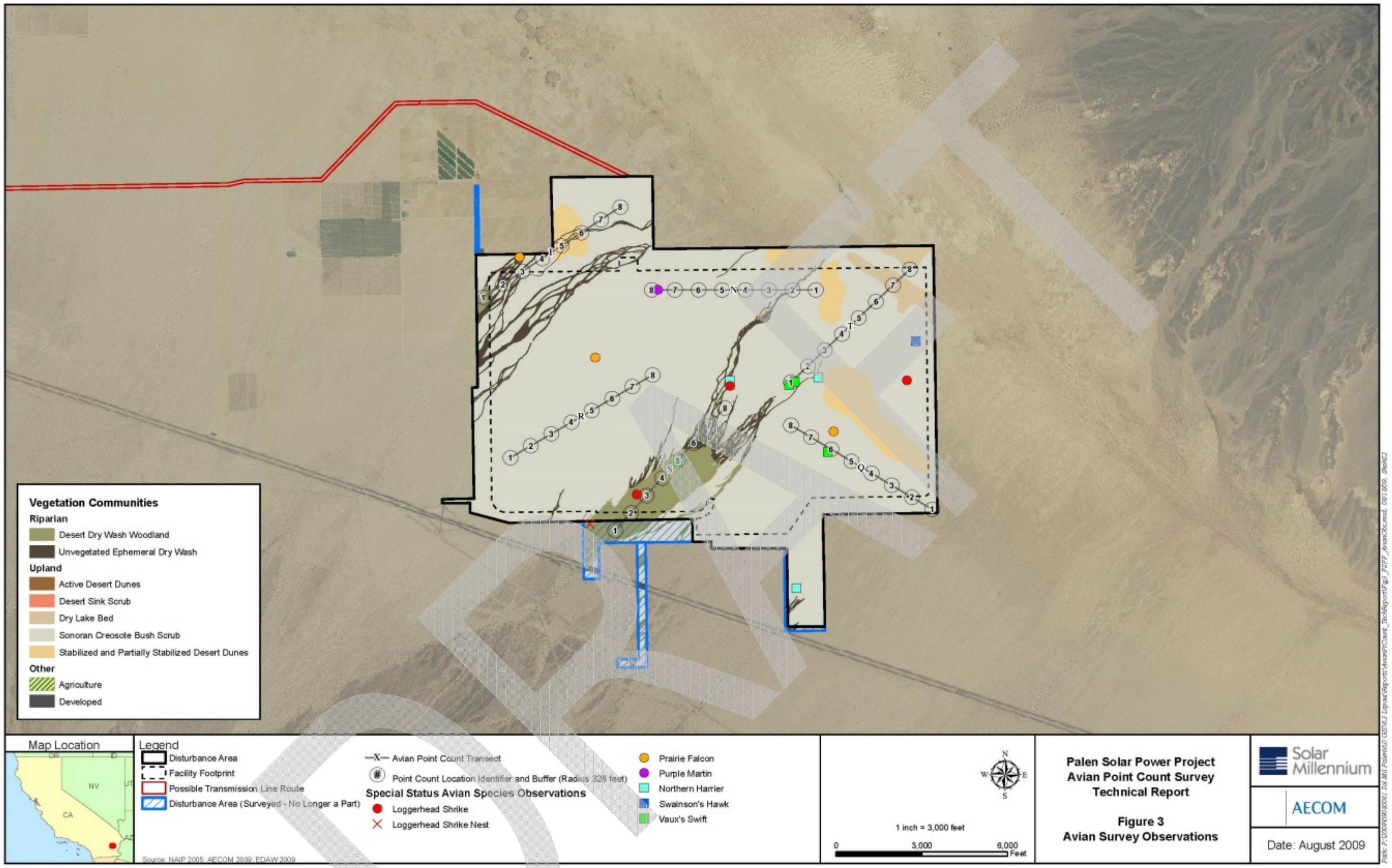

Figure 5. Location of spring 2009 small bird count survey points at the original Palen Solar Power Project.

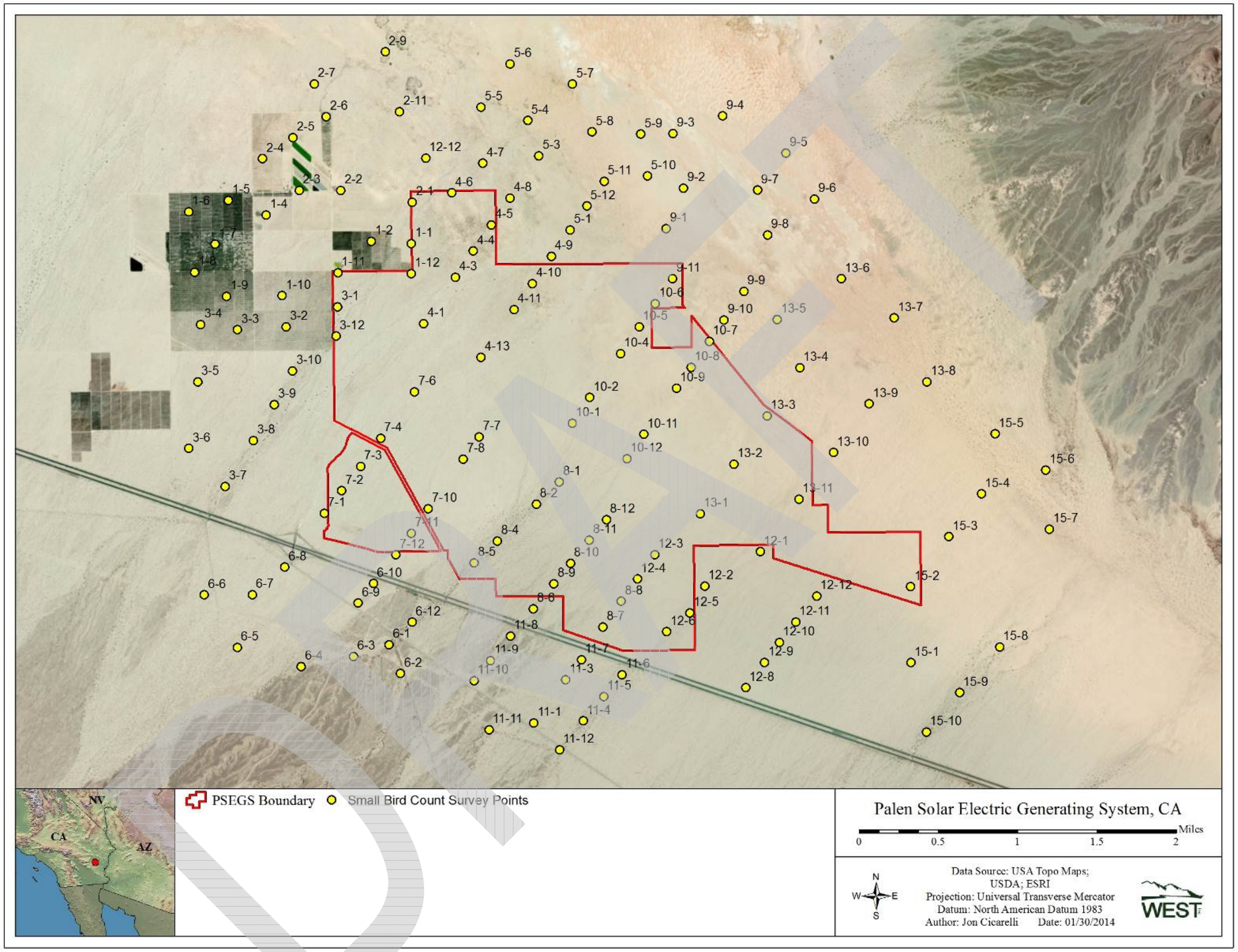

Figure 6. Location of fall 2013 small bird count (SBC) survey points at the Palen Solar Electric Generating System. Note: all 150 points pictured above were surveyed during fall 2013, while only 120 of the points were surveyed in early spring 2013 and 186 points (36 additional points not depicted above) were surveyed during summer 2013.

During the spring of 2013 (April 9 – May 1) a total of 120 points were surveyed. During the summer of 2013 (May 2 – June 29), the survey effort was increased to include 186 points. For the fall 2013 survey effort (August 19 – November 14), the number of points was reduced to 150. During each season, points were separated by at least 810 ft (247 m) to ensure independence of observations. SBC points were surveyed once per week during the spring 2009, spring and summer 2013, and fall 2013 study periods, with all surveys conducted between 15 minutes (min) before dawn and six hours after dawn to maximize the probability of detecting the target species (i.e., passerines). Surveys at each station consisted of a 10-min passive listening survey, during which time all species seen or heard were recorded. Though birds of all sizes and at all distances from the observer were recorded, an emphasis was placed on detecting all birds within 100 m (328 ft) of the observer. For each bird detected, the following data were recorded: station number, species, sex (if known), age (if known), distance from point count station, direction from station, flight height upon initial observation, flight direction, mode of detection (visual, song, call, other), and activity. If a sensitive species was detected, additional data, such as location (Universal Transverse Mercator [UTM] coordinates), were recorded.

2.2.2.2 Results

Spring 2009

Thirteen species of resident breeding birds were recorded at the PSPP site during weekly SBC surveys conducted between April 12 and May 8. The most abundant resident species observed was horned lark, which composed 77% of all individuals recorded during SBCs (Appendix B). All other species recorded composed less than 6% of total observations, individually. Vegetation communities with a desert dry wash woodland component had the highest resident species richness with nine species, followed by creosote bush scrub with six. As expected, desert dry wash woodland communities had the highest number of resident species detected per station (2.63 species/station) when compared to the other vegetation communities (i.e., creosote bush scrub, dunes, dry lake bed, and disturbed), which averaged 1.33 species/station.

Thirteen species of migratory nonresident birds were identified within or flying over the survey plots during SBCs. Of these, swallows were the most numerous with 12 individuals of three species recorded: tree swallow (*Tachycineta bicolor*), barn swallow (*Hirundo rustica*), and cliff swallow (*Petrochelidon pyrrhonota*). The latter two species are likely breeding in the vicinity of the proposed Project vicinity; however, no suitable nesting habitat for either is found within the site. These were followed by warblers with 11 individuals of four species: orange-crowned warbler (*Vermivora celata*), Wilson's warbler (*Wilsonia pusilla*), hermit warbler (*Dendroica occidentalis*), and yellow-rumped warbler (*Dendroica coronata*). As expected, desert dry wash woodland communities had the highest number of nonresident species detected per station (2.25 species/station) when compared to the other habitat types (creosote bush scrub and dune), which averaged 0.91 species/station.

Spring 2013

During the spring 2013, 479 10-min SBC surveys were conducted. A total of 1,982 individual bird observations were recorded and 73 unique species were observed. Cumulatively, five species (6.8% of all species) composed 50.3% of the individual observations: turkey vulture

(308 observations; most seen outside of the 100-m view shed), horned lark (40 observations), cliff swallow (205 observations), verdin (*Auriparus flaviceps*; 137 observations), and loggerhead shrike (*Lanius ludovicianus* ; 106 observations). All other species composed less than 5% of the observations individually.

Summer 2013

During the summer 2013, 1,296 10-min SBC surveys were conducted. A total of 6,837 individual bird observations were recorded and 78 unique species were observed. Cumulatively, six species (7.7% of all species) composed 64.9% of the individual observations: horned lark (1,463 observations), turkey vulture (1,242 observations; most seen outside of the 100-m view shed), common raven (*Corvus corax*; 584 observations), verdin (424 observations), house finch (*Haemorhous mexicanus*; 365 observations), and loggerhead shrike (358 observations). All other species composed less than 5% of the observations individually.

Fall 2013

During the fall 2013, 1,939 10-min SBC surveys were conducted. A total of 10,077 individual bird observations within 3,103 separate groups were recorded and 122 unique species were observed. Cumulatively, five species (4.1% of all species) composed 69.6% of the individual observations: horned lark (2,542 observations), turkey vulture (1,877 observations; most seen outside of the 100-m view shed), house finch (1,098 observations), common raven (1,002 observations), and yellow-rumped warbler (496 observations). All other species composed less than 4% of the observations individually. Passerines had the highest mean use estimate at points 2-3, 2-5, and 9-8 (25.2, 23.38, and 25.77 birds/plot/survey, respectively), and higher average use along transects 1, 2, 3, and 9 (Figure 7). For all bird species combined, use was highest at points 2-3, 2-4, 9-8, 3-10, and 7-11 (51.00, 27.08, 25.77, 18.77, and 18.77 birds/point/survey, respectively. Much higher use at point 2-3 in the northeast corner of the PSEGS was attributed to relatively high use by multiple bird types, including loons/grebes, waterbirds, waterfowl, shorebirds, vultures, and passerines. All bird use at other points ranged from 0.08 to 18.15 birds/point/survey.

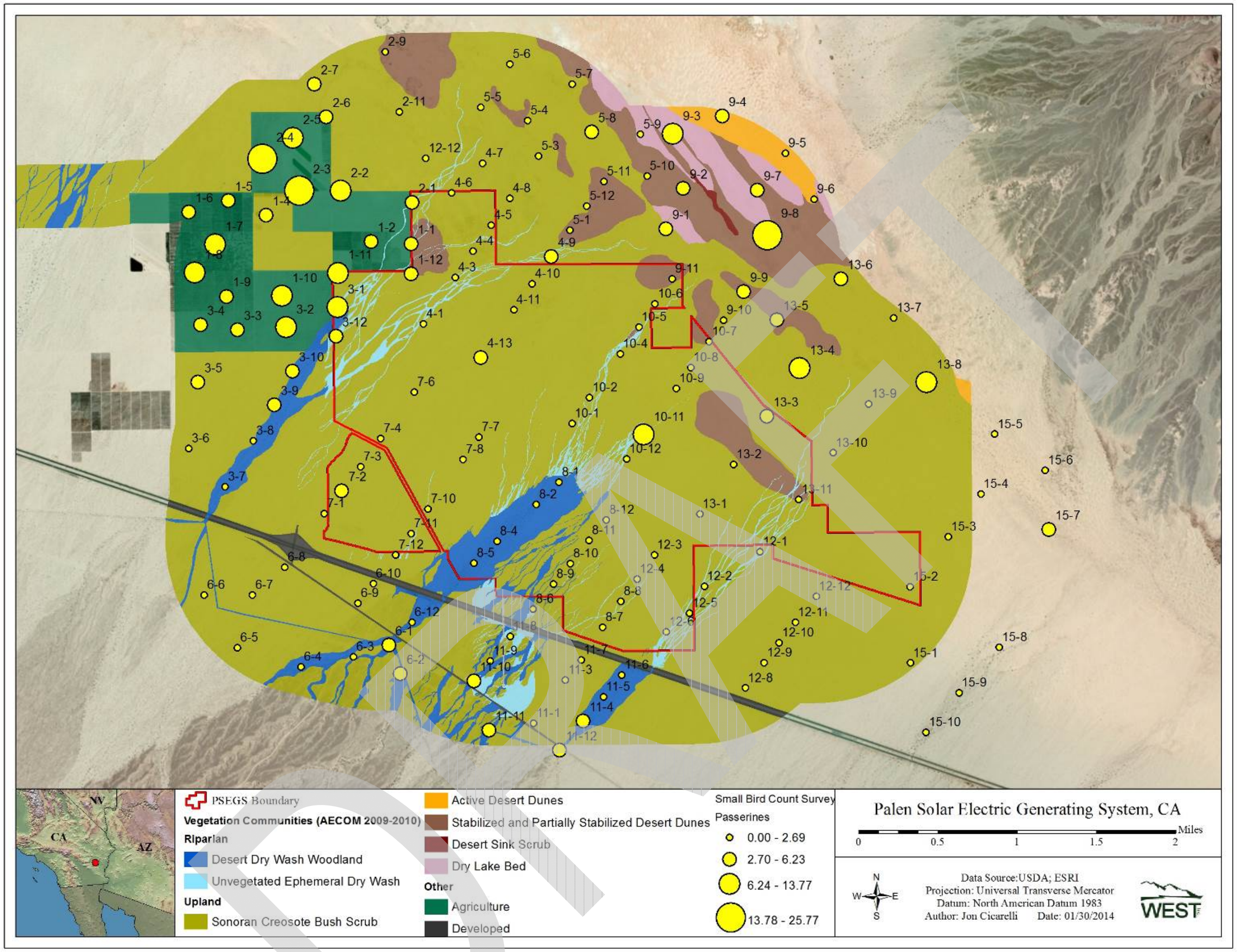

Figure 7. Bubble plots of passerine use (# birds/observer-hour/survey) by point during fall 2013 small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

2.2.2.3 Conclusions

The majority of the project site supports desert scrub vegetation and among terrestrial habitats in North America, creosote bush scrub is noted for its low avian diversity (Raitt and Maze 1968). The habitat and features of the PSEGS are not unique to the surrounding landscape, nor do they appear to be particularly preferred or critical to migrants. Consistent with SBC surveys conducted at the Project previously with similar methods (BBI 2013a; BBI 2013b), the area of greatest use was located outside the north-western boundary of the site close to and within a date palm plantation. This area also includes three small agricultural ponds which served to draw birds in from the surrounding arid landscape.

2.2.3 Mist Net Surveys

2.2.3.1 Methods

Avian mist net surveys were conducted by BBI during the spring (April 11 – May 4; BBI 2013a) and summer (May 9 – June 14; BBI 2013b) of 2013 and by WEST during the fall of 2013 (September 18 – October 30; Levenstein et al. 2014). Mist net surveys were conducted as a supplement to SBC surveys to increase the probability of detecting inconspicuous birds that might otherwise go undetected. From April 11 – May 4, mist net surveys were conducted for eight days at eight mist-net stations, with each mist-net (MN) station consisting of net arrays placed around three adjacent SBC point count stations in the same habitat type. A total of 12 standard 2.6 x 12 m (8.5 x 39 ft) mist nets were used daily at each MN station, with four nets placed within 50-100 m (164-328 ft; to the north, south, east, and west, respectively) of each of the three SBC stations that comprised the single MN station. The eight MN stations were equally divided among habitat types, with four each in Desert Dry Wash Woodland and Sonoran Creosote Scrub, and equally divided in regard to areas of proposed Project permanent impact, with four MN stations in areas of proposed permanent disturbance and four in areas adjacent to proposed permanent disturbance. Mist net surveys were conducted twice per week, with one survey at a MN station in Desert Dry Wash Woodland and the other in Sonoran Creosote Scrub habitat.

From May 9 – June 14, one of six MN stations was surveyed each week for three consecutive days. Three of these stations were situated in Desert Dry Woodland Wash habitat within the Project boundary and three were situated within the palm plantation immediately adjacent to and on the Northwest edge of the Project Site, in an area where the overstory consisted of date palm trees (*Phoenix dactylifera*) and the understory consisted of cultivated citrus trees with dense foliage. At each MN station, a total of 12 standard 2.6 x 12 m mist nets were arranged in two or three lanes, each with four to six nets strung together. On occasion, more than 12 nets were set up at a station to take advantage of active areas that were discovered after setting up the initial net lanes. These “Extra” nets were in addition to the 12 “Standard” nets and were sometimes placed outside of the targeted habitat for a MN station. As such, the results for Standard and Extra net lanes are presented separately. Net lanes were generally arranged within 50-100 m of one another at a given MN station, and placed among vegetative features at the MN station so as to minimize visibility and maximize the probability of capture. All net lanes were arranged along the east-west axis.

During the fall study, mist net surveys were conducted for three consecutive days (ambient conditions permitting) each week at one of four rotating stations. Two MN stations were located within Desert Dry Wash Woodland (stations 1 and 3) one station was located within Sonoran Creosote Scrub (station 2), and one station was located within the palm plantation (station 4; Figure 8). At each MN station, during both spring and fall studies, 12 standard 2.6 x 12 m mist nets were used with nets placed so as to minimize detection by small birds (e.g., out of direct sunlight to the extent possible, proximate to shrubs and/or trees when present). At each station, nets were opened at approximately dawn (between 0600 and 0700 hours) and remained open for approximately four hours or until conditions (i.e., temperature, wind, precipitation) required nets to be closed. All birds captured in nets were removed carefully, banded with a unique aluminum USFWS leg band, and released. Additionally, information recorded for all captured birds included: date, time, station, net number, bander's name, species, band number, molt, level of stored fat, and feather/plumage characteristics, and when possible, age and sex.

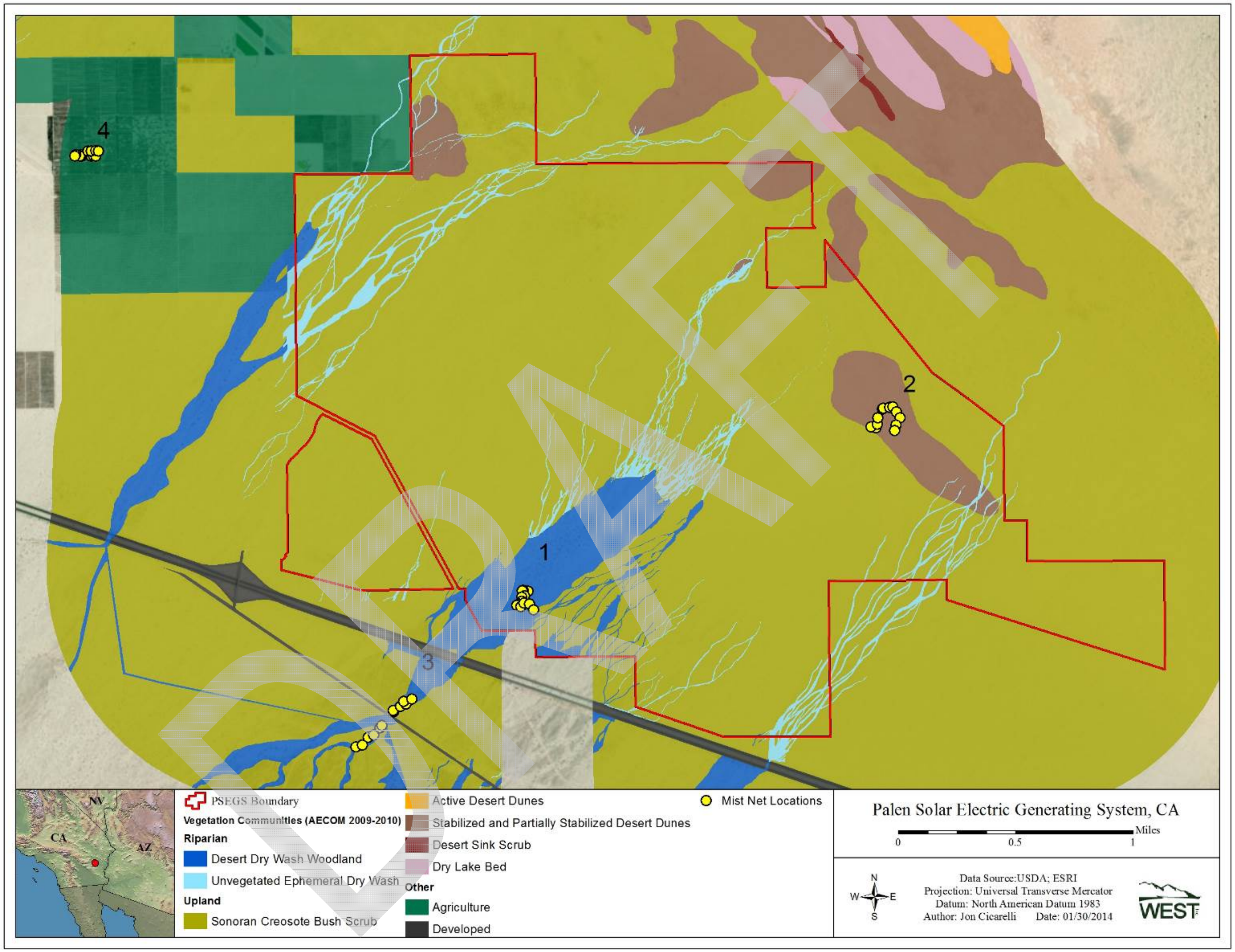

Figure 8. Location of fall 2013 mist net survey stations at the Palen Solar Electric Generating System.

2.2.3.2 Results

Spring 2013

From April 11 – May 4, MN surveys were conducted for two days per week for a total of 507 MN survey hours. During this period 21 birds, comprising 11 unique species, were captured. The overall capture rate for the 7-week period was 0.04 captures per net-hour, with daily capture rates ranging from zero to 0.16 captures per net-hour. The highest capture rates occurred at station 8, located within the dry wash woodland, while no birds were captured at stations 2, 6, and 7, all located within creosote scrub. The most common species captured included verdin (seven individuals) and black-tailed gnatcatcher (*Polioptila melanura*, five individuals). All nine other species captured were represented by one individual each. One species captured during this period of MN surveys, hermit warbler, was not recorded during any other type of survey during the spring 2013 effort.

From May 9 – June 14, MN surveys were conducted weekly, for three days per week for a total of 1,322.4 Standard MN survey hours and an additional 59.8 Extra MN survey hours. With roughly equal levels of survey effort, many more individuals (121 versus 26) and species (23 versus seven) were captured at MN stations in the palm plantation located northwest of the Project footprint compared to those in the Desert Dry Woodland Wash habitats on the Project Site (BBI 2013b). Sonoran Creosote Scrub habitat, which is by far the dominant habitat type on the Project Site, was not sampled during this MN survey period because no birds were captured in this habitat during previous MN surveys despite a reasonably large sampling effort.

The overall capture rate for Standard mist nets was 0.09 captures per mist net hour. The overall capture rate for Extra mist nets was 0.55 captures per mist net hour. During this period 114 birds comprising 24 unique species were captured in the Standard mist nets and 33 birds comprising 10 unique species were captured in the Extra mist nets. The most common species captured included Swainson's thrush (*Catharus ustulatus*, 22 individuals, verdin (21 individuals), Pacific-slope flycatcher (*Empidonax difficilis*, 16 individuals), and Wilson's warbler (*Wilsonia pusilla*, 15 individuals). Three species captured during this period of mist net surveys, northern waterthrush (*Parkesia noveboracensis*), yellow-breasted chat (*Icteria virens*), and swamp sparrow (*Melospiza georgiana*) were not recorded during any other type of survey.

Fall 2013

Fall MN surveys were conducted for three consecutive days per week from September 18 to October 30, 2013, for a total of 1,080 MN survey hours. During this period 107 birds, comprising 25 unique species, were captured. The overall capture rate for the 7-week period was 0.10 captures per net-hour, with daily capture rates ranging from zero to 0.51 captures per net-hour. The highest capture rates occurred at station 4, located within the palm plantation, while no birds were captured at station 2 located within creosote scrub. The most common species captured included orange-crowned warbler (*Oreothlypis celata*; eight individuals), white-crowned sparrow (*Zonotrichia leucophrys*; eight individuals), Lincoln's sparrow (*Melospiza lincolnii*; six individuals), ruby-crowned kinglet (*Regulus calendula*; six individuals), and verdin (four individuals). Seven species were captured during MN surveys that were not recorded during any other survey type during the fall study (yellow-green vireo [*Vireo flavoviridis*], warbling vireo [*Vireo gilvus*], fox sparrow [*Passerella iliaca*], Pacific-slope flycatcher, western wood-pewee [*Contopus sordidulus*], red-naped sapsucker [*Sphyrapicus nuchalis*], and blue-headed vireo [*Vireo solitarius*]).

2.2.3.3 Conclusions

Using MN surveys, researchers were able to detect 11 species that went undetected during other types of surveys conducted concurrently. Four of these species, yellow-green vireo, blue-headed vireo, northern waterthrush, and swamp sparrow are relatively uncommon in Riverside County and generally seen only during the fall and/or spring migration seasons. The yellow-green vireo is extremely uncommon and rarely seen only during a brief window of time in the fall. None of the species are listed as threatened or endangered and none are considered species of concern. The yellow-breasted chat, which was captured during spring MN surveys and not seen during any other spring surveys, is regarded by the CDFW as a species of special concern when nesting. No mention was made in the BBI report (2013b) of the bird exhibiting breeding characteristics when it was captured and banded, therefore, this individual was likely migrating through the area to nest elsewhere.

2.2.4 Winter 2013 Golden Eagle Surveys

2.2.4.1 Methods

Winter golden eagle surveys were conducted at the PSEGS by BBI from January 23 to February 27, 2013 (BBI 2013d). The purpose of the surveys was to evaluate use of the PSEGS and surrounding region by wintering and resident golden eagles using a combination of baited camera traps and visual surveys. Camera trapping was used to gage the use of lands within the study area by golden eagles and other wildlife, as golden eagles will regularly utilize carrion as a food source when it is available. Carcasses were placed as bait, staked to the ground at locations selected based on habitat features spread out across the study area near accessible roads. Reconyx™ 500 series cameras were staked within 15 ft (4.6 m) of the carcass to capture all visiting predators and scavengers. The cameras were set to record activity at a minimum of a picture every five seconds and were in operation 24 hours per day from the time of set-up to removal of the station. Image data stored on the camera memory cards were retrieved and downloaded during weekly survey visits to document all activity. Stations were left operating from the initial set-up date until the project ended or until evidence of lack of activity dictated taking down or moving the station. Bait station 1 was in operation for five weeks, station 2 for four weeks, stations 3 and 4 in operation for six weeks, station 6 for five weeks, and station 7 for three weeks. Camera trapping operations were conducted constantly from January 23 to February 27, 2013.

Visual surveys for golden eagles and other avian predators were conducted during each visit to the study area by driving all accessible roads and stopping at random locations and scanning the skyline and potential perch locations such as cliffs, rock outcroppings and trees with high powered binoculars and spotting scopes. Observations were also conducted from the location of each bait station. Large areas of the Palen and Coxcomb Mountains, as well as smaller portions of the Chuckwalla Mountains, were not accessible and not adequately surveyed. The project site is flat and not suspected as golden eagle foraging or nesting habitat and was therefore not surveyed during this study; however, intensive bird use count surveys, designed to document use of the project by resident and migrating eagles and other raptors, were conducted within the PSEGS boundary during the spring and fall of 2013 (see Section 2.2.1).

2.2.4.2 Results

A single sub-adult golden eagle was present during all five weeks at bait station 6, feeding on the carcass two to three days each week, usually until the remainder of carcass was taken away at night by coyotes (*Canis latrans*). Although not all adult golden eagles will readily land at carcasses, it is probable that more than one eagle would have been observed over a four week period of camera trapping with four to seven stations had high numbers of eagles actually been present in the area. During six full-length visual survey sessions, no eagles were observed within the study area.

2.2.4.3 Conclusion

Winter eagle surveys found definitive evidence for use of the study area by only one golden eagle during the winter months. The results of this study suggest low eagle winter usage of the PSEGS and surrounding region.

2.2.5 Eagle Nest Surveys

2.2.5.1 Methods

Spring aerial and ground golden eagle nesting surveys were conducted by BBI between March 20 and April 15, 2013 (BBI 2013c). Aerial surveys were conducted by helicopter on April 6 and 7, 2013, and covered all areas of suitable golden eagle nesting habitat and known eagle nest sites within the Palen Mountains and the Chuckwalla Mountains, including transmission structures along the Interstate 10 (I-10) power lines. Due to bighorn sheep (*Ovis canadensis*) lambing season flight restrictions, aerial surveys in the Chuckwalla Mountains were conducted from heights of greater than 1,500 ft (457 m) AGL in all areas. Aerial surveys were conducted in a helicopter (Bell Jet Ranger) and followed the survey methodology described in Pagel et al. (2010) to the extent possible. During surveys, all areas within the study area were searched for large stick nests used by golden eagles and other raptors on cliff faces and transmission towers. Three follow-up ground-based surveys were conducted on foot in the Chuckwalla Mountains between the dates of April 8 and April 15, 2013, to visit and observe potential golden eagle nest sites identified during aerial surveys. Three additional days of foot and vehicular surveys were conducted on March 20, 21, and 22, 2013 in the Coxcomb Mountains, which could not be surveyed by helicopter at any reasonable height due to flight restrictions in Joshua Tree National Park.

Summer aerial and ground golden eagle nesting surveys were conducted between May 24 and August 3, 2013. Aerial surveys were conducted by helicopter on May 24 and 25, 2013, in the southern Palen Mountains and along a 20-mile (32-km) length of the DPV2 transmission lines that follow the I-10 freeway corridor, and again on August 2-3 in the Chuckwalla Mountains, when aircraft flight restrictions related to bighorn sheep lambing no longer applied in this area.

Summer ground surveys were conducted in the Coxcomb Mountains on May 24 and 25, 2013, and again for three days on June 9, 11, and 15, 2013.

2.2.5.2 Results

Across the entire study area, only a single golden eagle observation was made during spring and summer 2013 golden eagle nesting surveys. This observation was of a third-year golden eagle flying around the cliffs in this southwestern portion of the Palen Mountains during an aerial survey conducted on April 6, 2013. Twelve golden eagle nests were detected in the study area during the surveys. None of these nests displayed any indications of activity during the 2013 breeding season. The locations of all golden eagle nests within the 10-mile (16-km) buffer of the project footprint, as well as those of other raptors and common ravens, are illustrated in Figure 9.

2.2.5.3 Conclusions

Based on results of spring and summer golden eagle nesting surveys, BBI estimates that approximately eight golden eagle nesting territories exist within the study area; however, none of the alternate nests within these eight territories were active or exhibited any signs of activity in the current (2013) breeding season. The estimate of eight territories in the vicinity of the PSEGS presents a likely maximum number of active golden eagle territories that would be expected under a moderate increase in the habitat quality in the region. However, in most regions, depending upon the expanse of the area studied, some eagle territories will normally always be inactive in any one year for a variety of natural and perhaps unnatural reasons. Surveys conducted by BBI in this region over the previous decade indicate that the lack of golden eagle productivity in the 2013 breeding season in the PSEGS study area is not an anomaly. BBI has conducted similar surveys, with 10-mile radius survey areas at three alternative energy projects that either overlap partially in area with the 10-mile buffer of the current project, or are almost immediately adjacent within the past four years, and no reproductively active eagle nests were discovered during those surveys. In addition, similar surveys conducted in 2010 for four solar projects in the same region revealed the presence of 14 golden eagle nesting territories, of which only one was documented to be reproductively active (Wildlife Research Institute [WRI] 2010). The observed low numbers of golden eagles at any season in the desert may also be related to Mojave Desert ecology and the high probability that many golden eagle nesting territories tend to be vacant or annually contain inactive nests due to low lagomorph numbers.

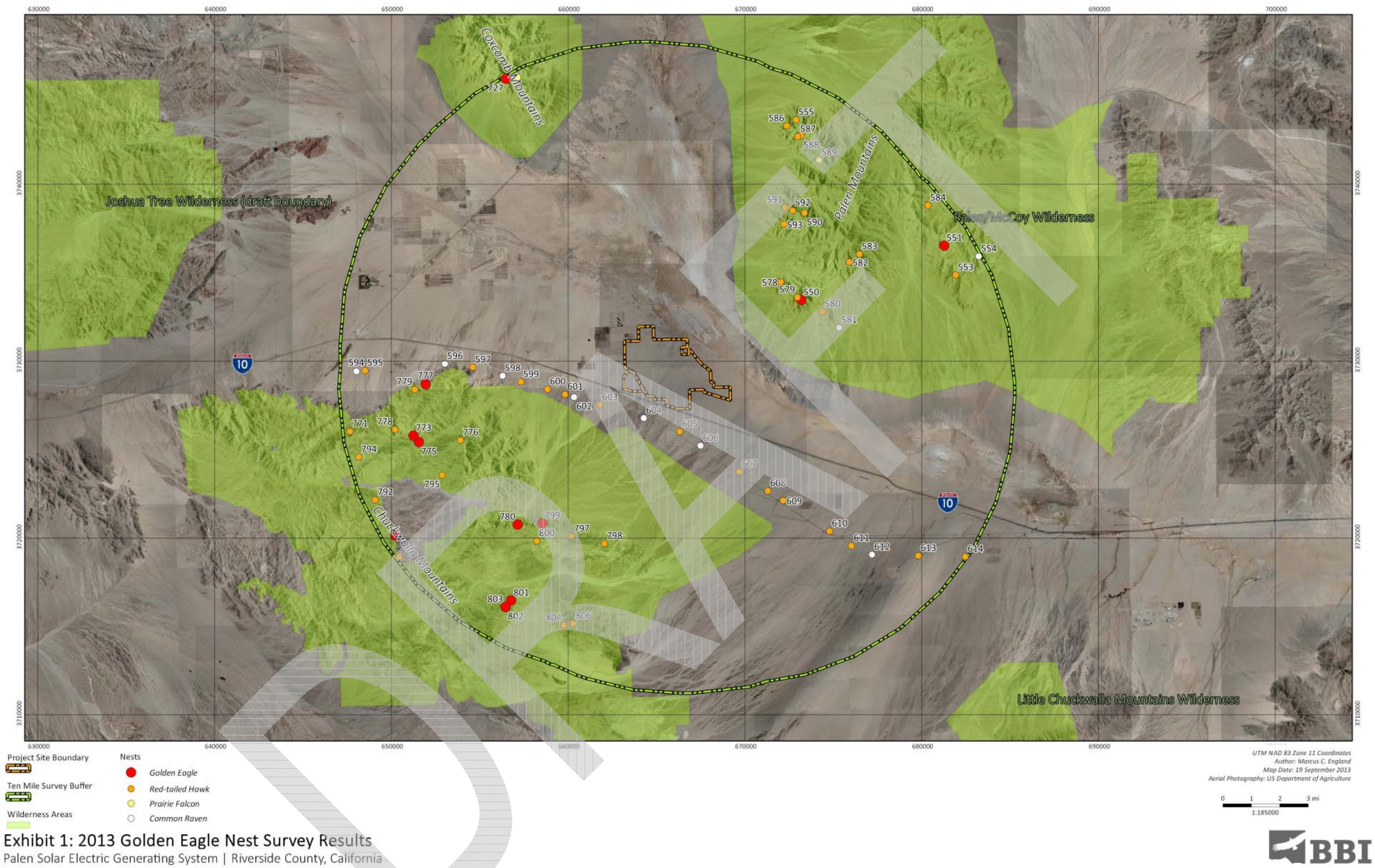

Figure 9. Eagle and other raptor nests located during 2013 eagle nest surveys at the Palen Solar Electric Generating System.

2.2.6 Golden Eagle Prey Abundance Surveys

2.2.6.1 Methods

Golden eagle prey abundance surveys were conducted concurrently with SBC surveys by BBI during the spring of 2013, from April 9 to June 29 (BBI 2013b). Prey abundance surveys were conducted as surveyors walked along transects between SBC survey points and recorded the number of black-tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) detected incidentally since leaving the previous station. These data provide relative measures of abundance which are spatially linked to SBC station locations for these two species.

2.2.6.2 Results

Over the 196.5 km (122 miles) of transects surveyed during prey abundance surveys, 17 black-tailed jackrabbits and one desert cottontail were observed. This computes to 0.086 and 0.005 individuals per km of transect, respectively. Investigation of the spatial data reveals two general areas within the project footprint and surrounding 1-km (0.6-mile) buffer where nearly all jackrabbit observations occurred. The majority of observations occurred in the southeastern quadrant of the site, both north and south of I-10. A second, smaller cluster of observations occurred in the north-central part of the site, including observations at SBC stations 20, 35, and 37. The only desert cottontail observation occurred near an abandoned house along the edge of the palm plantation on the northwest edge of the Project boundary, close to SBC station 8.

2.2.6.3 Conclusion

The results of the surveys suggest low use of the site by lagomorph species. The surveys were conducted during the morning hours (typically between 0500-1100 hours) in the course of conducting SBC surveys and may not be reflective of true lagomorph densities on site if these species are more active at other times of day or night. However, the data provide information about spatial variation in relative density during the diurnal hours, which is when golden eagles primarily hunt.

2.2.7 Burrowing Owl Surveys

2.2.7.1 Methods

In the spring of 2009 (March 10 – June 14), breeding burrowing owl (*Athene cunicularia*) surveys were conducted throughout the original Palen Solar Power Project by EDAW (EDAW AECOM 2009). Surveys were performed in conjunction with desert tortoise (*Gopherus agassizii*) surveys, and were consistent with the survey protocol established by the California Burrowing Owl Consortium (CBOC 1993) and accepted by the CDFW. Surveyors walked slowly and systematically along transects, spaced 10 m (33 ft) apart, throughout the entire disturbance area and 150-m (492-ft) buffer, while visually searching for burrowing owls, their sign (e.g., pellets, whitewash, feather, bones, etc.), and burrows potentially suitable for use by burrowing owls. All burrowing owl observations, sign, and burrows (regardless of sign presence) were mapped using global positioning system (GPS) units and recorded on datasheets. A minimum of four visits were made to each mapped burrow and carefully examined for burrowing owl sign. All burrows with owl sign were surveyed three additional times during the breeding season to determine burrowing owl presence.

In the spring of 2013, supplemental burrowing owl surveys were conducted by Dr. Alice Karl (Karl 2013) along portions of the PSEGS linear facilities (230-kilovolt [kV] generation-tie line and natural gas pipeline) that were modified from the original PSPP and not included in the 2009 survey effort. Surveys were consistent with the most recent burrowing owl survey guidelines (CDFG 2012) and consisted of four field visits during the breeding season, April 7 –June 26. During each field visit, surveyors walked a transect along the center of the corridor for both the modified gen-tie (120 ft [approximately 40 m] wide) and gas line (50 ft [approximately 20 m] wide), as well as buffer transects spaced at 20-m intervals, out to 120 m (394 ft) from the corridor edges.

2.2.7.2 Results

Two nesting pairs of burrowing owls with juveniles were detected within the original project during the spring of 2009 (Figure 10). One pair with juveniles was observed using two burrows near the center of the site, and a second pair with juveniles was observed using two burrows near the northwest corner of the site. Four additional burrows with burrowing owl sign were recorded within the site, and a fifth was recorded in the southeast corner of the 150-m buffer area. Follow-up visits were made to these locations, but no burrowing owls were observed.

During supplemental surveys in the spring of 2013, two burrowing owls were observed, both on buffer transects. No owls or their sign were observed within the linear corridors. One adult burrowing owl was observed during desert tortoise surveys on April 7 along the 400-m (1,312-ft) buffer transect east of the gen-tie and north of I-10, and a second burrowing owl observation was recorded on May 25 approximately 120 m east of the gas line and north of I-10. Despite a thorough search of both areas, no active burrows were found.

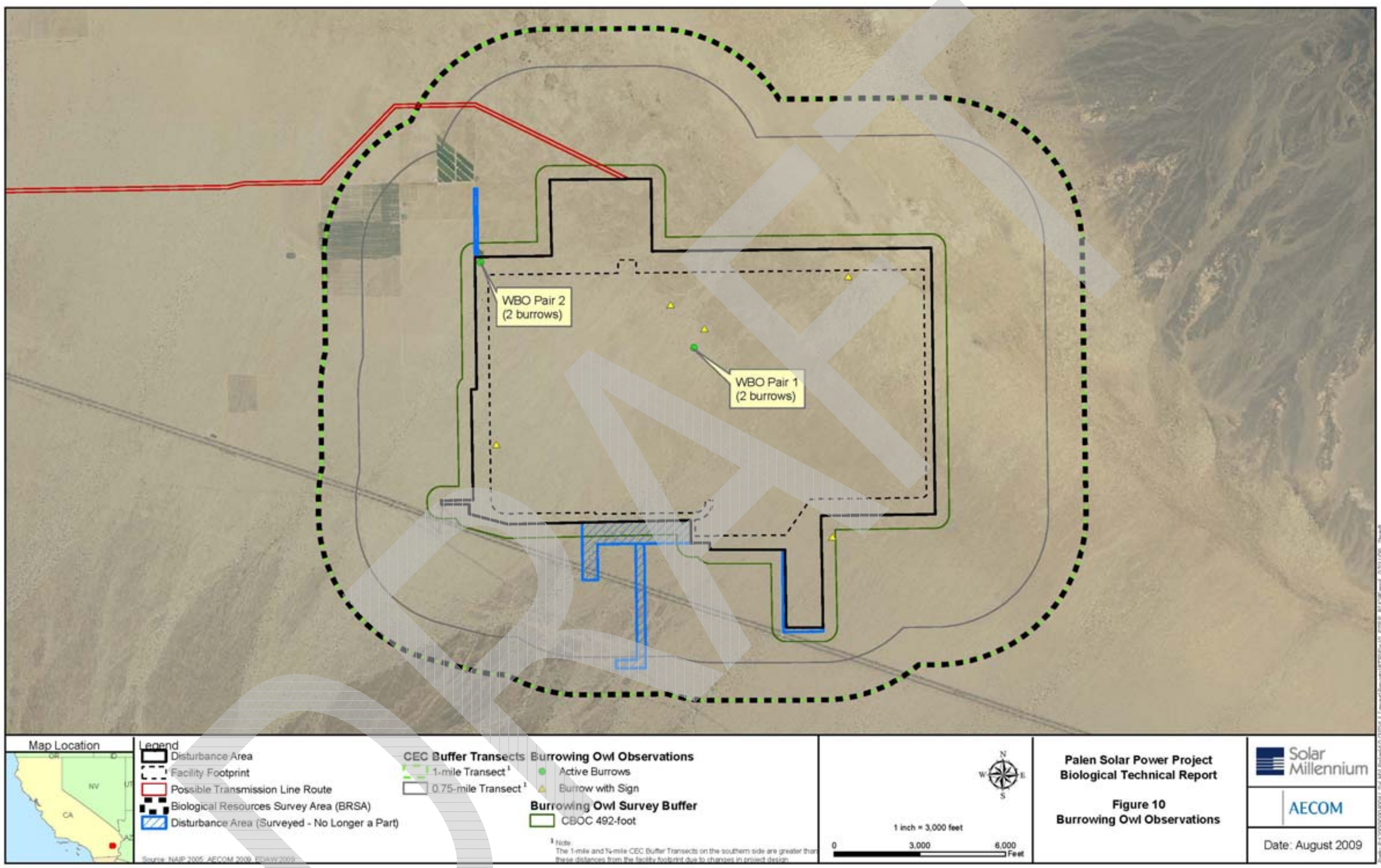

Figure 10. Locations active burrowing owl burrows or burrows with burrowing owl sign identified during spring 2009 surveys at the Palen Solar Power Project.

2.2.7.3 Conclusions

The entirety of the PSEGS site is suitable breeding habitat for burrowing owls. During surveys, two active burrowing owl nests were documented; however, the presence of at least several additional burrows with burrowing owl sign indicate burrowing owl occupancy either during previous years or by wintering owls. The majority of the PSEGS is considered suitable burrowing owl habitat, with numerous burrows potentially suitable for use by burrowing owl (more than 140) detected and mapped throughout the site and the surrounding 150-m buffer. Burrows where burrowing owls or their sign were observed were all located in flat, sparsely vegetated areas dominated by creosote. The low density of nesting burrowing owls documented within the PSEGS is generally consistent with that documented in the surrounding region.

2.2.8 Agricultural Pond Surveys

2.2.8.1 Methods

WEST conducted weekly surveys at the three agricultural ponds within the privately-owned land to the northwest of the PSEGS site and just beyond the palm plantation during the fall of 2013 (August 19 – December 10; Levenstein et al. 2014). The objective of the surveys was to evaluate use of three agricultural ponds adjacent to the northwest boundary of the PSEGS site by species that associate with water (e.g., migratory shorebirds, waterbirds, and waterfowl) that might go undetected during BUC surveys conducted within the PSEGS boundary. While the focus of the surveys was migratory water-dependent species, all medium to large birds seen or heard during each survey were recorded. One survey point was established at each of three agricultural ponds (Figure 4) and each point was surveyed for approximately 2.5 hours during each visit for a total of approximately eight hours of total survey time in the pond area each week. Points were selected to achieve good visual coverage of each pond and the surrounding landscape. Each survey plot was an 800-m radius circle centered on the point. Data collection methods were identical to those used during BUC surveys (see Section 2.2.1.1 above). Observations of all water-dependent species and other medium to large birds beyond the 800-m radius were recorded, but were not included in statistical analyses.

2.2.8.2 Results

Approximately 106 hours of surveys were conducted over the course of 17 visits to the agricultural ponds. A total of 3,169 individual bird observations in 754 separate groups were recorded, and 77 unique species were identified. Overall, water-dependent bird types (i.e., loons/grebes, waterbirds, waterfowl, shorebirds, gulls/terns, and rails/coots) composed 49.5% of total bird observations. The most frequently observed water-dependent species were eared grebe (*Podiceps nigricollis*; 191 observations), American coot (*Fulica americana*; 165 observations), American avocet (*Recurvirostra americana*; 152 observations), ring-billed gull (*Larus delawarensis*; 89 observations), common goldeneye (*Bucephala clangula*; 89 observations), and ruddy duck (*Oxyura jamaicensis*; 79 observations), which collectively composed 48.8% of all water-dependent bird observations and 24.1% of overall bird observations. The most common species observed during the shorebird/waterfowl surveys was turkey vulture, which composed 26.6% of all observations. During shorebird/waterfowl surveys, the majority of all bird types were recorded flying below 35 m (115 ft).

2.2.8.3 Conclusions

The agricultural ponds provide a ready source of water for birds migrating through or resident in the area. Along with few other small bodies of water in the area (e.g., the Eagle Mountain Pump Plant located approximately 13 miles (21 km) northwest of the Project and Lake Tamarisk, located approximately nine miles (14 km) west-northwest of the Project) these represent a rare resource in an otherwise dry desert environment and likely draw birds in from the surrounding area. Together with the irrigated palm plantation and its stands of citrus, this area northwest of the Project footprint represents an unusually hospitable habitat for birds seeking cover and foraging opportunities.

2.2.9 Nocturnal Migration Radar Surveys

2.2.9.1 Methods

WEST conducted nocturnal migration radar surveys at the PSEGS during the fall of 2013 (August 12 – October 31; Levenstein and Nations 2013). The goal of the radar survey was to document migration over the project area and to measure parameters of the migration relevant to the project. Surveys employed a mobile radar lab consisting of a mobile X-band marine radar unit mounted on a converted van. The X-band radar unit transmitted at 9,410 megahertz (MHz) with peak power output of 12 kilowatts (kW), and was similar to other radar labs used to study development sites throughout the US. A single radar site was monitored from approximately sunset until sunrise on approximately 50 nights during the late summer-fall 2013 migration period, with radar coverage of approximately 90% was achieved in both horizontal and vertical modes. The radar system used in this study has several controls which affect detection and tracking of targets. A "target" refers to a single radar echo. A target may represent more than one bird or bat if individuals are flying close together. Targets with air speeds less than 6.0 m/second (m/s; 19.7 ft/second [ft/s]; likely insects) or greater than 35.0 m/s (114.8 ft/s; aircraft) were judged not to be birds or bats and were excluded from further analysis of the data.

2.2.9.2 Results

Mean flight direction was southeast at 133.6 degrees, which is as expected for migrants heading south along the Pacific Flyway. Mean passage rate was 125.64 targets (targets/km/hr) in horizontal mode; and 562.31 targets/km/hr in vertical mode. Mean flight height of targets was 339.9 m (1,114.9 ft) above radar level (ARL) and approximately 45.3% of targets had flight altitudes less than or equal to the height of the proposed towers (229 m [751 ft]). Most (approximately 54.7%) of the nocturnal migrants recorded passing over the radar study area RSA were flying above the height of the proposed solar power towers.

2.2.9.3 Conclusions

The mean hourly passage rate (targets/km/hr) recorded by radar during the fall study (126 targets/km/hr) fell within the range of means calculated at other similar studies (19 to 464 targets/km/hr) in the western US, indicating the presence of a nocturnal avian migration route of relatively low use. This suggests impacts should be low, particularly if the facility incorporates obstruction lighting regime(s) that have been shown to reduce the risk of birds colliding with structures (Gehring et al. 2009, Kerlinger et al. 2010).

2.2.10 Acoustic Bat Surveys and Bat Roost Surveys

2.2.10.1 Methods

In 2009, AECOM conducted a one-day survey for bat roosts within the original PSPP and surrounding region (AECOM 2009). During baseline surveys for the PSEGS in spring of 2013, an additional bat roost survey was conducted within one mile of the modified linear facilities for the Project (Karl 2013). During both survey efforts, potential roosting habitat (e.g., freeway underpasses, bridges, buildings) were examined for signs of bat roosting.

Acoustic bat surveys were conducted at the PSEGS in May 2013 and October through mid-December 2013 (Brown and Rainey 2013, 2014). The goal of the surveys was to assess the potential for bat roosting and foraging habitat at the site. A list of the bat species with potential to occur on the site is shown in Table 5.

Table 5. Bat species detected within, or potentially occurring within, the Palen Solar Electric Generating System.

Common Name	Scientific Name	Status (Federal/State)*
High-Frequency (> 40 kHz)		
California myotis**	*Myotis californicus*	-/-
California leaf-nosed bat	*Macrotus californicus*	BLMS/SSC
canyon bat**	*Parastrellus hesperus*	-/-
cave myotis	*Myotis velifer*	BLMS/SSC
Yuma myotis	*Myotis yumanensis*	BLMS/-
Mid-Frequency (30-40 kHz)		
western yellow bat**	*Lasiurus xanthinus*	-/SSC
Low-Frequency (< 30 kHz)		
big brown bat	*Eptesicus fuscus*	-/-
big free-tailed bat**	*Nyctinomops macrotis*	-/SSC
hoary bat	*Lasiurus cinereus*	-/-
Mexican free-tailed bat**	*Tadarida brasiliensis*	-/-
pallid bat**	*Antrozous pallidus*	BLMS/SSC
pocketed free-tailed bat	*Nyctinomops femorosaccus*	-/SSC
Townsend's big-eared bat	*Corynorhinus townsendii*	BLMS/C, SSC
western yellow bat**	*Lasiurus xanthinus*	-/SSC
Very Low-Frequency (< 15 kHz		
western mastiff bat **	*Eumops perotis*	BLMS/SSC

*BLMS = Bureau of Land Management Sensitive Species (BLM 2010a); SSC = state species of special concern (CDFG 2011); C = state candidate for listing (CDFW 2014).

**Detected during spring/fall acoustic surveys

The initial acoustic monitoring was conducted for four nights, from May 11 through May 14, 2013, to sample bats utilizing the PSEGS site. Passive acoustic monitors consisting of an ultrasound detector and a programmable data storage device (Anabat II and CF-ZCAIM; Titley Electronics, Ballina, NSW, Australia) were deployed at 13 locations throughout the PSEGS (Figure 11). Half of the detectors had standard Titley ultrasonic microphones (20 kHz to greater than 120 kHz) and half had low-frequency microphones with the same ultrasonic capability, but higher sensitivity to sounds in the audible range (4.5 to 20 kHz). This enhances detection of human audible bat sounds (e.g., pallid (*Antrozous pallidus*) and California leaf-nosed bat (*Macrotus californicus*) social calls, and hoary bat (*Lasiurus cinereus*), western mastiff (*Eumops perotis*), and other larger free-tail bat calls), but also increases the probability of recording insects, rodents, birds and leaf rustle.

A second acoustic survey was conducted in the fall of 2013, from October 7 through December 14. This survey effort consisted of four Anabat SD1 ultrasonic detectors with standard microphones deployed at four sites throughout the PSEGS, including three of the same sites sampled during the spring of 2013 and a new site at a large constructed pond adjacent to the agricultural property approximately a kilometer from the northwest corner of the Project site (Figure 11).

Acoustic data were analyzed using Analook W 3.9c (available at: www.hoarybat.com/Beta), as well as visual examination of call sequences. In this analysis, three multispecies acoustic categories are M50 (typically steep calls that end near 50 kHz) and in the PSEGS could include two species of Myotis (Yuma myotis [*Myotis yumanensis*] and California myotis [*Myotis californicus*]); Q25 (calls ending near 25 kHz attributable to several mid-frequency larger species); and LACI/NYFE calls (largely below 20 kHz) that are attributable to either hoary bats or pocketed free-tailed bats (*Nyctinomops femorosacca*). All M50 calls were assigned to California myotis based on knowledge of distributional and habitat information. Relative activity rates presented in the results represent counts of one minute intervals during the night that had at least one identified sequence file for a species or multispecies category (activity index of Miller 2001).

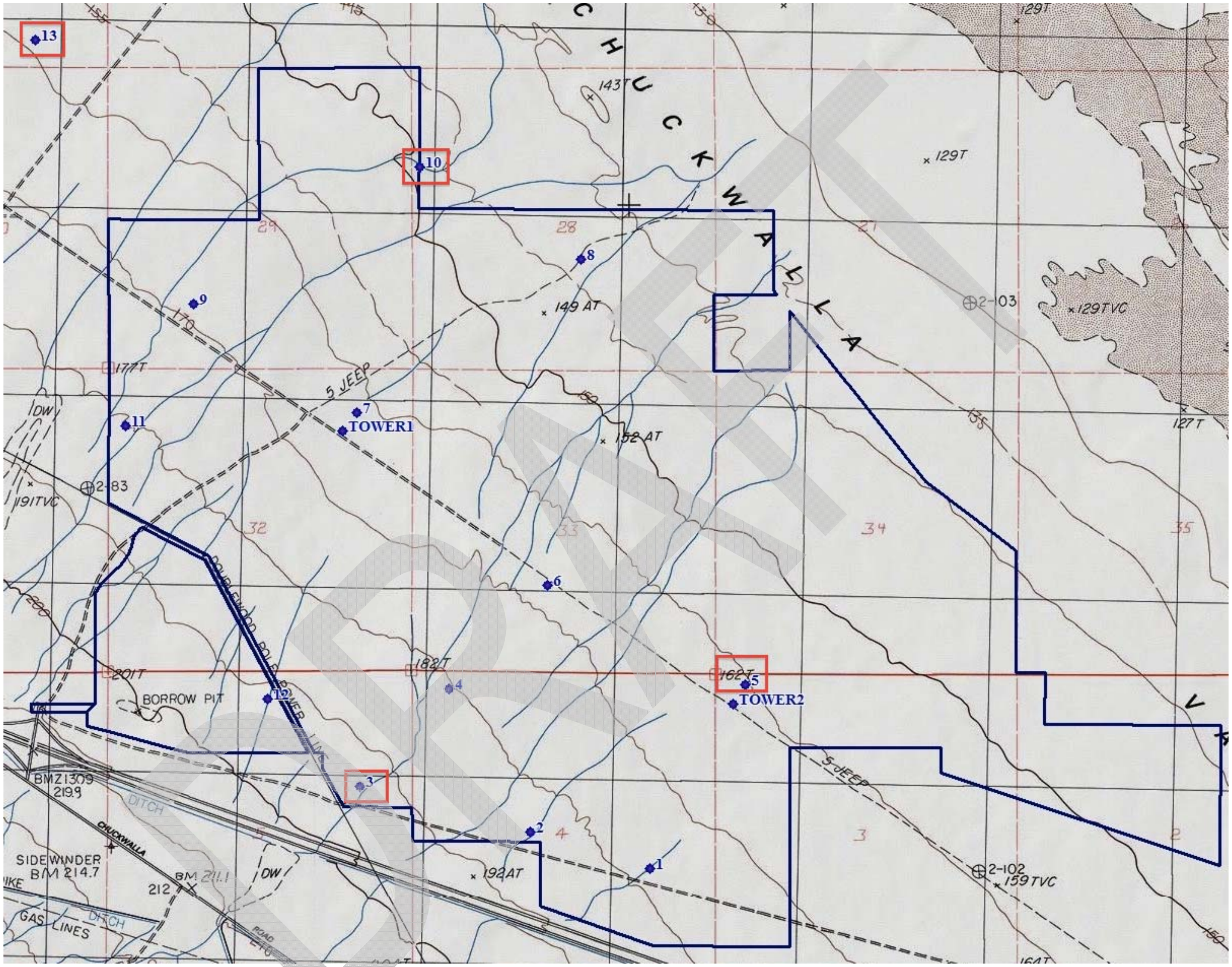

Figure 11. Location of acoustic bat sampling stations. Stations 1-12 shown as blue diamonds were monitored in May 2013, and stations with red rectangles, including an additional 13th station northwest of the Project, were monitored in October – December 2013.

2.2.10.2 Results

During the 2009 and 2013 bat roost surveys, only a single roosting bat was observed wedged into the underside of a bridge crossing Corn Springs Road. No other bat roosts were identified. Bridges surveyed in the Project vicinity tended to be smooth cement and provided minimal to negligible roosting habitat (Dr. P. Brown, pers. comm.). Roosting habitat for several tree and ground roosting species is present throughout the PSEGS in woodland microphyll habitats and crevices and burrows in the ground.

During the 4-day acoustic survey effort in the spring of 2013, three bat species, identifiable to species, were detected acoustically within the study area: pallid bat, canyon bat, and Mexican free-tailed bat (*Tadarida brasiliensis*; Table 5). There are also many 50 kHz Myotis sequences (M50). California myotis is nearly ubiquitous at low elevation in California deserts and far more common in open habitats distant from surface water than any other Myotis species, so all M50 call sequences were interpreted as California myotis (Table 5). Across the 12 detector locations, a total of 989 identified bat call minutes were recorded for the four nights of the spring study (Table 5). In this relatively low activity sample there were few instances of two different species or sonotypes calling within the same minute at one location, so the value obtained by summing across species and sonotypes is a reasonable representation of relative activity per location. The highest number of call minutes (443) was recorded at Site 10 (Figure 11, the northern-most station located next to a large palo verde tree). Canyon bats were the most common species detected at all stations, followed closely by California myotis. Canyon bats were the earliest detections at most stations and nights, with many recorded approximately 30 minutes after sunset. Pallid bats and Mexican free-tailed bats were detected less frequently and not detected at all stations (Table 5). Pallid bats were detected at six of the 12 stations concentrated along the western and northern Project boundaries (Table 6 and Figure 11).

Table 6. Minutes of bat activity per night[a] by site and species or acoustic category for acoustic monitoring conducted at the Palen Solar Electric Generating System, May 11-14, 2014.

	Species/Acoustic Category[b]				
Station	**PAHE**	**M50**	**ANPA**	**TABR**	**Q25**
1	7	2	0	0	2
2	8	2	0	0	0
3	17	62	1	0	1
4	12	43	0	1	0
5	8	4	0	1	0
6	22	49	0	0	0
7	25	6	0	0	2
8	70	45	2	1	1
9	52	7	1	0	2
10	171	247	3	2	10
11	78	8	1	0	1
12	11	0	1	0	0
Total	**481**	**475**	**9**	**5**	**19**

[a]Count of one minute intervals during the night that had at least one identified sequence file for a species or multispecies category

[b]PAHE = *P. hesperus*; M50 = *M. californicus*; ANPA = *A. pallidus*; TABR = *T. brasiliensis*; Q25 = non-diagnostic 25-35 kHz sequences;

During the 6-week fall survey effort in the fall of 2013, at least nine distinct bat species were detected acoustically within the study area (Table 5). This included the same five species/acoustic categories identified during the spring study, as well as an additional three species with call sequences identifiable to species: western yellow bat (*Lasiurus xanthinus*), western mastiff bat (*Eumops perotis*), and big free-tailed bat (*Nyctinomops macrotis*). In addition, several call sequences were attributable to either hoary or pocketed free-tailed bats, but lacked features that allow identification to species. Both species have the same probability of occurring in the study area in the fall. As is typical of surface water sources, especially in arid areas, the highest number of call minutes and species were recorded at the artificial pond (Station 13; Figure 11, Table 7). Canyon bats and California myotis were both common species at all detector locations, with Mexican free-tailed bats detected considerably less frequently. Pallid bats were detected at three stations in the fall and were most abundant at the pond (Table 7). Western yellow bats were detected only at the pond.

Table 7. Minutes of bat activity per night[a] by site and species or acoustic category for acoustic monitoring conducted at the Palen Solar Electric Generating System, October 7 – December 14, 2013.

	Species/Acoustic Category[b]								
Station	**PAHE**	**M50**	**ANPA**	**TABR**	**Q25**	**LAXA**	**EUPE**	**LACI/NYFE**	**NYMA**
3	17	849	0	26	21	0	3	6	0
5	29	13	1	18	12	0	3	7	1
10	208	212	2	8	23	0	1	6	1
13	3778	4714	85	69	1396	93	14	21	1
Total	**4032**	**5788**	**88**	**121**	**1452**	**93**	**21**	**40**	**3**

[a] Count of one minute intervals during the night that had at least one identified sequence file for a species or multispecies category

[b] PAHE = *P. hesperus*; M50 = *M. californicus*; ANPA = A*. pallidus*; TABR = *T. brasiliensis*; Q25 = non-diagnostic 25-35 kHz sequences; LAXA = *L. xanthinus*; EUPE = *E. perotis*; LACI/NYFE = *L. cinereus* and/or *N. femorosaccus*; NYMA = *N. macrotis*

2.2.10.3 Conclusions

Seven distinct species of bat were detected during the spring and fall studies. Six additional species could be active on the Project site during at least one season, though two (California leaf-nosed bat and Townsend's big-eared bat [*Corynorhinus townsendii*]) have typically low intensity echolocation signals may not be readily detectable acoustically even when present. Hoary bats and/or pocketed free-tailed bats were also present, but overlap in call characteristics making species identification impossible. Three special-status bat species are most likely to use the site – pallid bat, California leaf-nosed bat, and Townsend's big-eared bat. Other special-status bats known from the area (western mastiff bat) may pass through the PSEGS, but are inhabitants of rocky areas, so would not be considered to be using the site. Some common bat species (e.g., canyon bat and California myotis) could roost in crevices, burrow or tree cavities on site.

Possible impacts to bats would be largely through removal of roosting and/or foraging habitat. Because the Project site does not contain mountainous terrain, direct impacts would be to species (i.e., pallid bats and canyon bats) that roost in or under objects on the ground (e.g., rocks, woody debris), in crevices in soil, or standing wood. Direct impacts may also include the loss of foraging habitat for several species that roost in the rocky hills adjacent to the PSEGS and in multiple abandoned mines within a 16- km radius of the Project.

3.0 PALEN AVIAN RISK ANALYSIS: PRELIMINARY EXPOSURE AND RISK RATES BASED ON FALL 2013 SURVEY DATA

3.1 Introduction

The objective of this analysis was to assess risk to birds flying through regions of concentrated solar flux surrounding the two collection towers at the proposed PSEGS. Because little is known about the quantitative relationship between solar flux and physical harm (or death) of birds, attempts to estimate quantities such as probability of injury or expected number of fatalities were not made at this time. Rather, numbers of bird passages were conservatively predicted, by major taxonomic groups, through the area where levels of solar flux equals or exceeds levels that may cause effects. Predicted numbers of flights accounted for various assumptions about bird avoidance of concentrated solar flux and for the proportion of birds that are likely to fly through regions of potentially harmful flux.

Because there is little known about the levels of flux that can produce effects to avian species, BrightSource Energy commissioned a study that examined effects of solar flux on various sizes of bird carcasses (Santolo 2012). The Santolo study recognized effects in birds (smaller than eagles) at solar flux levels of 50 kW/m^2 and higher for a period of greater than 30 seconds. These elevated levels of solar flux are localized around the tower receiver. Effects on smaller avian species were thought to occur within high levels of solar flux during operation of Solar 1 (McCrary et al. 1986), which was corroborated by the Santolo study (2012). This information, the best available empirical data available, was used, along with projections of anticipated flux at operational Palen towers, to define the region in space in which passing birds are at risk.

The analysis makes a number of assumptions—some simplifying, others in lieu of any empirical data to better inform the model. All of the assumptions are conservative in the sense that the model almost certainly overestimates risk. These assumptions are as follows:

- In calculating the region of solar flux that may cause effects, 20% of the heliostats are assumed to be in a standby position, which increases the volume of the region where solar flux levels of 50 kW/m^2 or higher can be reached.
- In the model, 20% of the heliostats in standby position is assumed to occur during all operations. Larger numbers of heliostats in standby contributes to a larger and/or more intense region of flux around the tower. There will be many times when the facility is operating at conditions that would reduce the volume of the region where solar flux levels of 50 kW/m^2 or higher can be reached.

- The region of potential risk was over-estimated by assuming the solar flux contours are a constant height. As such, area where flux levels are projected to be lower than 50kW/m^2 are included in the risk zone.
- The aim was to model risk to a broad selection of taxonomic groups. The birds observed at the Palen site represent a diverse assemblage of avifauna, with considerable variation in flight characteristics. As such, no attempt was made to model flight time through regions of flux. Thus, the model considers every potential exposure, not just those long enough (i.e. 30 seconds at 50kW/m^2, as per the Santolo study) to have an effect.

3.2 Methods

3.2.1 Solar Flux

Two-dimensional images of solar flux (Figure 12) provided by BrightSource Energy were used to generate simplified models of risk zones. These images represent conservative assumptions about the flux field, including 20% standby. The area of flux deemed as potentially hazardous includes all regions of 50 kW/m^2 flux, as well as some of the 25 kW/m^2 region. This is a conservative assumption in light of the 50 kW/m^2 flux (at 30 seconds of exposure) deemed hazardous in a study by Santolo (2012), the only available scientific and commercial data where flux effects to avian species has been tested.

The area within 100 m of the tower was calculated from the plan view (Figure 12a), while the minimum (176 m [577 ft]) and maximum (280 m [919 ft]) height of each contour was measured from the profile view (Figure 12b). Conceptually, the zone was viewed as a round disc with circular area equal to area calculated from the plan view and constant height equal to the difference between the maximum and minimum heights measured from the profile view. Note that this approach is also conservative because it over-estimates the actual volume within a given risk zone because the estimated contours are not of constant height (Figure 12b).

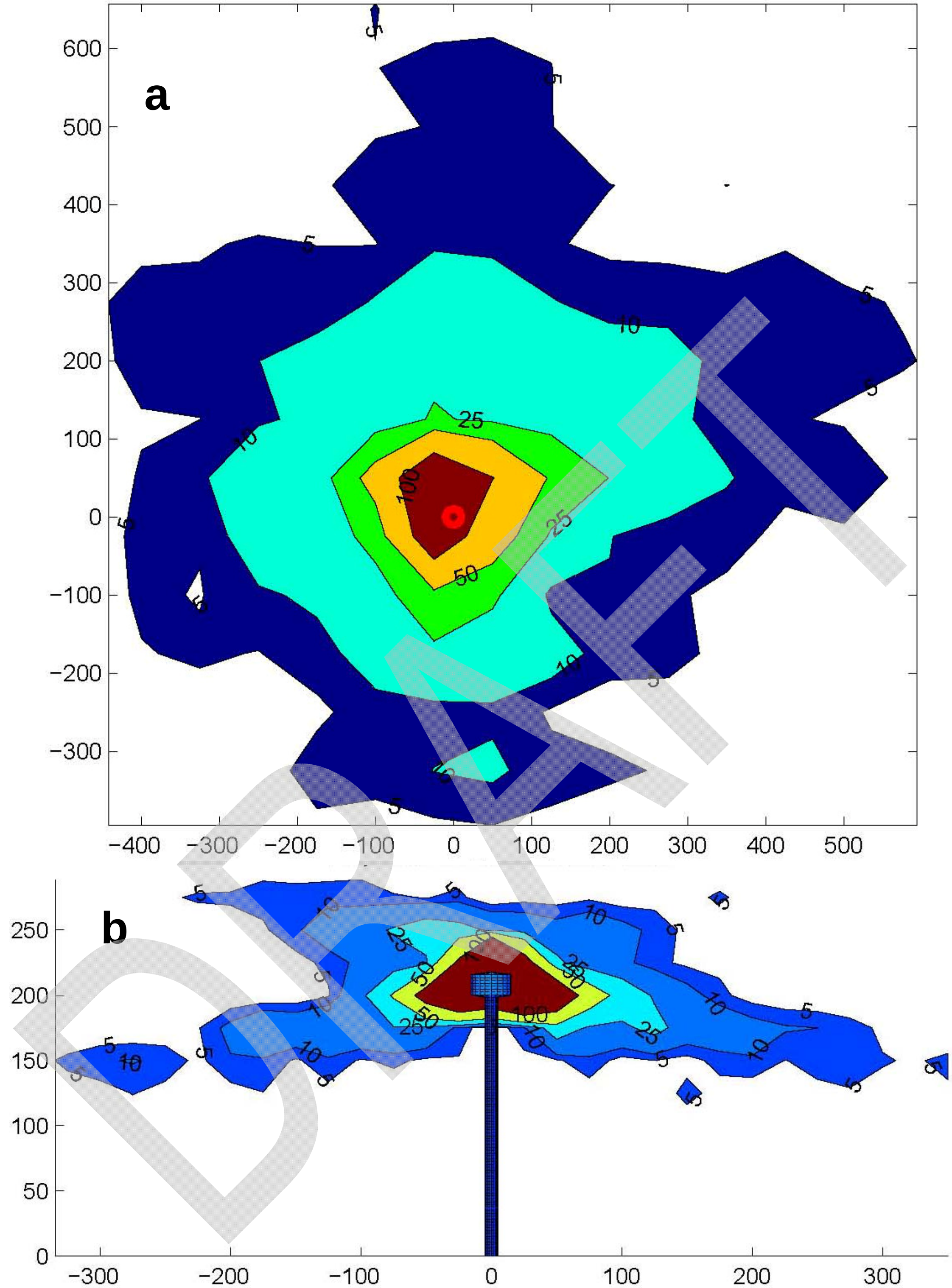

Figure 12. Estimated solar flux in (a) horizontal slice viewed from above (plan view), and (b) vertical slice viewed from the side (profile view), used in modeling bird exposure. Contours indicate flux in kW/m^2. Units on axes are meters.

3.2.2 Exposure Rate

For the Project, bird survey data were collected via six fixed-point BUC and 150 SBC survey points (Figures 4 and 6) during fall of 2013 (Levenstein et al. 2014). When birds were observed, species, behavior, distance from the observer and flight height was recorded. For BUC surveys birds were included in the analysis if the estimated distance was within 800 m of the observer, and use was standardized by observer hour at each BUC point location. For SBC surveys, birds were included in the analysis if the estimated distance was within 100 m of the observer, and use was standardized to 10-minute intervals at each SBC point location.

Exposure was calculated for major taxonomic groups and diurnal raptor subgroups based on standardized mean use, flight height, flight path data, and expected operational daylight hours at PSEGS. For each group, the proportion of birds observed flying within the flight heights occupied by the potentially dangerous flux region (176-280 m) was calculated. To account for small sample sizes with flight height information, the proportion at potentially dangerous flight heights over accipiters, buteos, eagles, falcons, osprey, other raptors, and vultures was averaged. Similarly, averages were calculated over shorebirds, dove/pigeons, passerines, and swifts/hummingbirds. For some taxonomic groups, observations indicated zero use in the 176-280 m height range associated with potentially hazardous flux, and/or zero use within 100 m of BUC points. To allow for the possibility of exposure among these groups of birds, the average across similar bird types (noted above) was used.

Similarly, the proportion of flight paths observed within the area occupied by the potentially hazardous flux region (disc of radius 100 m) was calculated, relative to the number of flight paths observed within 800 m of the BUC survey points. In particular, the average proportion of flights within 200 m of BUC points 3 and 5 were used because these points are within 200 m of the proposed tower locations at the PSEGS.

Passerines and other small birds were recorded during BUC surveys; however, due to detection bias associated with identifying small birds at large distances, SBC survey data was utilized to determine use for passerines, doves and pigeons, and swifts. The average use for these three groups from the SBC points located within the project boundary was calculated. The use values were subsequently scaled up to birds per hour to be comparable to BUC data. Since detection bias likely influenced the proportion of birds detected at heights above 100 m, exposure was calculated two ways for passerines, doves and pigeons, and swifts: Using the proportion of birds observed flying at heights between 176 and 280 m (0.3%), and the more conservative estimate of 1%, or about 1.25 times the proportion of small birds observed flying above 100 m (0.78%).

Daylight operational hours were estimated to be 4,080 hours per year (4,446 hours per year x 335 out of 365 operation days per year).

3.2.3 Exposure Model

The model used to calculate mean exposure is:

$$m_i * h_i * p_i * T_{operate}$$

where,

$m_i = mean\ use\ \left(\frac{birds}{survey\ hour}\right)\ in\ the\ i^{th}\ taxonomic\ group$

$h_i = proportion\ of\ birds\ observed\ flying\ between\ 176 - 280m\ AGL\ in\ the\ i^{th}\ taxonomic\ group$

$p_i = proportion\ of\ flight\ paths\ observed\ intersecting\ 100m\ disc\ around\ each\ proposed\ tower\ location\ in, the\ i^{th}\ taxonomic\ group$

$T_{operate} = expected\ number\ of\ operational\ daylight\ hours\ at\ Palen$

3.2.4 Avoidance

In lieu of any comparable model for 'collision' with the flux zone (or, non-avoidance) a framework similar to that of the USFWS fatality prediction model for eagles (USFWS 2013a) was adopted. It was assumed that birds will actively avoid regions of higher flux based on both visual cues (higher light intensity and/or presence of the tower) and increases in sensible heat; however, data that would allow estimation of avoidance rates was not available. Therefore, non-avoidance probability (the complement of avoidance) was modeled using four alternative Beta distributions with progressively lower mean (decreasing probability of flight through risk zones) and lower variance. These alternative distributions are summarized in Table 8 and Figure 13. With a Beta (3, 3) distribution, on average 50% of birds are expected to fly through the risk zones, with as few as 0% and as many as 100%; in contrast, with a Beta (1.5, 148.5) distribution, only 1% of birds are expected to pass through the risk zones and it would be extremely rare for more than 5% of birds to pass through. When the Project becomes operational, an attempt will be made to confirm, validate, and/or revise model assumptions such as avoidance.

Table 8. Parameters of four alternative Beta distributions used to model probability of non-avoidance of risk zones.

α	β	Mean	Standard Deviation
3.0	3.0	0.50	0.189
2.0	6.0	0.25	0.144
2.0	38.0	0.05	0.034
1.5	148.5	0.01	0.008

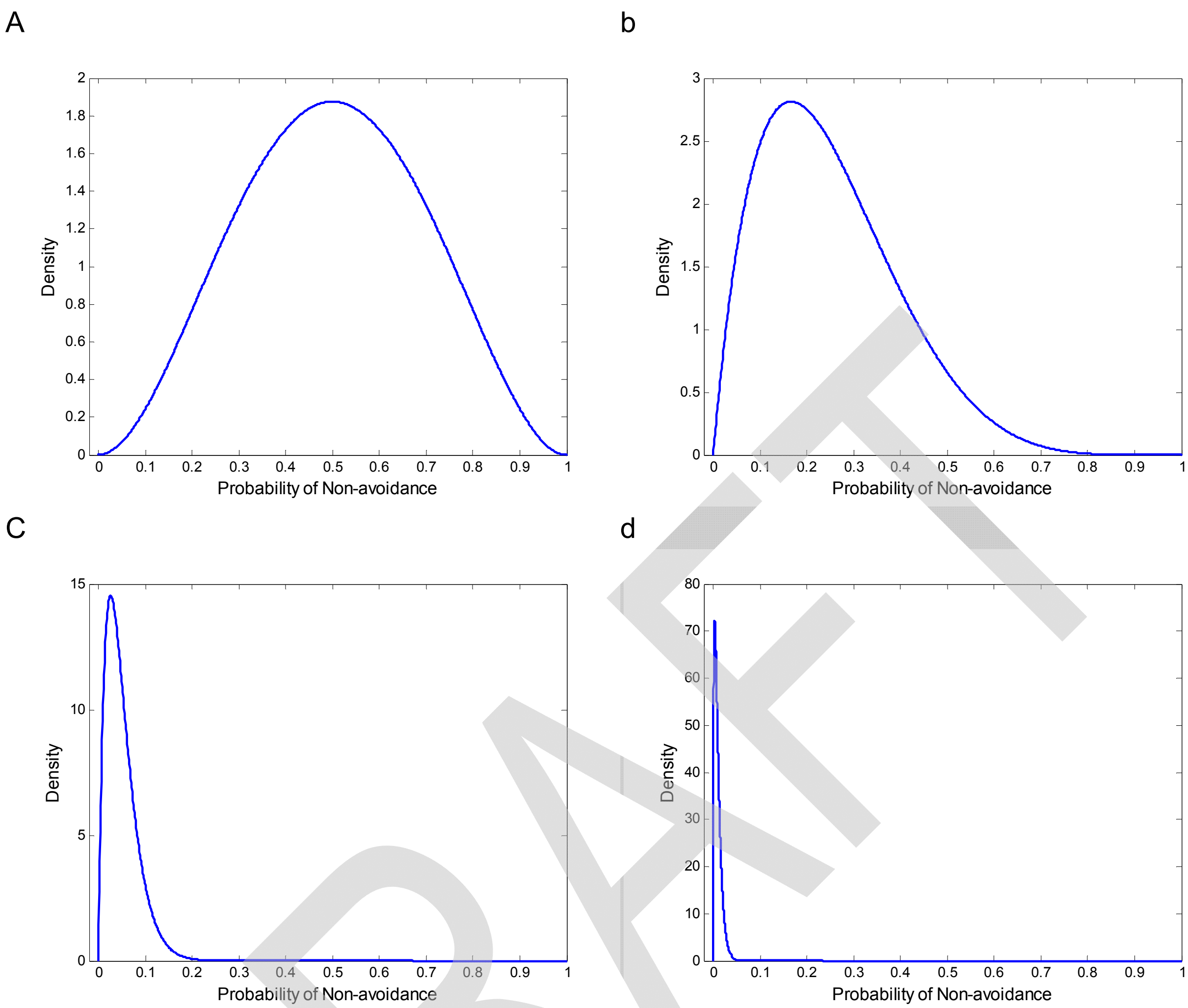

Figure 13. Alternative Beta distributions for the probability of not avoiding risk zones: (a) Beta (3,3); (b) Beta (2,6); (c) Beta (2,38); and (d) Beta (1.5, 148.5).

3.2.5 Risk Model

Therefore, the model used to calculate mean risk is:

$$m_i * h_i * p_i * T_{operate} * P_{na}^{i}$$

where,

$$m_i = mean\ use\ \left(\frac{birds}{survey\ hour}\right)\ in\ the\ i^{th} taxonomic\ group$$

$$h_i = proportion\ of\ birds\ flying\ from\ 176 - 280m\ AGL\ in\ the\ i^{th} taxonomic\ group$$

$$p_i = proportion\ of\ flight\ paths\ observed\ intersecting\ 200\ m\ disc\ around\ each\ proposed\ tower\ location\ in\ the\ i^{th} taxonomic\ group$$

$$T_{operate} = expected\ number\ of\ operational\ daylight\ hours\ at\ Palen$$

$$P^{(i)}{}_{na} = probability\ of\ non - avoidance\ in\ the\ i^{th} taxonomic\ group$$

3.3 Results

Table 9 contains results of the models of potential exposure to solar flux at the Palen facility by birds within different taxonomic groups. Based on the assumptions used in these models, and assuming no avoidance or attraction, it is estimated that approximately 665 to 1,228 flight paths of birds would be exposed to solar flux overall (Table 9). Of the taxonomic groups investigated, and using the more conservative assumptions, passerines have the potential for the highest level of exposure (229 – 764) while turkey vultures are the 2nd most common group identified (332). Other larger bird taxonomic groups that are expected to have some potential exposure include diurnal raptors (30), with buteos (16) the most exposed, followed by falcons (seven).

Table 9. Mean number of birds, by group, expected to enter potential risk area (200-m diameter disc around each bird use count [BUC] point), based on BUC 3 & 5 data.

Bird Group	Mean Use (Birds/Hour/Point) BUC 3	BUC 5	Mean Proportion within 100 m	Flight Height (176-280 m)	Mean Exposure
Waterbirds	0.08	*0.01	0.171	0.188	12
Waterfowl	0.07	0.11	0.191	0.159	23
Shorebirds	1.20	1.20	0.354	**0.003**	11
Gulls/Terns	0.08	0.10	0.418	0.048	15
Diurnal Raptors	0.14	0.18	0.207	0.085	31
Accipiters	0.01	0.02	0.234	0.133	4
Buteos	0.06	0.06	0.252	0.133	17
Northern Harrier	0.02	0.02	0.205	0.013	1
Eagles	*0.01	0.00	0.143	0.133	1
Falcons	0.02	0.05	0.194	0.133	8
Osprey	0.01	0.01	0.138	0.133	2
Other Raptors	0.01	0.02	0.061	0.133	1
Vultures	1.90	1.77	0.164	0.133	327
Upland Game Birds	*0.01	0.00	0.214	0.00	0
Small Bird Group	**Average Within Project Boundary**				
Doves/Pigeons	0.46		1.000	**0.003 – 0.01**	11 – 38
Passerines	9.36		1.000	**0.003 – 0.01**	229 – 764
Swifts	0.04		1.000	**0.003 – 0.01**	1 - 4
Total					**665 – 1,228**

*mean use actually <0.01

Table 10 illustrates what are the potential changes in the numbers of exposures based on varying degrees of potential avoidance (or non-avoidance = 1 – avoidance). While we anticipate some level of avoidance for most of the species due to the tower and heat, there is limited quantifiable information as to what that level of avoidance may be, so we provided a range. In addition, avoidance is expected to increase beyond background levels due to the use of bird deterrent methods.

Table 10. Mean number of birds at risk per year, using four different non-avoidance probability models. Birds at risk is presented with respect to the mean, and 80th percentile of 1,000 random variates from one of the four beta distributions used to model non-avoidance probability.

	50% Non-Avoidance Probability		25% Non-Avoidance Probability		05% Non-Avoidance Probability		01% Non-Avoidance Probability	
Bird Type	**Mean**	**80th %**	**Mean**	**80th %**	**Mean**	**80th %**	**Mean**	**80th %**
Waterbirds	5.8	7.8	3.0	4.5	0.6	0.9	0.1	0.2
Waterfowl	11.0	14.8	5.7	8.5	1.1	1.7	0.2	0.3
Shorebirds	5.1	6.9	2.6	3.9	0.5	0.8	0.1	0.2
Gulls/Terns	7.2	9.8	3.7	5.6	0.7	1.1	0.2	0.2
Diurnal Raptors	15.4	20.8	7.9	11.9	1.6	2.3	0.3	0.5
Accipiters	*1.9*	*2.5*	*1.0*	*1.5*	*0.2*	*0.3*	*0.0*	*0.1*
Buteos	*8.1*	*10.9*	*4.2*	*6.2*	*0.8*	*1.2*	*0.2*	*0.3*
Northern Harrier	*0.2*	*0.3*	*0.1*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*
Eagles	*0.4*	*0.5*	*0.2*	*0.3*	*0.0*	*0.1*	*0.0*	*0.0*
Falcons	*3.6*	*4.9*	*1.9*	*2.8*	*0.4*	*0.5*	*0.1*	*0.1*
Osprey	*0.7*	*1.0*	*0.4*	*0.6*	*0.1*	*0.1*	*0.0*	*0.0*
Other Raptors	*0.5*	*0.7*	*0.3*	*0.4*	*0.1*	*0.1*	*0.0*	*0.0*
Owls	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vultures	160.1	216.2	82.7	123.7	16.4	24.1	3.2	4.9
Small Birds	**Proportion flying 176-280 m AGL = 0.003**							
Doves/Pigeons	5.53	7.47	2.86	4.27	0.57	0.83	0.11	0.17
Passerines	112.32	151.69	58	86.78	11.5	16.92	2.27	3.45
Swifts	0.48	0.64	0.25	0.37	0.05	0.07	0.01	0.01
Total	**338**	**457**	**175**	**261**	**35**	**51**	**7**	**10**
Small Birds	**Proportion flying 176-280 m AGL = 0.01**							
Doves/Pigeons	18.6	25.2	9.6	14.4	1.9	2.8	0.4	0.6
Passerines	374.7	506.0	193.5	289.5	38.4	56.4	7.6	11.5
Swifts	2.0	2.6	1.0	1.5	0.2	0.3	0.0	0.1
Total	**615**	**831**	**318**	**475**	**63**	**93**	**12**	**19**

3.4 Discussion

3.4.1 Model Interpretation

Birds entering a region of flux must spend some time traversing that region. The amount of time will depend of flight speed, which may vary significantly by group or species and under varying weather conditions; the result is variation in the amount of flux exposure time. There is no publicly available data which would allow for a prediction of the amount of time necessary for exposure to result in ultimate mortality, even if accurate flight speeds could be predicted for all taxonomic groups, or species. Therefore, the models presented above should be interpreted as a conservative avian exposure rate, rather than a predicted mortality rate.

The models above also assume that the average bird use derived from fall 2013 is constant throughout the entire year. This period of time probably represents higher than average use for species migrating through this region of California. Spring breeding and migration season would be expected to have comparable, relatively high use as well; however, winter and summer use are likely lower than the estimates generated from the fall data. Moreover, the model assumes no disturbance in observed activity at the PSEGS site. This is an unlikely assumption given scale of construction efforts, and the level of human and mechanical activity necessary to run a 500 MW concentrated solar power facility on a daily basis.

3.4.2 Annual Number of Bird Flights through Risk Zone

The average number of bird flights through areas of potentially hazardous flux varies considerably depending on assumptions of avoidance probability. Under the most conservative avoidance model, birds are equally likely to pass through or avoid the risk zone. Under this assumption, on average 338-615 birds/year, or 28-51 birds/month, are expected to be exposed to potentially hazardous levels of flux, including 15 raptors, 29 water-associated birds, 112-374 passerines, and 160 vultures (Table 10). The 80th percentile under this model predicts 457-831 birds at risk. Under the least conservative model with 1% non-avoidance, approximately 7-12 birds/year, or 0-1 birds/month, are expected pass through the region of potentially hazardous flux.

3.4.3 Annual Number of Turkey Vulture Flights through Risk Zone

The analysis above suggests that turkey vultures may be subject to a large number of exposures to potentially hazardous flux. Without better knowledge of avoidance behaviors, it is difficult to predict exactly how many vultures may be at risk. Using the four non-avoidance probability models above, the average number of exposures for turkey vultures ranges from 3/year to 160/year (Table 10).

To provide some context, the Partners in Flight (PIF) Population Estimates Database (PIF 2012) estimates a turkey vulture population of 130,000 in Bird Conservation Region 33 (the region including PSEGS), and 240,000 in the state of California. Thus, the average amount of exposure per year given by the least conservative model (50% non-avoidance) constitutes

0.12% of the estimated population in BCR 33, or 0.06% of the estimated population in California.

3.4.4 Annual Number of Passerine Flights through Risk Zone

Passerines may also be subject to a large number of exposures to potentially hazardous flux based on these risk models. As with turkey vultures, lacking knowledge of avoidance behaviors, it is difficult to predict exactly how many passerines may be at risk. Using the four non-avoidance probability models above, the average number of exposures for passerines ranges from 2/year to 112/year (Table 10).

4.0 ASSESSMENT OF RISK TO BIRDS AND BATS

4.1 Impacts to Birds and Bats

The prediction of impacts to birds from the construction and operation of various types of solar facilities is going to be somewhat speculative in nature as no systematic studies detailing the impacts to birds and bats from these types of facilities have been made publicly available to date. However, information regarding impacts to birds from other types of facilities (e.g., wind) can be examined along with some information that is just beginning to become available from a number of new and existing solar facilities where efforts have been made recently to assess impacts to birds. To date, there exists only one other concentrating solar power tower project in the US and information has begun to become available regarding impacts to birds from that facility as well.

4.1.1 Habitat Loss

Construction of the Project will result in some habitat loss for avian and bat species. The bird and bat assemblages documented using the Project are typical of the arid Mojave-Colorado desert habitat. A majority of the Project will be constructed in creosote scrub habitat which is particularly depauperate relative to avian species found there during all seasons. A small portion of the project will be constructed in microphyl woodlands which are typically more important to various avian species; however, there are relatively large expanses of this habitat type both adjacent to and further outside of the Project, particularly to the south of the Project boundary. In addition, the project lies adjacent to large date palm plantations which have proven to be far more important to a great variety of species during both the breeding and migration seasons. These palm plantations should experience only minimal impacts and those impacts will likely be limited to the actual construction phase of the project. Potential causes of impacts to the plantations during construction could result from noise generated by construction equipment and machinery, artificial lighting, and possibly dust blown from the construction site. Any effects of habitat loss will be minimized and offset by the general avoidance and minimization measures outlined in Section 5.0.

4.1.2 Noise

Prior to construction of the Project, ambient noise consisted primarily of vehicle traffic on I-10 which lies adjacent to the southwest border of the site. Other noise emanated from equipment used in association with the palm and citrus plantations to the west of the Project including generators powering irrigation equipment and more occasional vehicle traffic. Natural sources of noise included wind, which can be intense in the area, and wildlife. In the Plan Amendment/Final EIS for the Palen Solar Power Project (BLM 2013) it was projected that a majority of the Project's operational noise would originate from the power block equipment (steam turbines, cooling towers, etc.) which would be roughly centered at each site and surrounded by solar fields. It was further projected in the document that assuming average construction noise of 85 decibels (adjusted; dBA) at 50 ft (15 m) from the noise center and noise attenuation of 6 dBA per doubling of distance (Solar Millennium 2009 as cited in the CEC Revised Staff Assessment [RSA] 2010), normal construction noise would attenuate to about 60 dBA approximately 800 ft (0.15 mile) from the noise center. The noise generated by a vacuum cleaner when heard from a distance of 100 ft will typically measure at approximately 60 dBA (BLM 2013). The majority of the construction activities would occur within the power blocks located approximately 3,750 ft (0.71 mile) from the project boundary. Studies have shown that noise levels over 60 dBA can result in nest abandonment by birds and intense, long-lasting noise can mask bird calls, which can reduce reproductive success (Dooling and Popper 2007; Hunsaker 2001 as cited in the CEC RSA 2010). Sensitive bird nesting habitat occurs in adjacent creosote scrub and desert dry wash woodland. It is anticipated that average construction noise levels would be less than 60 dBA adjacent to the project site.

4.1.3 Lighting

Artificial lighting can be a source of disturbance to birds nesting nearby and may in some instances lead to nest abandonment. Artificial lighting has also been shown in several studies to serve as an attractant when deployed on artificial structures (e.g., communication towers, offshore oil platforms), which can result in night-migrating birds colliding with these structures (Poot et al. 2008, Gehring et al. 2009, Kerlinger et al. 2010). Prior to construction of the Project, sources of light in the vicinity included traffic along the adjacent I-10 corridor, as well as lighting associated with the Desert Center Airport, a private facility (5.5 miles [8.9 km] away), the Chuckwalla Valley Raceway (6.25 miles [10.0 km]), the communities of Desert Center (9.0 miles [14.5 km]) and Lake Tamarisk (9.25 miles [14.9 km]), and the Chuckwalla Valley and Ironwood State Prisons (16 miles [26 km]), as well as lighting associated with a number of nearby palm and citrus plantations and related buildings. During construction, lighting will include lights from construction vehicles when and if construction occurs during the overnight hours, lights on structures (e.g., office trailers) and possible lighting associated with roads within the Project.

While the Project is in the operations phase, there will be down-shielded lights on buildings, and truck lights associated with the washing of heliostats, which occurs at night. The addition of Project lighting in an area that previously had relatively few sources of artificial light could increase the potential for bats to collide with Project infrastructure (Orbach and Fenton 2010, McGuire and Fenton 2010). In addition, as insects may be attracted to artificial light, there exists the potential to increase this source of prey for insect eating bats, further attracting them to the Project and, thereby, increasing the risk of collisions with lighted infrastructure. However, thus far, post-construction monitoring at several projects has resulted in very few bat carcasses being encountered. As it is currently not understood how bats may be impacted by the Project, post-construction mortality monitoring should prove valuable in gaining more insight into this area of interest and adaptive management measures may be enacted to reduce impacts should they become evident.

4.1.4 Collision

4.1.4.1 Siting in High Risk Areas

Avian mortality concerns are typically elevated when projects are sited in high use areas for bird species, bird groups or taxa considered at risk from the particular mortality source. For example, concern over levels of raptor mortality at wind projects are elevated at sites with high raptor nesting, high prey base, topography that is believed to increase risk, and other factors. Waterfowl and waterbird collision risk with tall structures such as unmarked transmission lines is often elevated near wetlands, playas and other suitable habitat. Concerns over potential risk of collision for migrating songbirds with structures is often elevated when projects are located in high migration areas such as the Texas Gulf Coast, near significant migration stopover areas. However, night migration in the more arid western United States is known to be much less dense than in the eastern one-half of North America (Gauthreaux et al. 2003). As a result, we know of no large-scale fatality events at communication towers in the western United States, yet there are dozens reported from the eastern part of the country (Shire et al. 2000).

4.1.4.2 Height of Structures

A primary risk factor for avian collision mortality is the height of structures within a development. For songbirds, height of structures has been a very important risk factor, with taller structures (buildings, communication towers) typically affecting more birds than shorter structures (Kerlinger et al. unpublished; Kerlinger et al. 2012; Gehring et al. 2011). Particular dangers associated with buildings are the presence of windows and certain lighting regimes known to attract birds (Klem et al. 2009). Very tall structures represent greater risk to birds because most night migrating birds fly at heights between 410 and 2,000 m (1,345 and 6,562 ft; Kerlinger 2001), generally occurring in higher densities at greater heights AGL. In a study by Gehring et al. (2011) and Kerlinger et al. (unpublished), the number of birds killed at communication towers was found to be positively correlated in a non-linear fashion with tower height.

4.1.4.3 Light Attraction

In most studies to date, poor weather has been associated with large-scale mortality events that have occurred at tall structures such as communication towers (Manville 2000; Kerlinger et al. 2010; Longcore et al. 2012, 2013), as well as street lights, lighthouses, water towers, ski lifts, and other tall, lit structures. In addition, large-scale fatality events have even been reported to occur at natural gas compressor stations that are equipped with bright flood lights. These events usually occur in inclement weather (fog, light rain, light snow, low ceiling) when navigational cues are obscured and as a result, attracted to the lights of facilities and structures, birds become disoriented and remain in the lighted zone where they circle the structures at risk of collision with the tower and its guy wires, and collisions with each other, or possible exhaustion (Gauthreaux and Belser 2006). Fortunately, recent studies have demonstrated that avian collisions with manmade structures can be reduced dramatically with the adoption of certain lighting regimes that do not attract birds (Gehring et al. 2009, Kerlinger et al. 2010, Patterson 2012). Furthermore, most birds that die after being attracted to communication towers by lighting are killed when they collide with the guy wires that support those towers (Gehring et al. 2011).

In 2010, Kerlinger et al. published a paper in which results similar to those reported in Gehring et al. (2011) regarding birds that were found at wind turbines. The study reported that the reason why so few night migrants are found dead at wind turbines was that almost all wind turbines that are equipped with Federal Aviation Administration (FAA) lights use flashing red strobes rather than steady burning lights. That flashing lights do not attract night migrants was demonstrated by the fact that at dozens of wind plants that had been studied, there was no difference in fatality rates of these birds between turbines with flashing lights and turbines with no lights. The lighting at the Project has been designed to standards that will ensure that they do not increase the risk of attracting migrating songbirds and other night-flying birds to the site.

4.1.4.4 "Lake Effect Hypothesis"

Discussion surrounding solar facility impacts to waterbirds and waterfowl includes the hypothesis that these species may potentially mistake the extensive solar arrays for water features on which the birds can land, usually at night. Moreover, such collisions, which also occur at structures like parking lots and train yards (usually a black cinder surface), both of which resemble water bodies at night, often do not result in direct mortality because the angle of collision is relatively shallow. Such birds sometimes cannot take off after collisions because they are adapted to take off from water, not dry land.

It is important to note that there is no empirical evidence that solar facilities lead to significant avian mortality resulting from contact or collision with heliostats. Further, a unique characteristic of heliostats is their flexibility with respect to movement and positioning. The project owner can control the positions in which individual heliostats are stowed at night. If the heliostat fields at PSEGS are determined to pose a hazard to avian species, as indicated by mortality monitoring, the stowing of heliostats at night is a Project operational aspect that could be modified and studied in response.

Ducks, geese, and other waterbirds rarely collide with structures. The minute percentages of birds that have been demonstrated to collide with tall towers (guy wires), buildings, and vehicles have never been documented to result in any significant impact to any of their populations. An examination of permitted harvest of waterfowl by the USFWS and state wildlife agencies will help the reader to understand the magnitude of those harvests, and the resilience of these avian populations. These birds are harvested from the total duck population which was estimated in 2013 at 45.6 ± 0.7 [SE] million birds in North America (33% higher than the long-term average 1955-2012; USFWS 2013b). Other sources of mortality identified for waterbirds and waterfowl in Canada include road vehicle collisions, powerline electrocutions, communication tower collisions, cat (*Felis catus*) predation, agricultural pesticides, hunter harvest, and marine gillnets (Calvert et al. 2013). Nest destruction was attributed to haying and mowing, commercial forestry, transmission line maintenance, hydroelectric reservoirs, terrestrial oil and gas activities, mining, and road maintenance (Calvert et al. 2013). The biological significance of what will assuredly be low numbers of avian deaths from collision with project infrastructure at this solar facility is statistically immeasurable compared to these other sources. Studies like that of Longcore et al. (2013) and Erickson et al. (2014, in review) suggest that avian mortality cumulatively from thousands of communication towers and wind turbines for the great majority of waterfowl, songbirds, and waterbirds, is likely immeasurable and there is very little possibility of significant impacts to avian species' populations.

4.1.5 Solar Flux

To date there has been only one study published regarding the impacts of a solar power tower facility on avian species (McCrary et al. 1986). Of 70 carcasses found during the McCrary et al. (1986) study at the Solar One facility near Daggett, California, the most frequent cause of avian mortality was from collision with project infrastructure (57 carcasses; 81% of carcasses found). Thirteen (19%) birds (seven species) died from exposure to solar flux. A significant difference between the Solar One facility and the proposed Palen facility is the height of the solar power tower(s). The solar power tower at the Solar One facility was 86 m (282 ft) in height while the proposed solar power towers at PSEGS will be 228.6 m (750 ft) in height. The height of the solar flux zones at the Project which are associated with the height of the solar power towers is well above the height at which most birds typically fly during the day. Exceptions include some raptors, including vultures.

The only currently operating solar power tower facility in the US is the Ivanpah Solar Electric Generating System (ISEGS) which is located in San Bernardino County, California, approximately 30 miles (48 km) south of Las Vegas, Nevada. At a height of 137.2 m (450 ft), the power towers at ISEGS are a little closer to reaching the height at which the Palen towers will stand. Bird carcasses encountered incidentally at ISEGS have been recorded since November 2011. Standardized mortality surveys have been conducted at various portions of the ISEGS facility since March 2013. Surveys included a systematic search of the entire area within 260 m (853 ft) of power towers. After October 2013, 20% of the heliostat fields surrounding the towers, perimeter fences, and condenser buildings were also added to the search protocol. Searcher efficiency and carcass removal trials have been and are being conducted at ISEGS; however, those data had not been made available at the time that this BBCS was being prepared. Of 168 bird carcasses found since November 2011, 48 carcasses (29%) exhibited signs of flux related injury/damage to feathers. Most (51%) were passerines, and doves and pigeons accounted for 10% of flux related mortalities.

4.1.5.1 <u>Waterbirds and Shorebirds</u>

Among water-dependent bird types, the majority of waterbirds (58.6%) and shorebirds (79.8%) were observed flying below 35 m (115 ft) during BUC surveys conducted during fall 2013 at the proposed Palen facility. Mean bird use for these two groups was low (0.03/observer-hour/survey). None of the waterbirds or shorebirds observed during surveys at Palen was recorded flying within the heights where the flux zone might occur (210 – 245 m [689 – 804 ft]).

4.1.5.2 Waterfowl

Overall waterfowl use recorded during fall BUC surveys was 0.11 birds/observer-hour/ survey. The waterfowl with the highest use were snow goose (*Chen caerulescens*; 0.05 birds/observer-hour/survey), and greater white-fronted goose (*Anser albifrons*; 0.03). None of the waterfowl observed during surveys at Palen was recorded flying within the heights where the flux zone might occur (210 – 245 m).

4.1.5.3 Diurnal Raptors

Overall diurnal raptor use recorded during fall BUC surveys was 0.18 birds/observer-hour/ survey. Diurnal raptors composed 5.7% of total bird use and were observed during 54.0% of surveys. The diurnal raptor species with the highest use was red-tailed hawk (0.05 birds/observer-hour/survey), which accounted for 28.0% of all diurnal raptor use. Other species observed included prairie falcon (0.03), Swainson's hawk (0.02 birds/observer-hour/survey), northern harrier (0.02), and Cooper's hawk (0.01). Of the diurnal raptors observed during fall BUC surveys, only 0.2% were recorded flying within the heights where the flux zone might occur (210 – 245 m). Potential for mortality or injury due to exposure within the zone of flux, though not nonexistent, should be low for diurnal raptors.

4.1.5.4 Vultures

Vultures, comprised entirely of turkey vultures, had a fall use of 1.74 birds/observer-hour/survey. Turkey vultures accounted for 56.5% of overall bird use and were observed during 47.4% of surveys. Of the vultures observed during fall BUC surveys, none were recorded flying within the heights where the flux zone might occur (210 – 245 m). Although vultures were not recorded flying within heights where the potential zone of flux might occur, with such high numbers of this species migrating through the area, it is possible that some of these birds could come into conflict with the flux zones. It is currently unknown how vultures will react to the presence of the solar power towers and associated zones of flux. Potential for mortality or injury to turkey vultures due to exposure within the zone of flux is difficult to predict, but it is anticipated to be moderate to high.

4.1.5.5 Swallows, Swifts/Hummingbirds

Despite being small birds, swallows and swifts/hummingbirds were also included in the data collection because they are potentially more susceptible to collision and flux-related impacts at solar energy projects, based on fatality monitoring results at the Solar One facility in San Bernardino County, California (McCrary et al. 1986). Swallows had a use estimate of 0.70 birds/observer-hour/survey and composed 27.2% of overall bird use. The swallow species with the greatest use was barn swallow (*Hirundo rustica*; 14.6 birds/observer-hour/survey) which composed 53.7% of all swallow use. Use by swifts/hummingbirds was 0.11 birds/observer-hour/survey, which accounted for 3.7% of overall bird use recorded during surveys. Swallows were recorded during 49.5% of all fall surveys, and swifts/hummingbirds were recorded during 9.8% of fall surveys. None of the swallows or swifts/hummingbirds observed during surveys at Palen was recorded flying within the heights where the flux zone might occur (210 – 245 m). Although this could be in part due to the difficulty associated with detecting these species at distances greater than 100 m, 19.2% of swifts/hummingbirds recorded during the surveys were flying at heights greater than 280 m, well above the heights where the zone of flux might be expected to occur. With relatively high numbers of these species migrating through the area, it is possible that some of these birds could come into conflict with the flux zones and, therefore, risk to these species is predicted to be low to moderate.

4.1.5.6 <u>Passerines</u>

At almost twice the height of power towers found at ISEGS, the towers at Palen are expected to cause fewer deaths and injuries to passerines than have occurred at ISEGS. While migrating at night, passerines commonly fly at heights far exceeding the height of towers proposed for Palen; however, flux is not present at night and passerines would be expected in very low numbers during the day at heights approaching the height of the proposed Palen power towers.
Unlike the exposure rates calculated for turkey vultures, the rates applied to passerines (see Section 3.2.2 of this document) are distributed among a broad variety of species. During fall 2013 surveys at the PSEGS site, at least 70 unique species were identified as passerines. Thus, risk associated with potentially dangerous levels of flux will be dispersed among many different species, suggesting no one species will experience anything close to population level impacts.

5.0 AVOIDANCE AND MINIMIZATION OF RISK USING BMP's and ACP's

PSH has designed the Project and will implement avoidance and minimization measures in the construction and operations phases to avoid and minimize Project-related bird and bat injury and fatalities. Implementation of a number of Conditions of Certification/Mitigation Measures is required to comply with the CEC license and BLM ROW Grant issued for the Project. A description of the avian and bat protection-related Conditions of Certification/Mitigation Measures is included in the following sections.

5.1 Project Siting

5.1.1 Project Location

The Project is located within the Riverside East Solar Energy Zone (SEZ), an area designated through the Solar Energy Development Programmatic EIS process as being appropriate for large utility scale solar development. On the BLM's Solar Energy Program Western Solar Plan website, the BLM has defined a SEZ as "an area well-suited for utility-scale production of solar energy where BLM will prioritize solar energy and associated transmission infrastructure development." The chosen Project location was the result of a lengthy study and analysis of the area. Numerous alternative sites were considered but eliminated, generally due to environmental constraints.

5.2 Project Design

5.2.1 Utility Poles and Lines

Transmission lines and all electrical components will be designed, installed, and maintained in accordance with the Avian Power Line Interaction Committee's (APLIC's) S*uggested Practices for Avian Protection on Power Lines* (APLIC 2006) and *Mitigating Bird Collisions with Power Lines* (APLIC 1994) to reduce the likelihood of large bird electrocutions and collisions. APLIC guidelines include recommended distances that phase conductors should be separated (minimum of 60 inches [152 centimeters (cm)]), or the use of perch diverters and/or specifically designed avian protection materials in areas where this distance is not feasible (APLIC 2006). The 230-kV transmission line transformers will be more than 60 inches apart, thus minimizing the risk for electrocution of golden eagles and other large raptors.

5.2.2 Lighting

The Project will be designed to minimize lighting, as required by Condition of Certification BIO-8 and in accordance with Condition of Certification VIS-3. To the extent feasible consistent with safety and security considerations PSH will design and install all permanent exterior lighting and all temporary construction lighting such that a) lamps and reflectors are not visible from beyond the project site, including any off-site security buffer areas; b) lighting does not cause excessive reflected glare; c) direct lighting does not illuminate the nighttime sky except for required FAA aircraft safety lighting (which should be an on-demand, audio-visual warning system that is triggered by radar technology); d) illumination of the project and its immediate vicinity is minimized; and e) the plan complies with local policies and ordinances. PSH will submit to the California Energy Commission CPM for review and approval, and simultaneously to the BLM and County of Riverside for review and comment, a lighting mitigation plan that includes the following:

A. Location and direction of light fixtures will take the lighting mitigation requirements into account;

B. Lighting design will consider setbacks of project features from the site boundary to aid in satisfying the lighting mitigation requirements;

C. Lighting will incorporate fixture hoods/shielding with light directed downward or toward the area to be illuminated;

D. Light fixtures that are visible from beyond the project boundary will have cutoff angles that are sufficient to prevent lamps and reflectors from being visible beyond the project boundary, except where necessary for security;

E. All lighting will be of minimum necessary brightness consistent with operational safety and security;

F. Lights in high illumination areas not occupied on a continuous basis (such as maintenance platforms) will have (in addition to hoods) switches, timer switches, or motion detectors so that the lights operate only when the area is occupied; and

G. Lighting plan will demonstrate that plant operational lighting (excluding FAA and emergency lighting) will, to the extent practical, not be directly reflected upward or off-site by heliostats in nighttime stow position.

5.3 Additional Pre-Construction BMP's and Conservation Measures

As required by Condition of Certification BIO-6, PSH will develop and implement a project-specific Worker Environmental Awareness Program (WEAP) and will secure approval for the WEAP from the CPM.

As part of the WEAP, pictures of golden eagles, burrowing owl, and other bird species of concern will be provided and information on sensitivity to human activities, legal protection, reporting requirements, and how to identify construction avoidance zones for these species as marked by flagging, staking, or other means, will be detailed. Further, protections for bird nests and information as described above will also be provided.

In addition, the WEAP will provide an overview of potential impacts to avian species from concentrated solar flux created during start up and the operations phase, and pertinent reporting requirements, and protection measures will be described.

5.4 Construction Phase BMP's and Conservation Measures

5.4.1 Designated Biologist

- As required by Condition of Certification BIO-1, PSH will assign at least one designated biologist to the project. PSH will submit the resume of the proposed designated biologist(s), with at least three references and contact information, to the CPM for approval in consultation with CDFW and USFWS. The designated biologist will:
    - Require a halt to all activities in any area when determined that there would be an unauthorized adverse impact to biological resources (e.g., disturbance to nesting birds) if the activities continued;
    - Inform the project owner and the construction/operation manager when to resume activities; and
    - Notify the CPM if there is a halt of any activities and advise them of any corrective actions that have been taken or would be instituted as a result of the work stoppage. If the work stoppage relates to any federal- or state-listed species, the Palm Springs Office of the USFWS and the Ontario Office of the CDFW will also be notified.

5.4.2 Noise Minimization

- As required by Condition of Certification BIO-8, PSH will minimize noise impacts.
  - o A continuous low-pressure technique will be used for steam blows to the extent possible in order to reduce noise levels in sensitive habitat proximate to the project site. Loud construction activities (e.g., unsilenced high-pressure steam blowing, pile driving, or other) will be avoided from February 15 to April 15, when it would result in noise levels over 65 dBA in nesting habitat (excluding noise from passing vehicles). Loud construction activities may be permitted from February 15 to April 15 only if:
    - ▪ The designated biologist provides documentation (i.e., nesting bird data collected using methods described in BIO-15 and maps depicting location of the nest survey area in relation to noisy construction) to the CPM indicating that no active nests would be subject to 65 dBA noise, or
    - ▪ The designated biologist or biological monitor monitors active nests within the range of construction-related noise exceeding 65 dBA. The monitoring will be conducted in accordance with a Nesting Bird Monitoring and Management Plan approved by the CPM. The plan will include adaptive management measures to prevent disturbance to nesting birds from construction related noise. Triggers for adaptive management will be evidence of project related disturbance to nesting birds such as: agitation behavior (displacement, avoidance, and defense); increased vigilance behavior at nest sites; changes in foraging and feeding behavior; or nest site abandonment. The Nesting Bird Monitoring and Management Plan will include a description of adaptive management actions, which will include, but not be limited to, cessation of construction activities that are deemed by the designated biologist to be the source of disturbance to the nesting bird.

5.4.3 Pre-Construction Nest Surveys and Avoidance Measures

- As required by Condition of Certification BIO-15, PSH will conduct pre-construction nest surveys if site mobilization and construction activities will occur from February 1 through July 31. The designated biologist or biological monitor conducting the surveys will be experienced bird surveyors familiar with standard nest-locating techniques such as those described in Martin and Guepel (1993). The goal of the nesting surveys will be to identify the general location of the nest sites, sufficient to establish a protective buffer zone around the potential nest site, and need not include identification of the precise nest locations. Surveyors performing nest surveys will not concurrently be conducting desert tortoise surveys. The bird surveyors will perform surveys in accordance with the following guidelines:
  - o Surveys will cover all potential nesting habitat in areas that could be disturbed by each phase of construction, as described in BIO-29 (Phasing). Surveys will also include areas within 500 ft (152 m) of the boundaries of the active construction areas (including linear facilities);

- At least two pre-construction surveys will be conducted, separated by a minimum 10-day interval. One of the surveys will be conducted within the 14-day period preceding initiation of construction activity. Additional follow-up surveys may be required if periods of construction inactivity exceed three weeks, an interval during which birds may establish a nesting territory and initiate egg laying and incubation;
- If active nests or suspected active nests are detected during the survey, a buffer zone (protected area surrounding the nest, the size of which is to be determined by the designated biologist in consultation with CDFW) and monitoring plan will be developed. Nest locations will be mapped and submitted along with a report stating the survey results to the CPM; and
- The designated biologist or biological monitor will monitor the nest until he or she determines that nestlings have fledged and dispersed; activities that might in the opinion of the designated biologist disturb nesting activities will be prohibited within the buffer zone until such a determination is made.

5.4.4 Avian Enhancement and Conservation Plan

- As required by Condition of Certification BIO-16a, PSH will implement the following measure to conserve and enhance avian populations in the vicinity of the project and throughout the region:
  - Regional Avian Electrocution Risk and Cable Collision Avoidance Measures. Consistent with the Desert Renewable Energy Conservation Plan (DRECP) framework (DRECP 2012), the project owner shall, prior to the commencement of commercial operations at the facility, fund the retrofitting of non-compliant utility poles in the vicinity of the project to APLIC (2006) standards or fund the installation of bird diverters in the vicinity of the project. A total amount of $300,000.00 will be provided for these enhancements. The funding shall be provided to an independent third party who will perform the actual retrofitting pursuant to a Retrofit Plan approved by the CPM.
  - The Retrofit Plan will develop a tiered approach to minimizing electrocution and collision risk wherein the first funding is applied to retrofit poles in areas where either mortalities are highest or area use is highest. The second tier of retrofitted poles would be areas of lesser importance. If funds remain available after first and second tier poles have been retrofitted, then the CPM may apply the remaining funds to other avian protection objectives outlined by the DRECP, in conjunction with BLM, USFWS, and CDFW. As an alternative to the Retrofitting Plan and the use of a CPM-approved third party, the total funding can be accomplished by making a payment in the amount of $300,000 to the National Fish and Wildlife Foundation's Bald and Golden Eagle Protection Act account.

- Additional Migratory Bird Conservation: The project owner shall, prior to the commencement of commercial operation of the facility, provide funds for mitigation in one of two ways:
  - Pay $1,500,000.00 to fund the activities of a CPM-approved third party that will perform additional migratory bird conservation measures. Alternatively, the project owner may prepare a promissory note to deposit said funds at the onset of operations while at the same time providing funding of the initial year of mitigation in the non-refundable amount of $50,000.00 to a project fund as determined by CPM in conjunction with BLM, CDFW, and USFWS for the initial year of mitigation in the absence of accrued interest.
  - Alternately, the project owner may pay $50,000.00 annually to fund the annual activities of the CPM-approved third party for the life of the project, not to exceed a period of 30 years commencing at commercial operation. If the project owner elects to make annual payments, the annual payments should be adjusted for cost of living increases using the CPI-U (All Urban Consumers) for the Los Angeles CMSA (includes the counties of Los Angeles, Orange, Riverside, San Bernardino and Ventura) as calculated and published by the California Department of Finance (http://www.dof.ca.gov/html/fs_data/latestecondata/FS_Price.htm). To avoid the adjustment, the project owner may elect to place the amount of $50,000.00 in an interest bearing account that would allow the cost of living increases to be paid from such account.
- Such measures shall be approved by the CPM and may include, but not be limited to: (i) restoration of degraded habitat with native vegetation; (ii) restoration of agricultural fields to bird habitat; (ii) restoration of agricultural fields to bird habitat; (iii) management of agricultural fields to enhance bird populations; (iv) invasive plant species and artificial food or water source management; (v) control and cleanup of potential avian hazards, such as lead or microtrash; (vi) retrofitting of buildings to minimize collisions; (vii) retrofitting of conductors and above ground cables to minimize collisions; (viii) animal control programs; (ix) support for avian and bat research and/or management efforts conducted by entities approved by the CPM within the project's mitigation lands or other approved locations; (x) funding efforts to address avian diseases or depredation due to the expansion of predators in response to anthropomorphic subsidies that may adversely affect birds that use the mitigation lands or other approved locations; and (xi) contribute to the Migratory Bird Conservation Fund managed by the Migratory Bird Conservation Commission.
  - Neither the principle of the fund nor its earned interest is redeemable by the project owner during the life of the project; specifically, the investment instrument will be prepared such that an independent investment firm/management entity manages and distributes monies. When developing the fund instrument, criteria will be established that will trigger the release of the fund residual to the project owner only at the conclusion of the project or, in the event that an alternative technology is implemented to replace the currently proposed solar energy generating facility.

  - The investment fund residual will be transferred to the project owner under specified conditions:
    - At end of the project's life after infrastructure removal has been completed and permit-specified site reclamation criteria have been met; and
    - If the proposed project is converted to an alternative technology that does not impose a similar threat to migratory birds or to bats.

- For Power Line Retrofits:
  - At least 6 months prior to commercial operation, the project owner shall submit the draft Retrofit Plan to the CPM for review and approval and CDFW and USFWS for review and comment. At least 30 days prior to commercial operation, the project owner shall provide the CPM the final version of the Retrofit Plan. Any modifications to the approved Retrofit Plan must be approved by the CPM in consultation with USFWS, BLM, and CDFW. The project owner shall notify the CPM no less than five working days before implementing any CPM approved modifications to the Retrofit Plan; alternately, the project owner may elect to deposit funds into the National Fish and Wildlife Foundation's Bald and Golden Eagle Protection Act account.
  - If the project owner elects not to fund a third party to perform retrofits, then no less than 30 days prior to beginning commercial operations, the project owner shall provide written verification to the CPM that Security has been established in the National Fish and Wildlife Foundation's Bald and Golden Eagle Protection Act account, in accordance with this condition of certification.
  - The project owner shall provide an annual summary of the actions taken, an accounting of money distributed, and a map of retrofitted power lines as per the Retrofit Plan. If the project owner elects to fund the National Fish and Wildlife Foundation's Bald and Golden Eagle Protection Act account, then the project owner shall, within five years of starting commercial operations, provide a summary specifying how the National Fish and Wildlife Foundation has or is using the funds.
- For Interest Bearing Fund:
  - No later than 30 days prior to commercial operation, the project owner shall provide the CPM written verification of selection of an interest-bearing account held by an approved investment entity, in accordance with this condition of certification. The account shall be fully funded no later than seven days prior to commercial operation.
  - If the project owner elects to provide a promissory note for $1,500,000.00 the CPM must be provided the note within 30 days of starting operations, and must also fund $50,000.00 for the first year's benefit, within seven days of starting operations.
  - The project owner or the account's administrator (investment entity) shall submit to the CPM an annual report summarizing the performance of the fund and describing all restoration/enhancement actions taken.

5.4.5 Burrowing Owl Impact Minimization

- As required by Condition of Certification BIO-18, PSH will implement the following measures to avoid, minimize and offset impacts to burrowing owls:
  - Pre-Construction Surveys. The designated biologist or biological monitor shall conduct pre-construction surveys for burrowing owls no more than 30 days prior to initiation of site mobilization and construction activities in accordance with CDFW guidelines (CDFG 2012). Surveys shall be focused exclusively on detecting burrowing owls, and shall be conducted from two hours before sunset to one hour after or from one hour before to two hours after sunrise. The survey area shall include the Project Disturbance Area and surrounding 500-ft survey buffer for each phase of construction in accordance with BIO- 29 (phasing).
  - Implement Burrowing Owl Mitigation Plan. The project owner shall implement measures described in the final Burrowing Owl Mitigation Plan. The final Burrowing Owl Mitigation Plan shall be approved by the CPM, in consultation with BLM, USFWS and CDFW, and shall:
    - Identify suitable sites within one mile of the Project Disturbance Areas for creation or enhancement of burrows prior to passive relocation efforts;
    - Provide guidelines for creation or enhancement of at least two natural or artificial burrows per relocated owl; design of the artificial burrows shall be consistent with CDFW guidelines (CDFG 2012) and shall be approved by the CPM in consultation with the CDFW and USFWS;
    - Provide detailed methods and guidance for passive relocation of burrowing owls occurring within the Project Disturbance Area; and
    - Describe monitoring and management of the passive relocation effort, including the created or enhanced burrow location and the project area where burrowing owls were relocated from, and provide a reporting plan.
  - Implement Avoidance Measures. If an active burrowing owl burrow is detected within 500 ft from the Project Disturbance Area the following avoidance and minimization measures shall be implemented:
    - Establish Non-Disturbance Buffer. Fencing shall be installed at a 250-ft (76-m) radius from the occupied burrow to create a non-disturbance buffer around the burrow. The non-disturbance buffer and fence line may be reduced to 160 ft (49 m) if all project-related activities that might disturb burrowing owls would be conducted during the non-breeding season (September 1 through January 31). Signs shall be posted in English and Spanish at the fence line indicating no entry or disturbance is permitted within the fenced buffer.

    - Monitoring. If construction activities would occur within 500 ft of the occupied burrow during the nesting season (February 1 – August 31) the designated biologist or biological monitor shall monitor to determine if these activities have potential to adversely affect nesting efforts, and shall make recommendations to minimize or avoid such disturbance.

- Acquire Burrowing Owl Habitat. The project owner shall acquire, in fee or in easement land suitable to support a resident population of burrowing owls and shall provide funding for the enhancement and long-term management of these compensation lands. The responsibilities for acquisition and management of the compensation lands may be delegated by written agreement to CDFW or to a third party, such as a non-governmental organization dedicated to habitat conservation, subject to approval by the CPM, in consultation with CDFW and USFWS prior to land acquisition or management activities. Additional funds shall be based on the adjusted market value of compensation lands at the time of construction to acquire and manage habitat.

    - Criteria for Burrowing Owl Mitigation Lands. The terms and conditions of this acquisition or easement shall be as described in BIO-12 (Desert Tortoise Compensatory Mitigation), with the additional criteria to include: 1) mitigation land that must provide suitable habitat for burrowing owls; and 2) the acquisition lands must either currently support burrowing owls or be within dispersal distance from areas occupied by burrowing owls (generally approximately five miles [eight km]). The burrowing owl mitigation lands may be included with the desert tortoise mitigation lands ONLY if these two burrowing owl criteria are met. If the burrowing owl mitigation land is separate from the acreage required for desert tortoise compensation lands, the project owner shall fulfill the requirements described below in this condition.

    - Security. If the burrowing owl mitigation land is separate from the acreage required for desert tortoise compensation lands the project owner or an approved third party shall complete acquisition of the proposed compensation lands within the time period specified for this acquisition (see the verification section at the end of this condition). Alternatively, financial assurance can be provided by the project owner to the CPM and CDFW, according to the measures outlined in BIO-12. The amount of the security shall be as described in BIO-29 - Table 3 for the proposed project or any of the project alternatives. These funds shall be used solely for implementation of the measures associated with the project. Financial assurance can be provided to the CPM in the form of an irrevocable letter of credit, a pledged savings account or another form of security (“Security”) prior to initiating ground-disturbing project activities. Prior to submittal to the CPM, the security shall be approved by the CPM, in consultation with CDFW and the USFWS to ensure funding. The final amount due will be determined by an updated appraisal and PAR analysis conducted as described in BIO-12.

5.4.6 Evaporation Ponds

- As required by Condition of Certification BIO-26, PSH will cover the evaporation ponds prior to any discharge with 1.5-inch (3.8-cm) mesh netting designed to exclude birds and other wildlife from drinking or landing on the water of the ponds. Netting with mesh sizes other than 1.5-inches may be installed if approved by the CPM in consultation with CDFW and USFWS. The netted ponds will be monitored regularly to verify that the netting remains intact, is fulfilling its function in excluding birds and other wildlife from the ponds, and does not pose an entanglement threat to birds and other wildlife. The ponds will include a visual deterrent in addition to the netting, and the pond will be designed such that the netting shall never contact the water. Monitoring of the evaporation ponds will include the following:
  - Monthly Monitoring. The designated biologist or biological monitor will regularly survey the ponds at least once per month starting with the first month of operation of the evaporation ponds. The purpose of the surveys will be to determine if the netted ponds are effective in excluding birds, if the nets pose an entrapment hazard to birds and wildlife, and to assess the structural integrity of the nets. The monthly survey will be conducted in one day for a minimum of two hours following sunrise (i.e., dawn), a minimum of one hour mid-day (i.e., 1100 to 1300 hours), and a minimum of two hours preceding sunset (i.e., dusk) in order to provide an accurate assessment of bird and wildlife use of the ponds during all seasons. Surveyors will be experienced with bird identification and survey techniques. Operations staff at the project site will also report finding any dead birds or other wildlife at the evaporation ponds to the designated biologist within one day of the detection of the carcass. The designated biologists will report any bird or other wildlife deaths or entanglements within two days of the discovery to the CPM, CDFW, and USFWS.
  - Dead or Entangled Birds. If dead or entangled birds are detected, the designated biologist will take immediate action to correct the source of mortality or entanglement. The designated biologist will make immediate efforts to contact and consult the CPM, CDFW, and USFWS by phone and electronic communications prior to taking remedial action upon detection of the problem, but the inability to reach these parties will not delay taking action that would, in the judgment of the designated biologist, prevent further mortality of birds or other wildlife at the evaporation ponds.
  - Quarterly Monitoring. If after 12 consecutive monthly site visits no bird or wildlife deaths or entanglements are detected at the evaporation ponds by or reported to the designated biologist, monitoring can be conducted on a quarterly basis.
  - Biannual Monitoring. If after 12 consecutive quarterly site visits no bird or wildlife deaths or entanglements are detected by or reported to the designated biologist, with approval from the CPM, USFWS, and CDFW, future surveys may be reduced to two surveys per year during the spring nesting season and during fall migration. If approved by the CPM, USFWS, and CDFW, monitoring outside the nesting season may be conducted by the Environmental Compliance Manager.

- Modification of Monitoring Program. The CDFW or USFWS may submit a request for modifications to the evaporation pond monitoring program based on information acquired during monitoring, and may also suggest adaptive management measures to remedy any problems that are detected during monitoring or modifications if bird impacts are not observed. Modifications to the evaporation pond monitoring described above and implementation of adaptive management measures will be made only after approval from the CPM, in consultation with the USFWS and the CDFW.

5.5 Advanced Conservation Practices (ACPs)

PSH is dedicated to minimizing and mitigating impacts to birds at the PSEGS as well as advancing the science relative to this goal through the implementation of a number of ACPs. In particular, PSH will test detect and deter methods at the PSEGS. Many methods exist for deterring birds from a specific location. Selection of methods is based on the targeted bird species, cost, effectiveness, potential for habituation, the amount of automation and required maintenance, how proven the technology is, and how applicable it is for a large scale solar facility. Generally, deterrents are used to startle and disperse birds by representing danger such as a predator, evidence of a predator attack, or some novel item that is unfamiliar to the bird. Deterrents may be visual, auditory, and/or physically irritating. Methods to detect incoming birds also vary, ranging from human observers to sophisticated radar systems paired with automated deterrent devices.

Due to habituation by birds and typically wide coverage of solar projects, more than one deterrent strategy may be necessary for a solar thermal power system. Visual and auditory deterrents may be useful to deter landing waterfowl and waterbirds, while the more-sophisticated radar-based detect and deter systems may be better at dissuading flying birds such as raptors from passing through the solar flux.

Timing of deterrents used to repel, haze, and frighten birds influences effectiveness. To combat habituation and re-occurring presence of birds, any deterrent action should be highly responsive and immediate to the extent possible. For example, a cannon firing repeatedly without any variation in timing or direction quickly loses its potential to scare birds (Bishop et al. 2003). Random or animal-activated devices may reduce habituation and increase the time of protection over nonrandom (i.e., systematic) devices.

The effectiveness of any technique varies with the bird species and habituation will eventually occur with any scaring technique that is not reinforced by a demonstration of actual danger. Constantly changing the appearance and location of a scaring device should help to prevent rapid habituation. An effective bird control program with existing devices should involve the use of several techniques in a random fashion

In order to further research in the area of detection and deterrent technologies and to evaluate the effectiveness of these systems in mitigating impacts to birds at PSEGS, PSH is committed to testing two different detection technologies and two different deterrent technologies at the

Project. Tests will be designed and conducted with strict adherence to robust research protocols in order that the different technologies may be properly evaluated. Results of the tests will be reported to the TAC and the potential use of the technologies in mitigating impacts to birds at PSEGS will be considered should the need for permanent implementation of detect and deter technologies become warranted.

6.0 MONITORING PROGRAM

This monitoring plan includes two investigations to determine the effects of the PSEGS project on avian species: a mortality and injury investigation and an avian use investigation.

The mortality and injury investigation will focus on the potential for collision and flux effects to occur during normal facility operation and during weather-related events. Survey protocols are detailed in Sections 6.1 and 6.2. The avian use investigation will focus on the use of habitat near and within the facility site by avian species. Avian use survey protocols are described in Sections 6.3, 6.4, and 6.5. All investigations will examine the effects of the PSEGS facility on use by resident and migratory birds, including golden eagles. This monitoring plan is adaptive, and modifications may be recommended by the TAC in response to the results obtained from the initial surveys.

6.1 Collision- and Flux-Related Monitoring

This section describes the monitoring studies that will be implemented to assess avian mortality and injury risks potentially associated with facility power towers, perimeter fence, heliostats, and transmission line collisions and sunlight (solar flux) reflected from the heliostat field toward the solar tower receivers. The primary objectives of the monitoring study are to estimate levels of avian mortality or injury and to understand the temporal and spatial distribution of these occurrences within the facility area (for example, uniform, clustered, etc.) that may be associated with towers, perimeter fence, heliostats, and transmission line collisions, or exposure to solar flux. All avian casualties detected within the study areas will be recorded and, based on a field inspection of each casualty, a cause of death or injury will be determined, if possible. The total number of avian casualties will be estimated by adjusting for search frequency, removal bias (length of carcass persistence in the field), and searcher efficiency bias (percent found).

The number and proportion of detections related to unknown causes will be reported. If a large portion (i.e., more than 40 percent) of the detections cannot be determined, or presumed without a reasonable doubt to be caused by the facility, potential other causes, such as unrelated avian disease or a lightning event, will be considered and the analysis adjusted as appropriate in the seasonal report. All bat mortalities detected ancillary to other study objectives will be recorded by field survey personnel and operations staff, and reported in the quarterly reports described in this plan.

Causes of injury or mortality will be categorized according to the following criteria:

1. **Collision effects:** Birds with broken bones, chipped beaks, or other evidence of collision trauma, or birds found at the base of heliostats with bird-strike imprints in the dust on the heliostat.
2. **Flux effects:** Birds with any signs of singed feathers or tissues or visible ocular damage (per field evaluation with handheld magnifying glasses or if detected during subsequent necropsy analysis). The following three-tiered system will be used to categorize flux-related effects on birds:
   - Grade 1: curling of <50% of flight feathers
   - Grade 2: curling of >50% of flight feathers
   - Grade 3: curling and visible charring of contour feathers
3. **Flux and collision:** Birds with evidence of both collision and flux effects (evidence that flux impacts could have affected a bird's ability to avoid facility structures).
4. **Other:** Known cause, but not 1, 2, or 3 above (for example, lightning struck, avian disease, etc.).
5. **Unknown:** No known or presumed cause.

6.1.1 Study Components and Field Methodology

This section describes a standardized field-survey approach based on USFWS and other guidance pertinent to renewable energy projects (e.g., CEC and CDFG 2007; Nicolai et al. 2011; Strickland et al. 2011; USFWS 2010, 2012). The approach primarily involves systematically walking transects in 145 (65 associated with Unit 1, 75 associated with Unit 2, and five in the logistics area) randomly selected, 5- acre (2-ha) plots inside the facility and randomly selected plots outside of the facility to detect avian casualties and injuries; it also considers detection biases in estimation of impacts. Observers trained in proper search techniques will conduct the field surveys.

6.1.2 Carcass Removal Trials

The carcass removal trials will be conducted during both the construction and operational phases of the Project. Trials conducted prior to the facility becoming operational will be used to calibrate initial timing for the carcass search interval. Based on the results of the pre-operational carcass removal trials, the interval between fatality searches will be determined based on the median removal time; that is, surveys will be separated by an interval of time no greater than the time necessary to remove half of the carcasses available from the beginning of the trial period. Trials will take place in each season (spring, summer, fall, and winter) to account for seasonal variation in mesopredator and aerial scavenger pressure (Smallwood 2013).

The trial carcasses will typically be placed every other week during each season to incorporate the potential effects of varying weather conditions, scavenger types and scavenging density. Each trial carcass will be monitored with the use of a Bushnell Trophy Camera (Model 119436) or equivalent remote camera at randomly chosen locations within the areas surveyed for fatalities. “Dummy” cameras (cameras without bias trial carcasses) will also be set up throughout the trial area in order to prevent scavengers from learning to key in on cameras as a way to find carcasses. At most, five carcasses will be placed in a survey area at one time to limit scavenger swamping. Each carcass will be checked on days 1, 2, 3, 4, 5, 7, 10, 14, 18, 24, and 30. Despite the presence of cameras, checking carcasses in this manner will ensure coverage of any carcasses that are removed from a camera’s field of view and remain detectable. . If the carcass has been scavenged, all remaining feathers and parts of the carcass and the camera will be removed. The final disposition of the carcass will be classified as “Removed” if the carcass cannot be located and there are fewer than 10 feathers of any type or fewer than two primary feathers remaining. The final disposition will be classified as “Not Removed” if there are 10 or more feathers of any type, two or more primary feathers, or any flesh or bone remaining.

Removal trials conducted concurrently with mortality surveys will help ensure that both studies are conducted under similar conditions, and the initial carcass search interval is relevant. Concurrent carcass removal trials will also be conducted for each of four seasons. The test species selected will be based on availability and their similarity to expected small and large birds on-site. To the extent authorized in the final USFWS Special Purpose – Utility (SPUT) permit, carcasses of native songbirds and larger birds that are analogous to those occurring on the site and that are found incidentally by biologists involved in the project (e.g., road-killed birds), or otherwise made available by the USFWS or others, will be used. Bird carcasses may also include house sparrows (*Passer domesticus*), brown-headed cowbirds (*Molothrus ater*), and/or European starlings (*Sturnus vulgaris*), rock pigeons (*Columba livia*), and commercially raised quail (*Coturnix japonica*) and mallard (*Anas platyrhynchos*) hens. The trial carcasses will be dropped from five ft (1.5 m) or higher and allowed to land in a random posture. Global positioning system locations of each trial carcass will be recorded, and each carcass will be discreetly marked with tape or thread prior to placement so that it can be identified as a trial carcass if detected by facility personnel or moved by a scavenger.

During these trials, 60 carcasses of small birds and 40 carcasses of large birds will be randomly placed within the on- and off-site survey areas, for a total of approximately 100 trial carcasses throughout the first year of monitoring study. Modeling of carcass removal trials should consist of at least 10 carcasses per group per season (Huso et al. 2012). Carcass removal trials will be conducted during the first year of monitoring and will only be continued for subsequent years if warranted.

6.1.3 Searcher Efficiency Trials

The objective of the searcher efficiency trials is to estimate the percentage of casualties found by individuals or teams of searchers. Trials will be conducted during each season as there is the potential that some conditions (e.g., vegetation present, predominant winds, etc.) may vary from one season to the next. Searcher efficiency will be estimated by size of bird (small and large). Estimates of searcher efficiency will be used to adjust the total number of birds found by observers to correct for detection bias.

Searcher efficiency trials will begin when standardized monitoring surveys begin. Observers conducting surveys will not know when these trials are conducted or the location of the detection trial carcasses. A minimum of two trials will occur during each season, with at least 10 small birds and 10 large birds, to spread the trials over time and varying site conditions. More or fewer searcher efficiency carcasses may be used, depending on site conditions and the number of observers at the facility.

All searcher efficiency trials will be coordinated with the Designated Biologist and placed at random locations within areas being searched prior to the monitoring survey on the given day. Trial carcasses will be dropped from five feet or higher and allowed to land in a random posture. The GPS coordinates of each efficiency trial carcass will be recorded and used to retrieve carcasses not found during the survey. To prevent a trial carcass from being confused with actual study detections, trial carcasses will be marked unobtrusively with dark tape or thread on the leg of the bird. Immediately following the trial, the person responsible for distributing the trial carcasses will determine the number of trial carcasses found by observers. Searcher efficiency trials are planned for completion during the first year of monitoring and will only be continued for subsequent years if warranted under conditions that had previously not been tested (e.g., a substantially different amount of cover because of an unusually high amount of rain or the addition of new observers to the project). After the first year of operation the TAC may recommend additional searcher efficiency trials if on-site conditions are different enough from those during previously conducted searcher efficiency trials.

6.1.4 On-Site Monitoring

Collision with PSEGS facility structures (towers, perimeter fence, and heliostats) will be evaluated by systematic sampling in each of the two PSEGS units. Potential flux effects (associated with the concentration of reflected sunlight near the top of the tower) will also be investigated within each of the units in accordance with the following methodology. The entirety of the area within one tower height (750 ft.; [228.6 m]) of each tower, comprising bare ground with and without high-density heliostats, roads, and buildings immediately around the towers, will be surveyed with 10-m transects. For the tops of some buildings and for other inaccessible areas, fatalities will be modeled based on the observed distribution of fatalities observed around the tower. A fatality density model will be generated based on the distance from the tower and the distribution of known fatalities, using methods developed for fatality studies at wind energy facilities with unsearchable areas around turbines (Huso and Dalthorp 2014).

6.1.4.1 Search Timing

The appropriate frequency of fatality surveys depends on the species of interest and average carcass persistence times (Smallwood 2007, Strickland et al. 2011, USFWS 2012). Large raptors tend to persist and remain detectable for extended periods (weeks to months) due to low scavenging rates and relatively slow decay rates. If only large species were of interest, extended search intervals of 30–45 days might be appropriate; however, smaller birds and bats typically disappear at much faster rates, so shorter search intervals are required to ensure effective documentation of fatality rates among these species. Persistence times for small birds (typically defined as smaller than a mourning dove) and bats often average less than a week (e.g., Johnston et al. 2013), but carcass persistence times may vary substantially depending on the habitat, the types of scavengers present, climatic conditions, the season, and the number of carcasses typically present on the landscape (Smallwood 2007, 2013).

The search interval for fatality monitoring ideally should be less than the average persistence time for a carcass. A 7-day interval is typically recommended when the focus includes monitoring for both smaller birds/bats with short persistence times and larger birds with longer persistence times (Strickland et al. 2011). Comparative analyses have demonstrated, however, that potential biases can be limited by using different analytical methods to estimate fatality rates corrected for searcher efficiency and carcass persistence, depending on whether the search interval is shorter or longer than the average carcass-persistence time (Huso 2010, Huso et al. 2012, Korner-Nievergelt et al. 2011, Strickland et al. 2011).

Publically accessible data from three wind-energy studies in the nearby Mojave Desert region of California and western Arizona provide additional, relevant insight (Chatfield et al. 2009, 2010; Thompson and Bay 2012). These studies recorded average persistence times of 17.5–46.8 days for large birds (average 29.0 days, median 22.6 days) and from 5.6–17.4 days (average 9.9 days, median 6.5 days) for small birds (Table 11). If the average carcass-persistence time for small birds and bats on the Project site ranks toward the low end of values from these studies, which is typical for a broad range of other studies, a 7-day search interval may be required to effectively document fatality rates for small birds and bats. If, however, small-bird and bat carcass-persistence rates are closer to or exceed the average value from these studies, then longer search interval may be more appropriate. The initial indications of rapid scavenging by ravens at the Project site suggest that a shorter search interval may be needed to provide precise fatality estimates for small carcasses.

Table 11. Mean removal times, searcher efficiency, and percent detected for large birds and small birds at projects with publicly available reports in similar vegetation and topography conditions to the Palen Solar Energy Generating System.

Project Name	Vegetation	Mean Removal Time: Large Birds (days)	Mean Removal Time: Small Birds (days)	Searcher Efficiency: Large Birds	Searcher Efficiency: Small Birds	Percent Composition of Adjusted Fatalities (Small Birds; Large Birds)
Alite, CA[a]	Shrub/scrub; grassland	17.5	5.85	0.85	0.57	57%; 43%
Dillon, CA[b]	Desert	46.78	17.39	0.96	0.72	10%; 90%
Dry Lake I, AZ[c]	Desert grassland/ forested	Not reported	Not reported	0.91	0.75	4%; 96%
Dry Lake II, AZ[d]	Desert grassland/ forested	22.60	6.50	0.96	0.86	17%; 83%
Average		**29.0**	**9.9**	**0.92**	**0.73**	**22%; 78%**
Number Used for Heliostat Sampling Analysis		**21.8**	**7.4**	**0.69**	**0.55**	**22%; 78%**

[a] Chatfield et al. 2010; [b] Chatfield et al. 2009; [c] Thompson et al. 2011; [d] Thompson and Bay 2012.

6.1.4.2 Search Areas/ Methodology

This section describes the robust nature by which avian fatalities and injuries will be evaluated through systematic sampling of the PSEGS towers, the transmission line, perimeter fence, and heliostats. Because the nature of avian risk varies among these project elements, search area methodologies also vary by project element, as described below. More than 25% of the total area composing units 1 and 2 will be systematically sampled through these methods. In addition to this sampling effort, 100% of the facility surface will be examined by workers throughout the year as part of standard operating and maintenance procedures.

Tower area: An area defined by a radius of approximately 750 ft (229 m) around each tower (the “tower area”) is generally cleared of vegetation for operational purposes. Each tower area is located beneath the portions of the solar field that would have the highest flux intensity and surrounds the tallest structure within the facility. Each tower area will be sampled according to a schedule to be determined based on carcass removal trials. Surveys will be conducted by walking transects and visually inspecting the area for evidence of avian and bat mortality and injury (e.g., carcasses, feathers, injured birds). Because the tower area is generally clear of vegetation, searcher efficiency is expected to be high. Each survey will result in a complete (100% coverage) assessment of the tower area; fatalities attributed to inaccessible areas will be modeled based on observed carcass densities around each tower. The tower area survey is primarily intended to examine the potential for birds and bats to be affected by acute flux exposure or tower-related collisions.

Perimeter fence: The perimeter fence around the common area is approximately 2.4 miles (3.8 km) long, and the perimeter fence around the solar units (the remaining facility) is approximately 13.5 miles (21.7 km). A 6-m (20-ft) wide transect along the solar field fence thus consists of 33 acres (13.3 hectares). An unpaved road parallels the interior perimeter of the fence, providing 100% access to the fence from inside the project boundary.. The unpaved interior road will be visually inspected for evidence of avian mortality and injury from a slow-moving vehicle, according to the schedule in Table 12. The search area will include a 6-m wide corridor, three m (10 ft) extending from each side of the fence. This area will be searched by a 2-person team (one primary searcher and the driver, who will provide search support) traveling in a vehicle at a speed of no more than four miles per hour (six km per hour) and at an appropriate distance from the fence to search the 6-m-wide transect. Visibility on these roads is excellent, so observers should be able to reliably locate evidence of affected birds (for example, carcasses, feathers, injured birds) from vehicles.

Project transmission line: The transmission line totals approximately eight miles (12..9 km) in length. This project component will be surveyed according to the prescribed survey schedule. Because the transmission line is considerably higher and because transmission lines are known high-risk sites for bird collisions, a 15-m (49-ft) wide search area on each side of the center line, for a total width of 30 m (98 ft), will be searched. Two searchers will walk the length of the transmission line, one on each side, spaced approximately seven m (23 ft) from the centerline.

Table 12. Basic search parameters for the Palen Solar Energy Generating System on-site and off-site mortality and injury monitoring study.

Topic	Details	Comments
Survey coverage in heliostat field	20%	Subject to TAC recommendations in response to mortality rates identified from searches.
Survey interval	Median Carcass Removal time, at most	Subject to TAC recommendations in response to scavenger trials
Rate of travel	1.7 to 2.2 miles/hour	Slow pace to allow careful visual inspection on each side of transect
Transect spacing	Tower area: Standardized at approximately 10 m apart Perimeter fence: Within five m of the fence Gen-tie line: Standardized at 30 m wide, centered on the transmission line Heliostat field: Standardized at approximately 10 m* apart, except in high-density heliostat fields in the inner arc plots where transects will be approximately eight m apart Off-site: Outbound and inbound transects separated by approximately 10 m	Heliostat field transect timing (early morning, mid-day or afternoon) and spacing may vary for searchers to maximize visibility considering vegetation density and/or logistical issues associated with mirror height and position
Transect length	On-site sample areas: Standard within each randomly selected sample area Perimeter fence: Full (100-% linear coverage) internal survey Gen-tie line: Entire length of the transmission line Off-site sample areas: 500-ft outbound and inbound transects	Parallel to ring roads and perimeter fence
Surveyor breaks	Approximately once per hour for humans Approximately once per hour for dogs and only four hours per day during hot seasons; eight hours per day is acceptable for some dogs during mild weather	Short breaks at 1-hour intervals to hydrate, snack, and stay alert; approx. 30 minutes for lunch Short breaks at about 1-hour intervals for water and also depending upon the rate of finding carcasses (i.e., finding rewards)
Surveyor continuity	Emphasized	Same staff used for each survey (as is practical given staffing constraints) to maximize consistency

*Transect spacing of 10 m is selected based on experience surveying for avian fatalities in low-growing desert vegetation and flat topography, comparable to conditions present on and off the facility site. The vegetated area between ring roads is 46.6 m (153 ft); therefore, surveying with four transects spaced at approximately 10 m apart (offset 5, 15, 25, and 35 m from the outside edge of each ring road, and at 10-m intervals in the cleared area surrounding the towers) allows thorough visual inspection of the sample areas. Six to 10 m is a generally accepted standard for fatality monitoring at other renewable projects in similar vegetation and topography, and the California guidelines recommend 6-m spacing with adjustments based on vegetation and topographic conditions (CEC and CDFG 2007). Additionally, the USFWS (2012) guidelines recommend spacing at 4- to 10-m intervals based on vegetation and topography.

Heliostat field: Twenty percent of each heliostat field will be visually inspected for evidence of avian mortality or injury, according to the prescribed schedule. Sampling units will consist of 5-acre arc plots distributed throughout the heliostat fields. Each region of the project area will be sampled to account for potential tendencies for bird fatalities based on the direction of approach and variation in the density of the heliostat arrays, resulting in a spatially balanced design, as suggested by Manuela Huso (pers. comm.). The heliostat arrays surrounding the two towers are divided into 24 segments that are each divided again by 2, resulting in inner and outer halves totaling 48 areas. Twenty percent of each of these 48 areas will be sampled.

The decision to sample 20% of each heliostat field was made based on an in-depth analysis that relied on conservative scenarios for potential avian mortality at the site and subjecting these scenarios to a sensitivity analysis to determine the coefficient of variation (WEST 2013). This analysis was undertaken to ensure that the outcome of the heliostat field surveys are effective for supporting the adaptive management goals of this plan and to allow accurate extrapolation of results to facility-wide estimates. The scenarios were evaluated with power analysis by simulating three hypothetical levels of fatality (based on per-MW mortality reported for other renewable energy projects) under conservatively assumed conditions. Details regarding the assumptions used in this analysis are presented in Tables 11 and 13.

Table 13. Assumptions used in analysis of the effect of sample area on fatality estimates and confidence limits (i.e., power analysis) for the Palen Solar Energy Generating System monitoring study.

Topic	Details	Comments
Area searched	Range from 1% to 30%	Range used for assessment of statistically valid search area.
Scavenging rate	Mean removal time of 7.4 days for small birds, 21.8 days for large birds	Based on wind project fatality studies conducted in similar vegetation and topography, reduced by 25% to be conservative. [a]
Searcher efficiency	0.55 for small birds; 0.69 for large birds	Based on wind project fatality studies conducted in similar vegetation and topography, reduced by 25% to be conservative. [a]
Distribution	Assumed evenly distributed throughout facility area	Because it is unknown what the distribution of fatalities might be, no attempt was made to account for potential unequal distribution. Due to the wedge-shaped design, the influence of carcass density, should it decrease as distance from tower increases, would not likely substantially change estimates.
Fatality rates [b]	A: 1 bird per MW/year B: 5 birds per MW/year C: 10 birds per MW/year	Assumed 13% of fatalities would be large birds based on percentage of large birds out of all birds at wind projects with similar vegetation and topography. [a]

[a] See Table 11 for details and references.

[b] Ranges are hypothetical, for analysis purposes only, and are not intended to indicate the potential range of annual PSEGS avian impacts per megawatt. Avian mortality per megawatt year at wind energy facilities has been documented to range from approximately 14 birds to less than one at wind installations in the United States (see, for example, National Wind Coordinating Collaborative [NWCC] 2010.)

The conditions assumed for each of the scenarios included a carcass removal rate, searcher efficiencies, and an even distribution of fatalities across the site. The initial assumptions for the carcass removal rates and searcher efficiencies were derived from publicly available fatality studies from other renewable technologies conducted in similar vegetation and topography. For the purposes of this analysis, the searcher efficiencies were decreased by 25% and the scavenger removal rates were increased by 25% to provide a conservative bias for the scenarios.

At the simulated levels of mortality, the 90% confidence interval for the facility-wide estimate narrows as the survey area increases, reaching a nearly asymptotic relationship at the 20% sample area in all cases. Additionally, for all levels modeled, the coefficient of variation (the standard deviation/estimate) reaches a level of less than 25% in all cases at a 20% sample area. At the assumed moderate and higher mortality levels, the coefficient of variation is less than 13% with a sample area of 20%.

The analysis demonstrates that, as the level of mortality increases, the sampling area can be decreased and still maintain lower coefficients of variation. Furthermore, at higher levels of mortality, the decrease in the coefficient of variation is small, particularly when considering the values associated with 10%, 20%, and 30% of the heliostat field being sampled. Thus, unless a very low mortality rate is encountered at the site, a sampling area of 20% of the field should be sufficient to establish the overall site mortality. Should a low mortality rate be established through this monitoring program, the precision of the estimate may be lower than desired; however, the concerns associated with the site will be confirmed as minimal.

As a result of this power analysis, sampling 20% of the heliostat field area with representative sampling is statistically and logically supported as sufficient to identify risk and impact areas in accordance with the goals of this plan. It will allow accurate extrapolation of sample results to facility- wide estimates of fatality. The increases in precision resulting from sampling more than 20% of the heliostat field are minor and are not likely to generate findings that would improve detection of issues of management concern. However, if monitoring identifies apparent mortality rates that are very low (i.e., less than 50/year), so that the precision of the mortality estimates and their applicability to the entire site are questionable, then the TAC will consider whether to recommend an additional sampling area.

In addition to the planned systematic site surveys, workers will be present in the tower areas on a daily basis, and mirror washing is currently scheduled to take place throughout the entire facility three to five times per year. Therefore, 100% of the facility surface will be examined by workers several times a year. In addition, fatality monitoring personnel moving between search areas may encounter carcasses incidentally; these will be tallied and reported separately from the standardized fatality monitoring results, following the same incidental reporting procedure used by operational personnel.

Collectively, the standardized searches and the incidental observations by operational staff and by search personnel will allow for adequate detection of fatalities of rarer species, such as golden eagles, that might not be detected adequately during standardized searches alone. In addition, carcasses of larger species such as eagles have a very long persistence time (usually over a year), which increases the probability of detection.

6.1.5 Off-Site Monitoring

To account for the possibility that injured birds may land offsite, search plots immediately outside the facility will be established. Off-site studies will be conducted by visually inspecting for evidence of avian and bat mortality and injury attributed to facility operations. Monitoring off-site will take place immediately along transects radiating outward from the perimeter fence.

Ten locations along the perimeter of the facility will be chosen at random. At each location, two 500-ft (152-m) long transects will be established, separated by approximately 10 m extending outward from the perimeter fence and back to the facility. Transects will be established on the western, northern, eastern, and southern borders of the facility where they do not intersect the I-10 right-of-way corridor. Each transect will be surveyed according to the prescribed schedule. The transect surveyors will walk each transect from the fence line and then return along the next adjacent transect. Searcher efficiency rates and carcass removal rates will be determined using the same methodology as that used for on-site surveys. However, as a result of the decreased survey area, a reduced number of trial carcasses will be required as compared to the on-site survey effort. Separate mortality rate estimates for the off-site survey results will be generated from the field data and incorporated into estimates of off-site fatality.

Table 12 summarizes the search parameters applicable to the monitoring studies of each tower area, each heliostat field, the facility's perimeter internal and external fence line, and the off-site transect locations.

6.1.6 Data Recordation and Detection Protocols

When detection is made, information about the type of bird, its condition, and the location will be recorded in a digital data dictionary. The term "detection" is used throughout this document to indicate that observers may find injured birds, intact dead birds, partial birds, and feather spots indicative of avian mortality, as well as injured or dead bats. Field personnel will undertake visual and manual inspection of all carcasses, feathers, and/or body parts discovered in the field. For all detections, data recorded will include species, sex, age, and breeding condition (for example, if a brood patch is present) when possible; distance from observer when detected; date and time collected; GPS location; distance to tower (or structure that caused mortality, if determined); dominant vegetation/ground cover at the location (i.e., within two meters of the carcass); condition (fresh, early decomposition, late decomposition, desiccated, scavenged, intact); and any indication of cause of death, such as type of injury. All detections will be plotted on a detailed map of the study area that shows the location of the surveyed areas, heliostats, tower, roads, and perimeter fence and photographed, using a 12-megapixel digital camera, in situ as well as with full-frame photographs of the dorsal, ventral and head areas of the bird or bat.

Under direction of the TAC and assuming the biologists involved are covered by required federal and state salvage/scientific-collecting permits (discussed further below), detections will be collected, labeled with a unique number, bagged, and frozen for future reference and possible necropsy if cause of death cannot be determined upon physical inspection. Carcasses may also be used for scavenger and searcher efficiency trials. The contractors, with TAC approval, or USFWS Law Enforcement branch will determine whether certain birds detected during the surveys should be removed from the project area so that a third-party wildlife laboratory, under the direction and expense of the USFWS or TAC agencies, may conduct formal necropsy assessments. Copies of all results of any formal necropsy assessment will be provided to the TAC and PSEGS within one week of completion. Detections outside of the surveyed areas, such as those identified while driving through the site or observed outside a survey area boundary during other project-related activities, will also be documented following the above protocol as closely as possible. These detections will be coded as incidental discoveries, and not included in statistically based estimation procedures for the facility because they would not represent systematic survey results.

In the event a dead or injured bald or golden eagle is found, USFWS Office of Law Enforcement (OLE) shall be contacted as soon as possible, but no later than 48 hours after discovery. If a dead eagle is found, the OLE agent will provide instructions on collection and disposition of the eagle carcass. Until then, the carcass will be left in place, unless a project-affiliated biologist has the necessary federal and state permits to authorize handling the carcass in coordination with the OLE.

Any state- or federally listed threatened or endangered species found dead or injured shall also be reported to OLE as soon as possible, but no later than 48 hours after discovery. If a dead animal is found, the OLE agent will provide instructions on collection and disposition of the carcass. A list of federal threatened and endangered species by state may be found in the USFWS's Threatened and Endangered Species System (TESS) database at: http://www.fws.gov/endangered. A list of California threatened and endangered species may be found at http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf.

Migratory birds, including eagles and threatened or endangered species, that are injured shall be captured, stabilized, and immediately transferred to a licensed veterinarian or federally permitted migratory bird rehabilitator for care. All injured birds observed within a survey area or elsewhere within the facility will be recorded and treated as detections for analytical purposes. The primary avian rehabilitation facility identified to care for injured birds potentially detected during the program is the Tennity Wildlife Hospital and Conservation Center located at The Living Desert Zoo and Gardens, 47900 Portola Avenue, Palm Desert, California (http://www.livingdesert.org/). The Tennity Wildlife Hospital and Conservation Center was constructed in 2002. Another avian rehabilitation center that may also be used is listed in Table 14.

Table 14. Avian rehabilitation centers.

County	City	Name	Phone
Riverside	Palm Desert	The Living Desert Zoo and Gardens	760-346-5694
Riverside	Indio	Coachella Valley Wild Bird Center	760-347-2647

6.1.7 Permitting to Handle Carcasses and Specimens Used in Bias Trials

To ensure accurate documentation of fatalities and probable causes of death, and to enable robust searcher efficiency and carcass removal assessments, biologists involved in mortality monitoring and related bias trials will be covered by federal and state permits that authorize handling and collection of carcasses of birds protected by the MBTA. At the federal level, PSEGS will seek to obtain a USFWS SPUT permit that specifically authorizes collection of bird fatalities associated with commercial energy and utility operations, and use of bird carcasses for related bias trials. If the USFWS processing time for obtaining a SPUT permit extends beyond when fatality monitoring and the associated bias trials must begin, an interim letter of authorization will be obtained from the USFWS to allow for carcass handling under the auspices of a personal USFWS salvage permit, held by either an employee of the PSEGS owner/operators or the biological consultant responsible for managing the monitoring program. If additional bird specimens acquired outside the project are necessary to achieve sufficient sample sizes for the described bias trials, these collections also will be appropriately authorized by the SPUT permit. All such specimens will then be formally transferred to and reported under the PSEGS SPUT permit, once it is in place.

Handling of migratory birds (and bats) is also prohibited under the California Fish and Game Code unless specifically authorized by a CDFW Scientific Collecting Permit. These permits generally are issued only to individuals. Therefore, all biologists involved in handling carcasses for this monitoring program will be authorized by a relevant CDFW Scientific Collecting Permit held by either an employee of the PSEGS owner/operator, or the biological consultant responsible for managing the monitoring program.

6.1.8 Study Duration

Standardized surveys within each of the two PSEGS solar facilities (power towers and heliostats), along the perimeter fences, transmission line, and off-site study areas, will be conducted for a minimum of three years. Monitoring intervals and survey areas may be adjusted as necessary to incorporate the results of the carcass removal trials and prior seasonal evaluations and conclusions. After each season and year of surveys, the monitoring program will be evaluated by the TAC to determine if modification or continuance is necessary.

6.1.9 Dissemination of Data

All data from pre-construction carcass removal trials will be compiled and reported at the conclusion of each trial season. Concurrent carcass removal trials, searcher efficiency trials, and fatality monitoring will be compiled quarterly and reported. Reporting will include all carcasses found during regularly scheduled searches, as well as all incidentally found carcasses during the reporting period. Analyses will included preliminary adjusted fatality estimates, break-down of fatalities by taxonomic group, resident or migratory status, location of fatality (i.e. tower, heliostats, road, etc.), and suspected cause of death (i.e. collision, flux, etc.). Additionally maps will be provided to display the spatial distribution of fatalities by taxonomic group and suspected cause of death.

6.2 Weather-Related Fatality Monitoring

Low-visibility weather conditions have been implicated in most larger-scale avian collision events at communication towers and other tall structures (Manville 2000; Gauthreaux and Belser 2006; Kerlinger et al. 2010; Longcore et al. 2012, 2013). High wind conditions may also be of concern with regard to collision risk. To document potential weather-related collision risks that may be associated with the two power towers at the facility, additional surveys will be conducted during the peak spring (late March to late May) and fall (mid August to late October) migration periods, within two days of up to two low-visibility or high-wind nocturnal weather events per season. For study purposes, a low-visibility weather event is defined as foggy, highly overcast, or rainy night-time weather typically associated with an advancing frontal system and can occur during the day or night. For the purposes of this monitoring program, high-wind events are defined as winds above 40 miles per hour (64 km per hour) for a sustained period of greater than four hours. In addition, the online Avian Hazard Avoidance System (AHAS), accessed at http://www.usahas.com/bam/, will be used to identify and monitor potential high-risk weather-related events for birds.

Surveys will be conducted by walking transects, approximately 10 m apart, throughout an approximately 229-m (750-ft) radius circular plot, a distance that is approximately equal to the tower height. The search radius is based on a conservative application of the CEC and CDFG's (2007) California guidelines for wind energy projects, which recommend a search distance extending out one-half the distance of the maximum height of the structures. Studies have found that over 80% of bat fatalities fall within half the distance of a wind turbine's height (as cited in USFWS 2012). Consequently, the proposed survey area would also allow identification of potential bat collisions during the weather-related fatality monitoring effort. All avian and bat detections will be documented and collected in a similar manner as described for the year-round standardized surveys.

6.3 Avian Use Studies

Avian use surveys will be implemented using standard, variable-radius point counts to assess bird use of the vegetated areas within the heliostat fields and comparable off-site study areas. The objectives of the study are to document avian species composition on-site and off-site and document changes in avian use in these areas over time. To achieve these objectives, point counts will be conducted twice per month during the migration seasons and monthly during summer and winter at 75 points distributed throughout the project footprint and 1-mile buffer that were also surveyed during preconstruction studies, with each count location affording a minimum, non-overlapping survey radius of 100 m. Avian use surveys are planned for completion once per month during summer (June 1 to August 31) and winter (December 1 to February 28), and twice per month during spring (March 1 to May 31) and fall migration periods (August 15 to October 31) at the 75 points distributed across the facility and off- site project area. The point counts will be conducted for 10 minutes at each avian use study point, with all surveys completed between 15 minutes before dawn and six hours after sunrise. The sampling scheme allows for assessment of the wintering and summering bird community, documentation of migrants, and will be directly comparable to surveys conducted during the pre-construction phase of the project. All birds heard or seen at each point up to 100 m from the observer will be recorded to document species occurrence and estimate abundance. Information about the survey location and time, weather conditions, bird species, number of individuals if in a group, initial detection distance from observer (to nearest 10 m), location relative to project infrastructure, behaviors, flight direction, flight height, use of facility airspace and infrastructure, and comments will be recorded. Behavioral categories will be coded as follows:

PE – perched; SO – soaring; FL – flapping; HU – hunting; GL – gliding; HO – hovering; AUD – auditory; OT - other

When relevant, additional details will be recorded concerning the specific nature of interactions with project infrastructure (e.g., hunting beneath heliostats, using heliostats as escape cover, response to elevated solar flux region), specific perch substrates used, and the specifics of any predator-prey interactions observed (e.g., species involved, setting, and outcome). Flight heights will be estimated as follows:

0 = < 10 m AGL; i.e., within the heliostat collision-risk zone

1 = 10–170 m AGL; i.e., between the heliostat collision-risk zone and the elevated solar flux risk zone near the power towers

2 = 170–280 m AGL; i.e., within the elevated solar flux risk zone)

3 = > 280 m AGL; i.e., above the elevated solar flux risk zone

Flight direction will be recorded as: N, NW, E, SE, S, SW, W, or NW. Weather data will be recorded on an hourly basis throughout each survey morning with the aid of a handheld weather-tracker (e.g., Kestrel) and compass, including information on cloud cover, precipitation, visibility, ambient temperature, wind speed, and wind direction. Species abundance will be estimated using standard distance-sampling data analysis techniques for variable-radius point counts, using programs such as DISTANCE (Buckland et al. 1993). Avian use study results will be prepared and submitted on a quarterly basis with the mortality and injury monitoring reports. Surveys will be completed for a minimum of three years, after which the avian use study will be evaluated by the TAC to determine if modification or continuance is necessary. The survey will be temporarily halted if any birds are observed exhibiting signs of injury, and immediate efforts will be made to capture, stabilize, and transfer injured birds to a licensed veterinarian or federally permitted migratory bird rehabilitator for care.

6.4 Raptor and Large-Bird Use Monitoring

Raptor and large-bird use surveys will be implemented using unlimited-distance point counts to assess use of the facility and off-site study areas. The objectives of the study are to compare seasonal and annual raptor and large-bird species composition and rates of use between the facility and the off-site study areas, and to document changes in use over time. Surveys are planned for completion once per month during summer (June 1 to August 31) and twice monthly the rest of the year at four points distributed across the facility and 1-mile buffer that were also surveyed during the pre-construction phase of the project. The protocols for these point counts will be identical to those for the general avian use studies, with five exceptions:

1. Only raptors and other large birds (e.g., waterbirds and gulls) will be tallied.
2. Relevant birds will be recorded regardless of distance from the observer.
3. The initial detection distance from observer will be estimated to the nearest 100 m.
4. The activity locations, perches used, and flight paths of all observed individuals will be immediately mapped using appropriate aerial imagery, and maps of the facility.
5. Additional data recording will include time-on-plot estimates to quantify the temporal presence of individuals in each study area.

The sampling scheme allows for assessment of the wintering and summering bird community as well as documentation of diurnal migrants. The six of the survey points are positioned to allow evaluation of both on- and off-site use of the project and will be directly comparable to surveys conducted during the pre-construction phase of the project. The towers are in view from each facility-oriented survey point, allowing observation of birds potentially using the area around each tower. Survey points will be evaluated for 4-hour sample periods randomly distributed through the middle portion of the day (approximately 9:00 a.m. to 5:00 p.m., depending on time of year) when diurnal raptors are generally considered most active, and sampling will be rotated so that every four months, all points are evaluated throughout the sample period. Regardless of the sampling period, all incidental observations of raptors and large birds by the observers should be recorded as incidental observations when observing outside the sampling period.

All raptors and large birds will be recorded to unlimited distance to document species occurrence and characterize use of the project and off-site area, but a survey-area radius of 800 meters will be used for standardized assessment and comparison of mean use for raptors and large birds. Species-specific mean use will be estimated for on- and off-site portions of the study area, allowing comparisons of the raptor and other large-bird community between areas, seasons, and years. Surveys will be completed for a minimum of three years, after which the avian use study will be evaluated by PSEGS and the TAC to determine if modification or continuance is necessary. The survey will be temporarily halted if any birds are observed exhibiting signs of injury, and immediate efforts will be made to capture, stabilize, and transfer injured birds to a licensed veterinarian or federally permitted migratory bird rehabilitator for care.

6.5 Golden Eagle Monitoring

The USFWS has requested that the PSEGS team summarize and incorporate data gathered during golden eagle surveys related to territory occupancy and reproductive success into the PSEGS avian monitoring reports. There are several proposed and operating solar facilities in the area with overlapping 10-mile buffers which is the distance recommended by the Guidance for conducting eagle nesting surveys at a renewable energy project (USFWS 2013). In an effort to increase efficiency and to decrease disturbance to nesting eagles, PSH will seek to partner with other firms operating in the area to combine eagle nesting/productivity surveys and data collection into a single integrated effort. These data will be collected and incorporated into the PSEGS avian monitoring reports. Golden eagle reporting will be undertaken for a minimum of three years, after which the data will be evaluated by the TAC to determine if modification or continuance is necessary. Golden eagle and raptor monitoring reports will be submitted to the TAC quarterly

7.0 DATA ANALYSIS AND REPORTING

Data analysis and reporting will consist of assessing the two principle investigations: (1) collision- and flux-related mortality and injury, and (2) avian use. The collision- and flux-related data analysis procedures are detailed in Section 3.1, along with the methodology for the assessment of weather-related events. The avian use analyses approaches are discussed in Section 3.2.

7.1 Statistical Methods for Collision- and Flux-Related Investigations

7.1.1 Fatality Estimation

The best available statistical methods will be used to analyze the data collected during monitoring studies and bias trials. Analyses will include a separate estimate of fatality rates for birds and bats, fatality composition by taxonomic group and flux versus non-flux related fatalities. Estimates of facility-related fatalities will be based on:

1. Observed number of carcasses found during standardized searches during the monitoring period;
2. Non-removal rates, expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials;
3. Searcher efficiency, expressed as the proportion of trial carcasses found by observers during the searcher efficiency trials; and
4. Search area adjustment based on proportion of area searched within the facility and observed carcass density.

Total number of bird or bat carcasses will be estimated by adjusting for carcass removal and searcher efficiency bias.

7.1.1.1 <u>Definition of Variables</u>

The following variables are used in the equations below:

c_i the number of carcasses detected at plot i for the entire study period

n the number of search plots

$\bar{c}$ the average number of carcasses observed per monitoring period

s the number of carcasses used in the carcass removal trials

s_c the number of carcasses in the carcass removal trials that remain in the study area after 14 days

t_i the time (in days) a carcass remains in the study area before it is removed, as determined by the carcass removal trials

$\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the carcass removal trials

d the total number of carcasses placed in the searcher efficiency trials

p_s the estimated proportion of detectable carcasses found by observers, as determined by the single-day searcher efficiency trials

$\bar{I}$ the average interval between standardized carcass searches, in days

A density-weighted proportion of searchable area around the tower

$\hat{\pi}$ the estimated probability that a carcass is both available to be found during a search and is found, as determined by the carcass removal trials and the searcher efficiency trials

m the estimated annual average number of fatalities per year, adjusted for carcass removal and searcher efficiency bias

7.1.1.2 Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring period is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{n} \quad (1)$$

7.1.1.3 Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for carcass removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \quad (2)$$

7.1.1.4 Single-Search Searcher Efficiency Trials

Trial carcasses that were available to be found (i.e. unscavenged) on the first day of the trial were counted for single-search searcher efficiency. The searcher efficiency rate is expressed as p_s and is given as the proportion of trial carcasses that were detected by searchers to the number of carcasses available during the carcass searches.

7.1.1.5 Search Area Adjustment

There will be portions of the area around towers that is unsearchable due to buildings and other structures; furthermore, only 20% of the heliostat field will be searched regularly. As demonstrated at wind facilities, a simple adjustment based on proportion of area searched around the source of mortality (i.e. wind turbine) generally leads to overestimates (Kerns et al. 2005, Huso and Dalthorp 2014). To account for unsearched area, a density-weighted searchable area adjustment will be derived for birds. To generate density weights, carcass density (per m^2) will be calculated in 2-m bands extending from the tower out to the maximum radius within the 100% search area (750 ft); only carcasses found during regular searches will be used. A model will be fit to density, as a function of distance from the tower base. The density weighted searchable area will then be summed over each 2-m band to derive the final estimate of density-weighted searchable area for the tower.

7.1.1.6 Bias Correction Factor Estimators

The modified Huso bias correction factor adjusts the ratio of average number of days the carcass remains in the study period ($\bar{t}$) to the average search interval ($\bar{I}$) is adjusted by an exponential distribution under the assumption that carcasses will be removed at an exponential rate (e.g., more carcasses will be removed within the first days after placement than during later trial dates). This bias correction factor is given as:

$$\hat{\pi}_{\text{modified Huso}} = \frac{\bar{t}\cdot p_m}{\min(\bar{I},\tilde{I})}\cdot\left(1-\exp\left(-\min(\bar{I},\tilde{I})\big/\bar{t}\right)\right)\cdot\min(1,\frac{\tilde{I}}{\bar{I}})$$

where:

$$\tilde{I} = -\log(0.01)\cdot\bar{t} \, .$$

7.1.1.7 Estimation of the Total Number of Facility-Related Fatalities

The total number of facility-related fatalities (M) using either the modified Huso estimator is calculated by dividing the observed fatality rate by $\hat{\pi}$, an estimate of the probability a carcass is not removed by a scavenger (or other means) and is detected, and multiplying by A, a search area adjustment:

$$m = \frac{N\cdot\bar{c}\cdot A}{\hat{\pi}}$$

To use the Huso estimator, it is assumed that all carcasses used as input (i.e. $\bar{c}$) entered the morbid population within one search interval of being found. Thus, carcasses must be identified as having been on the ground less than or equal to one search interval in order to be used in the calculation of $\bar{c}$, and thus *m*.

The adjusted fatality estimates will be calculated and 5,000 bootstrap replicates will be run to obtain 90% confidence intervals for searcher efficiency rates, carcass removal rates, and adjusted fatality estimates.

7.2 Methods for Assessments of Avian Use

Methods for assessing avian use studies will focus on species composition and abundance to provide descriptive statistics. For species composition and abundance, the focus will be on comparison between the on- and off-site areas. For raptor and large-bird studies, the data will generate descriptive statistics. The details of each of these methods are presented below.

7.2.1 Avian Use Survey Assessment Methods

Variable-radius point-count surveys will be analyzed to allow comparison of species composition and species abundance between on-site and off-site areas. Species lists will be prepared for on-site and off-site survey areas, and species abundance will be estimated using standard distance-sampling data analysis techniques for variable-radius point-count data and using programs such as DISTANCE (Buckland et al. 1993). Avian use study results will be prepared and submitted on a quarterly basis with the mortality and injury monitoring reports. Avian use surveys will be completed for a minimum of three years, after which the avian use study will be evaluated by the TAC to determine if modification or continuance is necessary.

7.2.2 Raptor and Large-Bird Surveys Assessment Methods

Separate species lists of all raptors and large birds detected on- and off-site, regardless of distance from observer (i.e., including those observed beyond 800 m and those recorded incidentally/outside standardized raptor and large-bird surveys), will be prepared for each season of monitoring. Data will be analyzed to generate descriptive statistics that will be presented in text, tables, and figures that summarize the number of observations of each species, the locations of species observed, and the relative frequency of observation (i.e., the mean number of birds observed per hour of observation) on- and off- site and between seasons and years. Flight paths of all raptors and large birds will be reported in figures, flight heights will be reported in tables, and any areas of concentrated use will be identified if present. In addition, behavioral responses to the facility will be summarized if detected. Surveys will be completed for a minimum of three years, after which the avian use study will be evaluated by PSEGS and the TAC to determine if modification or continuance is necessary.

7.3 Reporting

All detections will be recorded in the USFWS Special Purpose – Utility (SPUT) permit report and submitted to the TAC monthly. During the first year of operations, seasonal monitoring reports will be prepared within three months of completion of each seasonal monitoring period (once per quarter) by the contractor responsible for field studies and data analysis. During the second year of operations, reports will be prepared on a semi-annual basis, and during the third year of operations, a single annual report will be provided. These reports will include the results of the studies, as well as a discussion of the data collection and analytical methods. The report will also include an appendix that lists each individual detection observed, identification number, species, date of find, GPS location, condition, type of injury and other evidence of cause of death, and additional notes or comments. This list will include all documented injuries and fatalities, even if the detection is not believed to have been caused by the solar energy facility, and will include all detections found during both standard surveys and incidentally.

Adjusted fatality rates will be estimated in two of the first four reports (i.e., semi-annually during the first year) and in all reports during the second and third year. In these instances, the report will include results of the carcass removal and searcher efficiency trials, including estimates of removal rates and searcher efficiency by size and season from both on- and off-site study areas. Observed and adjusted fatality rates[1] (and associated standard error and 90-% confidence intervals) resulting from collision, exposure to solar flux, both, unknown, and all causes will be estimated for all birds, small birds, large birds, and raptors for both on- and off-site areas. Maps will be provided showing the location of each detection relative to the facility. Subjective and potentially quantitative statistical evaluation will be made of locations to consider the spatial arrangement in relation to facility features to aid in future study design. These analyses will carefully consider the ramifications of including (or not) incidental finds discovered outside of the standard fatality surveys; in the case of rare species and events, consideration of incidental finds may be imperative to yield appropriate insight. Photographs of all detections will be separately provided. In addition, avian use, raptor and large-bird, and golden eagle monitoring results will be included in the quarterly reports. All reports described here will be provided to the TAC

The results of the detection and deterrent research conducted at PSEGS will be reported as results of the studies become available. Reports will include the methods and results of the studies conducted to date as well as a discussion of the technologies employed and an assessment of their value for the purposes of mitigating potential impacts of the Project to birds and bats.

Reports will also include the methods and results of studies regarding the stowage of heliostats in various positions intended to reduce any potential risk of collision with heliostats by birds and bats and a discussion of the efficacy of the protocols for mitigating such impacts.

7.3.1 Regional Awareness Effort and Assessment

In addition to direct monitoring of the off-site area, a communication protocol will be implemented to monitor local veterinarians, game wardens, and wildlife rehabilitation facilities during facility operations to determine if significant new incidences of avian injury or fatality are reported to occur in the facility vicinity and region. Facility biologists will communicate with these entities on a quarterly basis to evaluate potential increases in frequency of injured birds in the project vicinity in response to project operations. Findings will be reported to the TAC in quarterly reports.

7.4 Wildlife Reporting Program

In addition to the post-construction fatality monitoring study described above, PSEGS will implement a wildlife reporting program into the WEAP training at the start of operations, and it will remain active for the life of the PSEGS facility. The purpose of this program is to standardize the actions taken by site personnel in response to wildlife incidents encountered in the PSEGS and to fulfill the obligations for reporting wildlife incidents. In addition, this system is also intended to complement the standard searches as detailed in the mortality monitoring sections. However, employees will be instructed only to report incidences to the Designated Biologist and not to disturb any evidence of mortality within the 5-acre plots, to avoid interfering with the standardized searches and total fatality estimates. All observed fatalities will be reported in the reports described in this BBCS and in the monthly or annual compliance reports for the CEC. The wildlife reporting program will be utilized by site operations and maintenance personnel who encounter dead or injured wildlife incidentally while conducting general facility maintenance activities, such as mirror washing. The program is designed to provide a means of recording and collecting fatalities at the PSEGS project to increase the understanding of power tower solar facilities and wildlife interactions. In addition, this system will specifically train personnel to identify evidence of mortality of rare species, particularly large birds such as eagles.

Any native bird found injured within the PSEGS facility will be taken to the nearest appropriate wildlife rehabilitation facility. Any incident involving a state- or federally listed threatened or endangered species or a bald or golden eagle must be reported to the USFWS and CDFW within 24 hours of identification. PSEGS maintains an ongoing commitment to investigate wildlife incidents involving company facilities and to work cooperatively with federal and state agencies in an effort to prevent and mitigate future wildlife fatalities. It is the responsibility of PSEGS employees and subcontractors to report all wildlife incidents to their immediate supervisor and to the on-site Designated Biologist as per CEC Conditions of Certification (COCs).

8.0 ADAPTIVE MONITORING AND MANAGEMENT

Adaptive management is a framework by which information gathered may be utilized to inform and update mitigation efforts. Adaptive management at the PSEGS has been designed to use monitoring data to evaluate whether impacts are determined to be significant or unique, and if so, to implement measures to reduce them to acceptable levels or consider some other type of minimization or mitigation. The adaptive management techniques described in this section have been developed to ensure that potentially significant levels of mortality from operation of the PSEGS are effectively mitigated. This section describes the adaptive management process that will be applied for avian and bat species. Changes in federal, state, and/or BLM status for wildlife species occurring within the project area may result in the addition of, or changes to, adaptive management strategies, as determined by the Project Proponent and BLM through TAC recommendations. As part of this adaptive process, a step-wise table of advanced conservation practices will be developed.

8.1 TAC

A Technical Advisory Committee (TAC) will be formed to review Project avian and bat surveys and to advise on the implementation of various components of the BBCS. The TAC will consist of a single representative of the BLM, CEC, CDFW, USFWS, one representative of the project owner involved in operation of the project, and one representative of the project owner with environmental compliance responsibilities.

The TAC will provide advice and recommendations to the BLM AO and the CEC CPM. If the TAC takes votes on the recommendations to be provided, the two TAC members representing the project owner will not have voting rights. The BLM AO and the CEC CPM will evaluate any recommendations of the TAC, including discussions with the owner on new measures or measures that are not completely detailed in this BBCS, and make a decision on what measure(s) to require for implementation.

A TAC Lead will be designated for the group. The TAC Lead's duties will include disseminating project data, including data on mortality events, setting up and moderating meetings, reviewing mortality data, and documenting mitigation recommendations for the PSEGS. Because the PSEGS located on federal land and the BLM is the federal decision-maker, BLM will provide a designated TAC Lead for the duration of the project. The TAC Lead shall also have the right to make recommendation decisions under extraordinary circumstances or when all TAC members are unable to meet.

A Memorandum of Agreement (MOA) will be signed by each party to ensure participation in the TAC. Unless there is a failure on the part of any of these representatives to respond or agree to participate, the TAC will be formed prior to project operations.

The guiding principles, duties, and responsibilities of the TAC include the following:

- Approve TAC charter and sign MOA.
- Make recommendations based on best available science and to address specific issues resulting from this project.
- In the event decisions cannot be made by consensus, decisions of the TAC will be made by simple majority vote.
- The TAC is only an advisory committee, and final management decisions will be made by the BLM AO.
- Provide sufficient flexibility to adapt as more is learned about the project as well as strategies to reduce avian and bat impacts.
- Review initial and any subsequent revised monitoring protocols for mortality monitoring studies.
- Review results of mortality monitoring.
- Recommend appropriate mitigation measure(s) to the BLM AO for implementation in the event that a significant or unique event occurs.
- Develop and recommend additional mitigation measures or research to the BLM AO if deemed necessary.
- Evaluate effectiveness of implemented mitigation strategies and provide the BLM AO with recommendations based on findings.

- Recommend mitigation funding opportunities for implementation of off-site habitat enhancement, protection/conservation measures, or other mitigation measures.
- The TAC will terminate when the BLM AO determines that it is no longer a necessary pathway in reducing avian and bat impacts.

The TAC will hold its first meeting prior to the commencement of operations to develop and approve the charter and requirements of this BBCS. The charter will include an MOA ensuring participation in the TAC and agreeing to how funds provided by the owner would be accessed.

8.2 TAC Data Review Framework

At a minimum, the TAC will meet annually for the first three years of Project operations to review data and recommend whether additional adaptive monitoring or management actions are necessary. The TAC may meet more often to discuss monitoring results, adaptive management needs, or if the TAC Lead determines that a significant event has occurred. Attendance at TAC meetings will be by invitation of its members only. Should the operational monitoring studies indicate significant adverse impacts to avian resources, either to a particular species or group of species at the regional population level, PSEGS is committed to taking appropriate action to address the issue(s). As the technology which will be employed at the PSEGS is relatively new, it is difficult to predict the extent or level of impacts to birds or bats (if any), that may result from operation of the facility. Therefore, PSEGS is committed to working with the TAC in a collaborative manner to identify and implement measures commensurate in scale with the identified impact. Performance Standards have been identified to further facilitate the adaptive management process.

The TAC will ensure that management recommendations to mitigate impacts are directed specifically at identified problems. For example, if nocturnal migrants are affected by a tower during low-visibility weather events, modifications to the tower lighting regime could be implemented in an effort to mitigate for the particular issue. The TAC will assess impacts and identify appropriate responses in a collaborative manner with the project operations and environmental TAC members for recommendation to the BLM AO and CEC CPM.

The reports described in this BBCS will serve to inform the TAC regarding any issues that may need to be addressed. The reports will categorize potential migratory bird mortality issues as high, medium, or low to provide an appropriate biological basis for TAC review and decision-making, and will reflect the following definitions (Table 15):

1. High: Estimated avian mortality or injury levels are facility-caused and likely to seriously and negatively affect local, regional, or national avian populations within a particular species or group of species.
2. Medium: Estimated avian mortality or injury levels are facility-caused and have the potential to negatively affect local, regional, or national populations within a particular avian species or group of species.

3. Low: Estimated avian mortality or injury levels that have minimal or no potential to negatively affect local, regional, or national populations within a particular species or group of species.

Table 15. Adaptive management responses.

Issue	Management Response	Study Response
High levels of general or species- specific mortality associated with a particular facility feature (for example, heliostats) or characteristic (for example, flux, weather events)	Immediate management action taken if cause can be addressed*	Studies modified, refined, or expanded to better understand and address impact issue and assess effectiveness of management response
Medium levels of general or species-specific mortality associated with a facility feature or characteristic	Management action taken to address impact issue if deemed necessary*	Studies modified, refined, or expanded to better understand and address impact issue and assess effectiveness of response
Low mortality rates at or near background rate	No management responses taken	Studies completed according to plan, or stopped earlier than planned if appropriate

* Management actions must be feasible and commensurate with the impact. Some examples of measures include placement of visual and/or auditory bird flight diverters in critical locations, retrofitting power lines to APLIC standards, installing perch guards on overhead electric lines in the vicinity, modification of mirror resting angles, modifications to tower or other facility lighting.

If a bald or golden eagle fatality should occur at the facility, PSEGS will report it to the USFWS Office of Law Enforcement within 24 hours and will consult with the USFWS to determine the need for an eagle permit.

PSH will prepare an Eagle Protection Plan that meets the requirements of CEC Condition of Certification BIO-16b. The document will be prepared in accordance with the current USFWS Land-Based Wind Energy Guidelines to the extent the guidelines are relevant to Solar Power Tower Technology.

8.3 Addressing Resource Impacts

If, based on the analytical framework above, the TAC identifies significant impacts to avian resources that warrant an immediate response to either change the monitoring/reporting procedures or to protect the resources involved, a recommendation will be developed by the TAC. If the recommendation is adopted and required by the BLM AO and CEC CPM, it will be implemented by PSEGS in a timeframe agreed upon by all parties. If a deterrent measure is adopted, the owner will propose and the TAC will approve a performance standard for that measure

Other performance standards may be developed by the owner in consultation with the TAC. Performance standards can be considered quantitative means by which an impact is identified, a threshold necessitating action is determined, the result of an action is measured, or various actions are compared to one another, Performance standards may be developed to help answer the following questions:

- What is the best use of compensatory mitigation funds and how may they best be proportionally applied to species/taxa groups impacted?
- What additional monitoring, research, or mitigation should be conducted if mortality is higher than predicted?
- What are the most effective technologies or combination of technologies to detect, deter, and reduce mortality of bird and bat species?
- If mortality on a given day or in a given period is considered high based on a specific threshold, what were the factors that appeared to be related to the event or series of events?

9.0 REFERENCES

AECOM. 2009. Palen Solar Power Project Biological Technical Report. Riverside County, California. Submitted to Solar Millennium, LLC, Berkeley, California, and Chevron Energy.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington, D.C.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Public Interest Energy Research Program (PIER) Final Project Report CEC-500-2006-022. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, California.

Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 United States Code (USC) § 668-668d. Bald Eagle Protection Act of 1940, June 8, 1940, Chapter 278, § 2, 54 Statute (Stat.) 251; Expanded to include the related species of the golden eagle October 24, 1962, Public Law (P.L.) 87-884, 76 Stat. 1246. As amended: October 23, 1972, P.L. 92-535, § 2, 86 Stat. 1065; Nov. 8, 1978, P.L. 95-616, § 9, 92 Stat. 3114.

Bloom Biological, Inc. (BBI). 2013a. Palen Solar Electric Generating Facility Spring 2013 Avian Survey Results. Prepared for Palen Solar Holdings, Inc., Oakland, California. Prepared by BBI, Lake Forest, California. July 2013.

Bloom Biological, Inc. (BBI). 2013b. Palen Solar Electric Generating Facility Summer 2013 Avian Survey Results. Prepared for Palen Solar Holdings, Inc., Oakland, California. Prepared by BBI, Lake Forest, California. August 2013.

Bloom Biological, Inc. (BBI). 2013c. Palen Solar Electric Generating System 2013 Golden Eagle Nesting Survey Results. Prepared for Palen Solar Holdings, Inc., Oakland, California. Prepared by BBI, Lake Forest, California. October 2013.

Bloom Biological, Inc. (BBI). 2013d. Palen Solar Electric Generating System Winter 2013 Golden Eagle Survey Results. Prepared for Palen Solar Holdings, Inc., Oakland, California. Prepared by BBI, Lake Forest, California. March 2013.

Bloom Biological, Inc. (BBI). 2013e. Palen Solar Electric Generating Facility Spring 2013 Avian Survey Results Supplement. Prepared for Palen Solar Holdings, Inc., Oakland, California. Prepared by BBI, Lake Forest, California. July 2013.

Bibby, C. J., N. D. Burgess, and D. A. Hill. 1992. Bird Census Techniques. Academic Press, New York. 257 pp.

Bishop, J., H. McKay, D. Parrott, and J. Allan. 2003. Review of International Research Literature Regarding the Effectiveness of Auditory Bird Scaring Techniques and Potential Alternatives.

Brown, P. E., and W. E. Rainey. 2013. Bat Habitat Assessment for Palen Solar Electric Generation System. Conducted for Alice E. Karl and Associates. Conducted by Brown-Berry Biological Consulting. July 20, 2013.

Brown, P. E., and W. E. Rainey. 2014. Bat Habitat Assessment for Palen Solar Electric Generation System. Conducted for Alice E. Karl and Associates. Conducted by Brown-Berry Biological Consulting. May 17, 2014.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman & Hall, London, United Kingdom.

Bureau of Land Management (BLM). 2010a. CDCA Plan Amendment/FEIS. July 2010. Available online at: http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/needles/lands_solar.Par.19048.File.dat/1-CDCA-Ivanpah-Final-EIS.pdf

Bureau of Land Management (BLM). 2010b. Instruction Memorandum No. 2010-156. Bald and Golden Eagle Protection Act – Golden Eagle National Environmental Policy Act and Avian Protection Plan Guidance for Renewable Energy. July 13, 2010. Expires September 30, 2011. Available online at: http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/ 2010/IM_2010-156.html

Bureau of Land Management (BLM). 2013. Plan Amendment/Final EIS for the Palen Solar Power Project. Available at: http://www.energy.ca.gov/sitingcases/palen/

Bureau of Land Management (BLM). 2014. Supplemental EIS for the Palen Solar Power Project. Available at: http://www.energy.ca.gov/sitingcases/palen/

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Prepared by the California Burrowing Owl Consortium. April 1993.

California Department of Fish and Game (CDFG). 2011. Special Animals (898 Taxa). State of California Natural Resources Agency, Biogeographic Data Branch, California Natural Diversity Database (CNNDB). January 2011. http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf

California Department of Fish and Game (CDFG). 2012. Staff Report on Burrowing Owl Mitigation. State of California, Natural Resources Agency, Department of Fish and Game. March 7, 2012.

California Department of Fish and Wildlife (CDFW). 2014. State & Federally Listed Endangered & Threatened Animals Of California. March 2014..

California Endangered Species Act (CESA). 1984. Fish and Game Code § 2050 - 2115.5.

California Energy Commission (CEC). 2010a. Commission Decision. Palen Solar Power Project.

California Energy Commission (CEC). 2013. Presiding Members Proposed Decision. Palen Solar Power Project. December 13, 2013.

California Energy Commission (CEC) and California Department of Fish and Game (CDFG). 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. . Commission Final Report. CEC, Renewables Committee, and Energy Facilities Siting Division, and CDFG, Resources Management and Policy Division. CEC-700-2007-008-CMF.

Calvert, A. M., C. A. Bishop, R. D. Elliot, E. A. Krebs, T. M. Kydd, C. S. Machtans, and G. J. Robertson. 2013. A Synthesis of Human-Related Avian Mortality in Canada. Avian Conservation and Ecology 8(2): 11; http://dx.doi.org/10.5751/ACE-00581-080211.

CEC RSA. 2010. Revised Staff Assessment for the Proposed Blythe Solar Power Project. June 4, 2010.

Chatfield, A., W. Erickson, and K. Bay. 2009. Avian and Bat Fatality Study, Dillon Wind-Energy Facility, Riverside County, California. Final Report: March 26, 2008 - March 26, 2009. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 3, 2009.

Chatfield, A., W. P. Erickson, and K. Bay. 2010. Final Report: Avian and Bat Fatality Study at the Alite Wind-Energy Facility, Kern County, California. Final Report: June 15, 2009 – June 15, 2010. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. Prepared for CH2M HILL, Oakland, California.

Dooling, R. J. and A. N. Popper. 2007. The Effects of Highway Noise on Birds. Report to the California Department of Transportation, contract 43A0139. California Department of Transportation, Division of Environmental Analysis, Sacramento, California.

Desert Renewable Energy Conservation Plan (DRECP). 2012. Desert Renewable Energy Conservation Plan Framework.

EDAW AECOM. 2009. Palen Solar Power Project Burrowing Owl Technical Report. July 2009.

EDAW AECOM and Bloom Biological, Inc. (BBI). 2009. Palen Solar Power Project Avian Point Count Survey Technical Report. Prepared for Solar Millennium, LLC and Chevron Energy Solutions. August 2009.

Endangered Species Act (ESA). 1973. 16 United States Code (USC) § 1531-1544, Public Law (PL) 93-205, December 28, 1973, as amended, PL 100-478 [16 USC 1531 *et seq.*]; 50 Code of Federal Regulations (CFR) 402.

Erickson, W. P., A. Chatfield, and K. Bay. 2009. Review of Avian Studies in the Tehachapi Wind Resource Area. Prepared for CH2M HILL, Oakland, California. Prepared by Western EcoSystems Technology, Inc.(WEST), Cheyenne, Wyoming. June 10, 2009

Erickson, W. P., D. Johnson, J. L. Gehring, M. Wolfe, and K. Bay. 2014 (in review). A Comprehensive Review and Analysis of Data on Small Passerine Fatality Impacts Due to Wind Energy Facilities with Comparisons to Impacts from Communications Towers and Other Sources. PLoS ONE.

ESRI. 2014. Geographic Information System (GIS) Online Topographic Base Map. ESRI, producers of ArcGIS software. Redlands, California.

Executive Order (EO) 13186. 2001. Responsibilities of Federal Agencies to Protect Migratory Birds. 66 FR 3853. January 10, 2001.

Gauthreaux, S.A. Jr. and C. G. Belser. 2006. Effects of Artificial Night Lighting on Migratory Birds. Pp. 67- 93. *In*: Ecological Consequences of Artificial Night Lighting. C. Rich and T. Longcore, eds. Island Press, Washington, D.C.

Gauthreaux, S.A. Jr., C. G. Belser, and D. van Blaricom. 2003. Using a Network of Wsr 88-D Weather Surveillance Radars to Define Patterns of Bird Migration at Large Spatial Scales. Pp. 335-346. *In*: Avian Migration. P. Berthold, E. Gwinner, and E. Sonnenschein, eds. Berlin: Springer.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2009. Communication Towers, Lights, and Birds: Successful Methods of Reducing the Frequency of Avian Collisions. Ecological Applications 19(2): 505-514.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2011. The Role of Tower Height and Guy Wires on Avian Collisions with Communication Towers. Journal of Wildlife Management 75: 848-855.

Hawk Migration Association of North America (HMANA). http://hmana.org

Hunsaker, D., II. 2001. The Effects of Aircraft Operations on Passerine Reproduction. In Proceedings of the Effects of Noise on Wildlife Conference. Institute for Environmental Monitoring and Research. August 22 to 23, 2000. pp. 41-49.

Huso, M. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22(3): 318-329. doi: 10.1002/env.1052.

Huso, M., and D. Dalthorp. 2014. Accounting for Unsearched Areas in Estimating Wind Turbine-Caused Fatality. Journal of Wildlife Management 78(2): 347-358. doi: 10.1002/jwmg.663.

Huso, M., N. Som, and L. Ladd. 2012. Fatality Estimator User's Guide. US Geological Survey (USGS) Data Series 729. 22 pp. Available online at: http://pubs.usgs.gov/ds/729/pdf/ds729.pdf

Johnston, D. S., J. A. Howell, S. B. Terrill, N. Thorngate, J. Castle, J. P. Smith, T. J. Mabee, J. H. Plissner, N. A. Schwab, P. M. Sanzenbacher, and C. M. Grinnell. 2013. Bird and Bat Movement Patterns and Mortality at the Montezuma Hills Wind Resource Area. Final Project Report. CEC-500-2013-015. Prepared for the California Energy Commission. Prepared by H.T. Harvey and Associates. H.T. Harvey and Associates, Los Gatos, California, and ABR, Inc. Forest Grove, Oregon. June 2013. Available online at: http://www.energy.ca.gov/2013publications/CEC-500-2013-015/CEC-500-2013-015.pdf

Karl, A. E. 2013. Palen Solar Electric Generating System Supplemental Spring 2013 Biological Surveys. Prepared for Palen Solar Holdings, LLC. July, 2014.

Kerlinger, P. 2001. How Birds Migrate. Stackpole Books, Mechanicsburg, Pennsylvania.

Kerlinger, P., J. L. Gehring, W. P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. Wilson Journal of Ornithology 122(4): 744-754.

Kerlinger, P., J. Guarnaccia, A. Hasch, R. C. E. Culver, R. C. Curry, L. Tran, M. J. Stewart, and D. Riser-Espinoza. 2012. Avian Collision Mortality at 50- and 60-M Guyed Towers in Central California. Condor 114(3): 462-469.

Kerns, J., W. P. Erickson, and E. B. Arnett. 2005. Bat and Bird Fatality at Wind Energy Facilities in Pennsylvania and West Virginia. Pp. 24-95. *In*: Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. A Final Report Submitted to the Bats and Wind Energy Cooperative. Arnett, E.B., technical ed. Bat Conservation International, Austin, Texas. http://www.batsandwind.org/pdf/ar2004.pdf

Klem, D. Jr. 2009. Avian Mortality at Windows: The Second Largest Human Source of Bird Mortality on Earth. Pp. 244-251. *In*: Proceedings of the 4th International Partners in Flight Conference: Tundra to Tropics. T. D. Rich, C. Arizmendi, D. Demarest, and C. Thompson, eds. McAllen, Texas.

Levenstein, K., A. Chatfield, W. Erickson, and K. Bay. 2014. Fall 2013 Avian Field Surveys for the Palen Solar Electric Generating System, Riverside County, California. Prepared for Palen Solar Holdings, LLC. February 13, 2014.

Levenstein, K. and C. Nations. 2014. Fall 2013 Nocturnal Migration Surveys for the Palen Solar Electric Generating System, Riverside County, California. Final Report. Prepared for Palen Solar Holdings, LLC. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, A.M. Manville, II, E. R. Travis, and D. Drake. 2012. An Estimate of Avian Mortality at Communication Towers in the United States and Canada. PLoS ONE 7(4): e34025. doi: 34010.31371/journal.pone.0034025.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, A.M. Manville, II, E. R. Travis, and D. Drake. 2013. Avian Mortality at Communication Towers in the United States and Canada: Which Species, How Many, and Where? USDA National Wildlife Research Center - Staff Publications. Paper 1162. http://digitalcommons.unl.edu/icwdm_usdanwrc/1162

Manville, A. 2000. Avian Mortality at Communication Towers: Background and Overview. Pp. W. R. Evans and A. M. Manville, II, eds. Proceedings of the Workshop on Avian Mortality at Communication Towers; 1-5. l

Martin, T.E. and G.R. Geupel. 1993. Nest-monitoring plots: Methods for locating nests and monitoring success. Journal of Field Ornithology 64:507-519.

McCrary, M. D., R. L. McKernan, R. W. Schreiber, W. D. Wagner, and T. C. Sciarrotta. 1986. Avian Mortality at a Solar Energy Power Plant. Journal of Field Ornithology 57(2): 135-141.

McGuire, L. P. and M. B. Fenton. 2010. Hitting the Wall: Light Affects the Obstacle Avoidance Ability of Free-Flying Little Brown Bats (Myotis lucifugus). Acta Chiropterologica 12: 247-250.

Migratory Bird Treaty Act (MBTA). 1918. 16 United States Code (USC) § 703-712. July 13, 1918.

Miller, B. W. 2001. A Method for Determining Relative Activity of Free-Flying Bats Using a New Activity Index for Acoustic Monitoring. Acta Chiropterologica 3: 93-106.

National Environmental Policy Act (NEPA). 1970. 42 United States Code § 4321-4347. January 1, 1970.

National Geographic Society (National Geographic). 2013. TOPO! Digital Topographic Map.

National Wind Coordinating Collaborative (NWCC). 2010. Wind Turbine Interactions with Birds, Bats, and Their Habitats: A Summary of Research Results and Priority Questions. NWCC c/o RESOLVE, Washington, D.C. Available online at: http://www.nationalwind.org/ publications/bbfactsheet.aspx

Nicolai, C., S. Abele, H. Beeler, R. Doster, E. Kershner, and T. McCabe. 2011. Monitoring Migratory Bird Take at Solar Power Facilities: An Experimental Approach. US Fish and Wildlife Service (USFWS). April 26, 2011.

North American Datum (NAD). 1983. NAD83 Geodetic Datum.

Orbach, D. and B. Fenton. 2010. Vision Impairs the Ability of Bats to Avoid Colliding with Stationary Obstacles. PLosONE 5: 11.

Pagel, J. E., D. M. Whittington, and G. T. Allen. 2010. Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance. US Fish and Wildlife Service (USFWS). February 2010. Available online at: http://steinadlerschutz.lbv.de/fileadmin/www.steinadlerschutz.de/terimGoldenEagleTechnicalGuidanceProtocols25March2010_1_.pdf

Palen Solar Holdings (PSH). 2012. Petition to Amend. Available online at: http://www.energy.ca.gov/sitingcases/palen/compliance/2012-12-18_Pettition_to_amend_TN-68910.pdf.

Partners in Flight Science Committee (Partners in Flight). 2012. Population Estimates Database, Version 2012. Partners in Flight and Rocky Mountain Bird Observatory (RMBO). Accessed 2012 Available online at: http://rmbo.org/pifpopestimates

Patterson, J.W. Jr. 2012. Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities. DOT/FAA/TC-TN12/9. May 2012. Available online from the Federal Aviation Administration William J. Hughes Technical Center at: http://www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/library/

Poot, H., B. J. Ens, H. de Vries, M. A. H. Donners, M. R. Wernand, and J. M. Marquenie. 2008. Green Light for Nocturnally Migrating Birds. Ecology and Society 13(2): 47.

Raitt, R. and R. L. Maze. 1968. Densities and Species Composition of Breeding Birds of a Creosotebush Community in Southern New Mexico. Condor 70(3): 193-205.

Reynolds, R. T., J. M. Scott, and R. A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. Condor 82(3): 309-313.

Santolo, G. 2012. Hidden Hills Solar Electric Generating System (HHSEGS) (11-AFC-2). Potential for Solar Flux Impacts to Avian Species. Attachment DR201. Submitted to the California Energy Commission (CEC). Submitted by Hidden Hills Solar I, LLC, and Hidden Hills Solar II, LLC, with assistance from CH2M HILL, Sacramento, California. November 21, 2012.

Shire, G. G., K. Brown, and G. Winegrad. 2000. Communication Towers: A Deadly Hazard to Birds. A Report Compiled by American Bird Conservancy Documenting the Killing of 230 Bird Species. American Bird Conservancy, Washington, DC.

Smallwood, K. S. 2007. Estimating Wind Turbine-Caused Bird Mortality. Journal of Wildlife Management 71: 2781-2791.

Smallwood, K. S. 2013. Comparing Bird and Bat Fatality-Rate Estimates among North American Wind-Energy Projects. Wildlife Society Bulletin 37(1): 19-33.

Strickland, M. D., E. B. Arnett, W. P. Erickson, D. H. Johnson, G. D. Johnson, M. L. Morrison, J. A. Shaffer, and W. Warren-Hicks. 2011. Comprehensive Guide to Studying Wind Energy/Wildlife Interactions. Prepared for the National Wind Coordinating Collaborative (NWCC), Washington, D.C., USA. June 2011. Available online at: http://www.batsandwind.org/pdf/Comprehensive_Guide_to_Studying_Wind_Energy_Wildlife_Interactions_2011.pdf

Thompson, J. and K. Bay. 2012. Post-Construction Fatality Surveys for the Dry Lake II Wind Project: February 2011 – February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western Ecosystems Technology, Inc. (WEST), Cheyenne, Wyoming. June 6, 2012.

Thompson, J., D. Solick, and K. Bay. 2011. Post-Construction Fatality Surveys for the Dry Lake Phase I Wind Project. Iberdrola Renewables: September 2009 - November 2010. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western Ecosystems Technology, Inc. (WEST), Cheyenne, Wyoming. February 10, 2011.

US Department of Agriculture (USDA). 2014. Imagery Programs. USDA - Farm Service Agency (FSA). Aerial Photography Field Office (APFO), Salt Lake City, Utah.

US Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP). 2005. NAIP Imagery and Status Maps.

US Fish and Wildlife Service (USFWS). 2009. United States Fish and Wildlife Service, Department of the Interior. 50 CFR 13 and 22. Eagle Permits; Take Necessary to Protect Interests in Particular Localities. 74 Federal Register (FR) 46836-46879. September 11, 2009.

US Fish and Wildlife Service (USFWS). 2010. Region 8 Interim Guidelines for the Development of a Project- Specific Avian and Bat Protection Plan for Solar Energy Plants and Related Transmission Facilities. USFWS, Region 8, Sacramento, California.

US Fish and Wildlife Service (USFWS). 2012. Final Land-Based Wind Energy Guidelines. March 23, 2012. 82 pp. Available online at: http://www.fws.gov/windenergy/docs/WEG_final.pdf

US Fish and Wildlife Service (USFWS). 2013a. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Available online at: http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

US Fish and Wildlife Service (USFWS). 2013b. Waterfowl: Population Status, 2013. US Department of the Interior (USDOI), Washington, D.C. July 24, 2013. Available online at: https://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus/Waterfowl/StatusReport2013.pdf

US Geological Survey (USGS). 2014. The National Map/US Topo. Last updated January 5, 2014. Homepage available at: http://nationalmap.gov/ustopo/index.html

Wildlife Research Institute, Inc. (WRI). 2010. Golden Eagle Surveys Surrounding Four Proposed Solar Developments in Eastern Mojave Desert, Riverside and San Bernardino Counties, California. Prepared for Tetra Tech EC 22 June.

Appendix A. Mean Bird Use (Number of Birds/Observer-Hour/Survey), Percent of Total Use (%), and Frequency of Occurrence (%) for Each Bird Type and Species During Fall Bird Use Count Surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013

Appendix A. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Type/Species	Mean Use	% of Use	% Frequency
Waterbirds	**0.03**	**1.0**	**4.6**
American white pelican	<0.01	<0.1	0.6
great blue heron	<0.01	0.1	1.9
great egret	<0.01	0.2	1.1
sandhill crane	<0.01	<0.1	0.4
white-faced ibis	0.02	0.6	0.6
Gannets	**<0.01**	**<0.1**	**0.2**
blue-footed booby	<0.01	<0.1	0.2
Waterfowl	**0.11**	**3.4**	**5.9**
American wigeon	<0.01	<0.1	0.2
blue-winged teal	<0.01	<0.1	0.4
Canada goose	<0.01	0.2	0.3
cinnamon teal	<0.01	<0.1	0.2
greater white-fronted goose	0.03	0.9	0.6
green-winged teal	<0.01	<0.1	0.4
northern shoveler	<0.01	0.1	0.2
Ross' goose	<0.01	0.2	1.6
snow goose	0.05	1.5	2.9
unidentified duck	<0.01	0.2	0.8
unidentified goose	<0.01	<0.1	0.4
unidentified waterfowl	<0.01	<0.1	0.2
Shorebirds	**0.03**	**0.9**	**5.6**
American avocet	<0.01	<0.1	0.2
black-bellied plover	<0.01	<0.1	0.2
black-necked stilt	<0.01	0.2	0.2
greater yellowlegs	<0.01	<0.1	0.4
killdeer	<0.01	0.1	2.3
least sandpiper	<0.01	<0.1	1.4
long-billed curlew	<0.01	<0.1	0.6
mountain plover	<0.01	<0.1	0.2
pectoral sandpiper	<0.01	<0.1	0.2
semipalmated plover	<0.01	<0.1	0.2
western sandpiper	<0.01	0.3	0.8
Gulls/Terns	**0.05**	**1.5**	**3.5**
Bonaparte's gull	<0.01	<0.1	0.4
California gull	<0.01	0.2	0.8
Herring gull	<0.01	0.2	0.4
laughing gull	<0.01	<0.1	0.4
mew gull	<0.01	0.3	0.2
ring-billed gull	0.02	0.6	1.6
unidentified gull	<0.01	0.1	0.4
Diurnal Raptors	**0.18**	**5.7**	**54.0**
Accipiters	*0.02*	*0.7*	*12.8*
Cooper's hawk	0.01	0.5	10.6
sharp-shinned hawk	<0.01	0.3	4.1
unidentified accipiter	<0.01	<0.1	0.2

Appendix A. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Type/Species	Mean Use	% of Use	% Frequency
Buteos	*0.07*	*2.4*	*30.8*
ferruginous hawk	<0.01	<0.1	0.6
red-shouldered hawk	<0.01	<0.1	0.2
red-tailed hawk	0.05	1.6	25.6
Swainson's hawk	0.02	0.7	7.6
unidentified buteo	<0.01	<0.1	0.3
zone-tailed hawk	<0.01	<0.1	0.2
Northern Harrier	*0.02*	*0.7*	*14.8*
northern harrier	0.02	0.7	14.8
Eagles	*<0.01*	*<0.1*	*1.3*
golden eagle	<0.01	<0.1	1.3
Falcons	*0.04*	*1.3*	*20.9*
American kestrel	<0.01	0.3	7.3
merlin	<0.01	<0.1	0.2
prairie falcon	0.03	1.0	16.0
unidentified falcon	<0.01	<0.1	0.4
Osprey	*<0.01*	*0.2*	*4.9*
osprey	<0.01	0.2	4.9
Other Raptors	*0.01*	*0.3*	*6.2*
unidentified hawk	<0.01	<0.1	1.5
unidentified raptor	<0.01	0.3	4.9
Owls	**<0.01**	**<0.1**	**0.4**
burrowing owl	<0.01	<0.1	0.2
short-eared owl	<0.01	<0.1	0.2
Vultures	**1.74**	**56.5**	**47.4**
turkey vulture	1.74	56.5	47.4
Upland Game Birds	**<0.01**	**<0.1**	**0.2**
ring-necked pheasant	<0.01	<0.1	0.2
Doves/Pigeons	**<0.01**	**<0.1**	**0.8**
common ground-dove	<0.01	<0.1	0.2
mourning dove	<0.01	<0.1	0.6
rock pigeon	<0.01	<0.1	0.2
white-winged dove	<0.01	<0.1	0.2
Goatsuckers	**<0.01**	**<0.1**	**0.4**
lesser nighthawk	<0.01	<0.1	0.4
Large Corvids	**0.14**	**4.5**	**8.6**
American crow	<0.01	<0.1	0.4
common raven	0.14	4.5	8.6
Swallows	**0.70**	**27.2**	**49.5**
bank swallow	<0.01	0.2	3.0
barn swallow	0.45	14.6	33.2
cliff swallow	0.05	1.6	11.1
northern rough-winged swallow	0.01	0.3	3.0
tree swallow	0.03	1.0	6.9
unidentified swallow	0.10	3.1	14.3
violet-green swallow	0.06	1.9	5.9

Appendix A. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Type/Species	Mean Use	% of Use	% Frequency
Swifts/Hummingbirds	**0.11**	**3.7**	**9.8**
Anna's hummingbird	<0.01	<0.1	0.2
black-chinned hummingbird	<0.01	<0.1	0.4
Costa's hummingbird	<0.01	<0.1	0.9
unidentified hummingbird	<0.01	<0.1	0.5
unidentified swift	<0.01	<0.1	0.6
Vaux's swift	0.05	1.7	7.2
white-throated swift	0.06	1.9	2.0
Overall	**3.09**	**100**	

[a] 800-m radius plot

Appendix B. Total Number of Groups and Individuals for Each Bird Type and Species during Small Bird Count Surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013

Appendix B. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Loons/Grebes		**14**	**85**
eared grebe	*Podiceps nigricollis*	6	65
pied-billed grebe	*Podilymbus podiceps*	3	11
western grebe	*Aechmophorus occidentalis*	5	9
Waterbirds		**29**	**189**
American white pelican	*Pelecanus erythrorhynchos*	1	1
cattle egret	*Bubulcus ibis*	1	8
great blue heron	*Ardea herodias*	5	6
great egret	*Ardea alba*	8	11
green heron	*Butorides virescens*	4	4
snowy egret	*Egretta thula*	3	3
white-faced ibis	*Plegadis chihi*	7	156
Waterfowl		**27**	**63**
American wigeon	*Anas americana*	1	1
blue-winged teal	*Anas discors*	4	13
bufflehead	*Bucephala albeola*	2	3
greater scaup	*Aythya marila*	2	2
green-winged teal	*Anas crecca*	2	6
northern shoveler	*Anas clypeata*	2	3
redhead	*Aythya americana*	4	4
ring-necked duck	*Aythya collaris*	2	3
ruddy duck	*Oxyura jamaicensis*	4	9
snow goose	*Chen caerulescens*	2	9
unidentified duck		1	8
unidentified teal		1	2
Shorebirds		**43**	**93**
American avocet	*Recurvirostra americana*	2	22
black-necked stilt	*Himantopus mexicanus*	3	19
greater yellowlegs	*Tringa melanoleuca*	3	4
killdeer	*Charadrius vociferus*	15	15
least sandpiper	*Calidris minutilla*	6	15
lesser yellowlegs	*Tringa flavipes*	1	2
long-billed dowitcher	*Limnodromus scholopaceus*	3	3
semipalmated plover	*Charadrius semipalmatus*	1	1
short-billed dowitcher	*Limnodromus griseus*	1	2
spotted sandpiper	*Actitis macularia*	4	4
unidentified dowitcher		1	1
unidentified shorebird		1	1
western sandpiper	*Calidris mauri*	1	3
Wilson's snipe	*Gallinago delicata*	1	1
Gulls/Terns		**1**	**9**
Herring gull	*Larus argentatus*	1	9
Rails/Coots		**8**	**48**
American coot	*Fulica americana*	8	48

Appendix B. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Diurnal Raptors		**123**	**128**
American kestrel	*Falco sparverius*	5	6
Cooper's hawk	*Accipiter cooperii*	8	8
ferruginous hawk	*Buteo regalis*	2	2
northern harrier	*Circus cyaneus*	22	22
osprey	*Pandion haliaetus*	4	4
prairie falcon	*Falco mexicanus*	24	26
red-shouldered hawk	*Buteo lineatus*	2	2
red-tailed hawk	*Buteo jamaicensis*	42	43
sharp-shinned hawk	*Accipiter striatus*	3	4
Swainson's hawk	*Buteo swainsoni*	6	6
unidentified accipiter		1	1
unidentified buteo		1	1
unidentified raptor		3	3
Owls		**3**	**3**
burrowing owl	*Athene cunicularia*	2	2
short-eared owl	*Asio flammeus*	1	1
Vultures		**100**	**1,877**
turkey vulture	*Cathartes aura*	100	1,877
Upland Game Birds		**22**	**144**
Gambel's quail	*Callipepla gambelii*	22	144
Doves/Pigeons		**112**	**302**
Eurasian collared-dove	*Streptopelia decaocto*	10	23
mourning dove	*Zenaida macroura*	96	266
white-winged dove	*Zenaida asiatica*	6	13
Passerines		**2,576**	**7,081**
Blackbirds/Orioles		*52*	*194*
Brewer's blackbird	*Euphagus cyanocephalus*	6	21
brown-headed cowbird	*Molothrus ater*	7	7
Bullock's oriole	*Icterus bullockii*	3	3
European starling	*Sturnus vulgaris*	6	52
great-tailed grackle	*Quiscalus mexicanus*	15	78
red-winged blackbird	*Agelaius phoeniceus*	2	3
western meadowlark	*Sturnella neglecta*	2	3
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	11	27
Corvids		*379*	*1,002*
common raven	*Corvus corax*	379	1,002
Finches/Crossbills		*354*	*1,124*
American goldfinch	*Spinus tristis*	2	2
house finch	*Haemorhous mexicanus*	337	1,098
Lawrence's goldfinch	*Spinus lawrencei*	1	1
lesser goldfinch	*Spinus psaltria*	14	23
Flycatchers		*164*	*171*
ash-throated flycatcher	*Myiarchus cinerascens*	9	10
black phoebe	*Sayornis nigricans*	33	34
Say's phoebe	*Sayornis saya*	112	117
unidentified flycatcher		1	1
western kingbird	*Tyrannus verticalis*	3	3
willow flycatcher	*Empidonax traillii*	6	6

Appendix B. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Gnatcatchers/Kinglet		*96*	*122*
black-tailed gnatcatcher	*Polioptila melanura*	86	106
blue-gray gnatcatcher	*Polioptila caerulea*	5	9
ruby-crowned kinglet	*Regulus calendula*	5	7
Grassland/Sparrows		*568*	*2,799*
American pipit	*Anthus rubescens*	7	9
Bell's sparrow	*Artemisiospiza belli*	61	106
Brewer's sparrow	*Spizella breweri*	1	3
chipping sparrow	*Spizella passerina*	4	5
dark-eyed junco	*Junco hyemalis*	1	2
horned lark	*Eremophila alpestris*	447	2,542
house sparrow	*Passer domesticus*	2	2
lark sparrow	*Chondestes grammacus*	1	1
Lincoln's sparrow	*Melospiza lincolnii*	3	4
Savannah sparrow	*Passerculus sandwichensis*	4	9
song sparrow	*Melospiza melodia*	1	1
unidentified sparrow		5	7
white-crowned sparrow	*Zonotrichia leucophrys*	31	108
Mimids		*45*	*48*
crissal thrasher	*Toxostoma crissale*	1	1
Le Conte's thrasher	*Toxostoma lecontei*	39	42
northern mockingbird	*Mimus polyglottos*	4	4
sage thrasher	*Oreoscoptes montanus*	1	1
Swallows		*178*	*520*
bank swallow	*Riparia riparia*	2	3
barn swallow	*Hirundo rustica*	112	321
cliff swallow	*Petrochelidon pyrrhonota*	12	42
northern rough-winged swallow	*Stelgidopteryx serripennis*	12	26
tree swallow	*Tachycineta bicolor*	18	72
unidentified swallow		14	33
violet-green swallow	*Tachycineta thalassina*	8	23
Tanagers/Grosbeaks/Cardinals		*9*	*10*
black-headed grosbeak	*Pheucticus melanocephalus*	1	1
blue grosbeak	*Guiraca caerulea*	1	1
lazuli bunting	*Passerina amoena*	4	4
painted bunting	*Passerina ciris*	1	1
western tanager	*Piranga ludoviciana*	2	3
Shrikes		*153*	*160*
loggerhead shrike	*Lanius ludovicianus*	153	160
Thrushes		*2*	*2*
hermit thrush	*Catharus guttatus*	1	1
unidentified thrush		1	1
Titmice/Chickadees		*219*	*242*
verdin	*Auriparus flaviceps*	219	242
Vireos		*2*	*2*
Bell's vireo	*Vireo bellii*	1	1
Cassin's vireo	*Vireo cassinii*	1	1

Appendix B. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Warblers		*270*	*556*
black-throated gray warbler	*Setophaga nigrescens*	1	1
common yellowthroat	*Geothlypis trichas*	10	10
MacGillivray's warbler	*Geothlypis tolmiei*	4	4
Nashville warbler	*Oreothlypis ruficapilla*	1	1
orange-crowned warbler	*Oreothlypis celata*	15	20
unidentified warbler		2	2
Wilson's warbler	*Cardellina pusilla*	13	14
yellow-breasted chat	*Icteria virens*	1	1
yellow-rumped warbler	*Setophaga coronata*	217	496
yellow warbler	*Setophaga petechia*	6	7
Waxwings		*5*	*5*
phainopepla	*Phainopepla nitens*	5	5
Wrens		*40*	*53*
Bewick's wren	*Thryomanes bewickii*	3	3
cactus wren	*Campylorhynchus brunneicapillus*	31	44
house wren	*Troglodytes aedon*	2	2
rock wren	*Salpinctes obsoletus*	4	4
Unidentified Passerines		*40*	*71*
unidentified passerine		40	71
Swifts/Hummingbirds		**6**	**9**
Vaux's swift	*Chaetura vauxi*	6	9
Woodpeckers		**36**	**42**
Gila woodpecker	*Melanerpes uropygialis*	1	1
ladder-backed woodpecker	*Picoides scalaris*	1	1
northern flicker	*Colaptes auratus*	34	40
Unidentified Birds		**3**	**4**
unidentified small bird		3	4
Overall		**3,103**	**10,077**

[a]Regardless of distance from observer