| DOCKETED | |
|---|---|
| **Docket Number:** | 99-AFC-08C |
| **Project Title:** | Blythe Energy Project Compliance & Blythe Transmission Line Modification |
| **TN #:** | 224517 |
| **Document Title:** | Post-Construction Monitoring at the Blythe Solar Power Project Riverside, California Final 2016 Summer Quarterly Interim Report |
| **Description:** | Final Report |
| **Filer:** | Susan Fleming |
| **Organization:** | Energy Commission |
| **Submitter Role:** | Public Agency |
| **Submission Date:** | 8/20/2018 6:43:10 AM |
| **Docketed Date:** | 8/20/2018 |

# Post-Construction Monitoring at the Blythe Solar Power Project Riverside County, California

**Final**

**2016 Summer Quarterly Interim Report**

**Prepared for:**

**NextEra Blythe Solar Energy Center, LLC**

700 Universe Blvd.,
Juno Beach, Florida 33408

**Prepared by:**


**Western EcoSystems Technology, Inc.**

415 West 17th Street, Suite 2000
Cheyenne, Wyoming 82001



**Initial Submittal: April 2017**
**Revised: March 2018**

# EXECUTIVE SUMMARY

Avian and bat monitoring surveys were conducted from June 1 to September 3, 2016 (the summer reporting period) at the Blythe Solar Power Project (Project) in accordance with the Project's Bird and Bat Conservation Strategy (BBCS). The Project is a 485 megawatt (MW) photovoltaic (PV) solar energy facility consisting of four units, on approximately 1,675 hectares (ha; 4,138 acres) of Bureau of Land Management (BLM) -administered land in Riverside County, California. Unit 1 and Unit 2 have been designed, constructed, and included in the current monitoring study. These units total 235 MW made up of seven blocks and cover approximately 536 ha (1,326 ac.). The Project's 11.5-mile (18.5-kilometer) 230-kilovolt generation-interconnection line (gen-tie) extends south from the Project to the Colorado River Substation. Four of the seven solar array blocks were operational and surveyed as part of the summer monitoring study. The remaining three solar array blocks were still being constructed. Specifically, standardized carcass searches, searcher efficiency trials, and carcass persistence trials were conducted. This report represents the second seasonal report for the first year of monitoring, and summarizes monitoring methods and results for those surveys based on the procedures and requirements specified in the BBCS. This report is considered a preliminary summary of data and information for the single quarter. Data and final information from all four quarterly monitoring periods will be included in a comprehensive final annual report.

Included in this report are data from standardized carcass searches conducted at the Project during the summer season, defined as June 1 to September 3, 2016. Standardized carcass searches were conducted: 1) in the operational blocks of the solar arrays, consisting of a random stratified sample of ~40% of the PV panels; 2) along inner portions of the perimeter fence (fence line) resulting in approximately 95% of the length of the fence line; and 3) along 25% of the total length of gen-tie from the Project fence to the substation located south of Interstate 10. The McCoy Solar Energy Project (McCoy) sampled an additional 25% along the shared gen-tie for a total 50% surveyed area. Searches were conducted approximately every 21 days during the summer season. Three blocks were turned over to operations at the start of the 2016 summer period and one additional block was turned over during the 2016 summer period. All bird and bat carcasses and injuries or strandings found are referred to as detections in this report. Detections were found during standardized searches and incidentally by searchers and site personnel.

During summer 2016, a total of 12 avian detections (including incidental detections) of eight identified species were recorded. Of these 12 detections, three were unidentified species. The most common identified species was lesser nighthawk (*Chordeiles acutipennis*) with two detections. All other species had one detection. Detections were spread across project components with four detections (33.3%) in the solar array, four detections (33.3%) along the gen-tie, and three detections (25.0%) along the fence line. One detection occurred at other project infrastructure (interior overhead lines). Six (50.0%) of the 12 detections occurred during standardized carcass searches and six were documented as incidental detections. One live bird was found during the summer period. No bats were detected during the summer season.

During the reporting period, carcass persistence was influenced by carcass size and Project component. Sample sizes within the solar arrays for carcass persistence trials were 30 small, 20 medium, and 11 large bird carcasses. Along the gen-tie line, 25 small, 15 medium, and 10 large trial carcasses were placed. Trial carcasses placed along the gen-tie were pooled between the Blythe and McCoy projects. Small carcasses (0-100 g) in the arrays and along the fence (combined) had a 42% chance (90% confidence interval [CI]: 33-50%) of persisting through the effective search interval, medium carcasses (101 – 999 g) had a 48% (90% CI: 38-57%) chance, and large carcasses (1,000+ g) had an 87.0% chance (90% CI: 78-93%). Median removal time within the arrays for small, medium, and large carcasses was 5.0, 6.8, and 47.6 days, respectively. Along the gen-tie (pooled data from Blythe and McCoy), chances of persistence for small, medium, and large carcasses were 11.0% (90% CI: 9-14%), 22% (90% CI: 13-32%), and 32% (90% CI: 19-44%) respectively; median removal time for small, medium, and large carcasses was 1.6, 1.7, and 3.2 days, respectively.

For trial carcasses placed in the solar arrays, searcher efficiency was modeled separately for small, medium, and large birds. The best model for small and medium bird size classes was an exponential distribution. For large birds the best model was a half-normal distribution. Within the solar arrays, searcher efficiency was 80.0% (90% CI: 65-94%) for large birds, 56.0% (90% CI: 40-72%) for medium birds, and for small birds 49.0% (90% CI: 39-59%). For linear Project components, the distance sampling approach was not implemented; therefore, the searcher efficiency rates were calculated based on the number available and number found along the fence line and gen-tie. Along the fence line, searcher efficiency was 100% (no CI) for both large and medium size class trials. Searcher efficiency for small birds was 93% (90% CI: 85-100%). Along the gen-tie, searcher efficiency was 100% for large birds, 89.0% (90% CI: 78-100%) for medium birds, and 78.0% (90% CI: 65-91%) for small birds. The gen-tie data presented in this report includes pooled trial data for Blythe and McCoy.

The adjusted fatality estimate for the 2016 summer reporting period in the solar array was modeled at eleven (90% CI: *[1]* - 26) small bird fatalities and zero medium and large bird fatalities. This estimate is based on one small bird detection and no medium or large bird detections in the solar array during summer searches. The estimate was adjusted based on searcher efficiency and carcass removal rates. The total fatality estimate of eleven (90% CI: *[1]* – 26) fatalities in the solar array during the summer season represents approximately 0.047 fatalities per MW (assuming 235 MW) and 0.008 fatalities per acre (assuming 1,326 acres).

The adjusted fatality estimate for summer along the fence line was modeled at approximately three (90% CI: *[1]* - 6) small bird fatalities and four (90% CI: *[2]* - 7) medium bird fatalities. This estimate was based on one small bird and two medium bird detection along the fence. No large birds were detected along the fence line during the summer period.

Gen-tie fatality estimates were informed by pooling McCoy and Blythe data. The adjusted fatality estimate along the gen-tie was modeled at 45 small bird fatalities (90% CI: *[2]* - 57) and 47 medium bird fatalities (90% CI: *[5]* - 91). Assuming each project is responsible for half of the gen-tie, an estimate for the Blythe Project gen-tie would equate to approximately 23 small bird fatalities and 24 medium bird fatalities for a total of 47 fatalities. Fatality estimates along the gen-tie were influenced by the high scavenging rates observed during the spring and summer trials along the gen-tie (i.e., large correction factors).

## STUDY PARTICIPANTS

**Western EcoSystems Technology**

| | |
|---|---|
| Luke Martinson | Project Manager |
| Wallace Erickson | Senior Review/Support |
| Michael Gerringer | Wildlife Biologist |
| Sarah Nichols | Field Supervisor/Research Biologist |
| John Lombardi | Statistician |
| Andrea Palochak | Technical Editor |
| Jason Pietrzak | Designated Biologist |

## REPORT REFERENCE

Western Ecosystems Technology, Inc. (WEST). 2018. Post-Construction Monitoring at the Blythe Solar Power Project, Riverside County, California. 2016 Summer Quarterly Interim Report. Prepared for NextEra Blythe Solar Energy Center, LLC, Juno Beach, Florida. Prepared by WEST, Cheyenne, Wyoming. March 2018.

# TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

## LIST OF APPENDICES

# 1.0 INTRODUCTION

## 1.1 Project Background

NextEra Blythe Solar Energy Center, LLC (NextEra Blythe Solar) developed the Blythe Solar Power Project (Project), a 485 megawatt (MW) photovoltaic (PV) solar energy facility, on approximately 1,675 hectares (ha; 4,138 acres) of Bureau of Land Management (BLM) -administered land in Riverside County, California (Figure 1). The Project is a 485 megawatt (MW) photovoltaic (PV) solar energy facility consisting of four units, on approximately 1,675 hectares (ha; 4,138 acres) of Bureau of Land Management (BLM) -administered land in Riverside County, California. Unit 1 and Unit 2 have been designed, constructed, and included in the current monitoring study. These units total 235 MW made up of seven blocks and cover approximately 536 ha (1,326 ac.). Four solar array blocks (approximately 65% of the total facility size) were operational and surveyed as part of the summer monitoring study. Renewable energy is provided to the California electrical grid through an interconnection at Southern California Edison's (SCE's) Colorado River Substation (CRS). The Project's 11.5-mile (18.5-kilometer) 230-kilovolt generation-interconnection line (gen-tie) extends south from the Project to the CRS.

## 1.2 Monitoring Plan Overview and Goals

A Bird and Bat Conservation Strategy (BBCS; Western EcoSystems Technology, Inc. [WEST] 2016b) was prepared by the Project proponent in collaboration with the California Energy Commission (CEC), US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and BLM to guide comprehensive monitoring of impacts to birds and bats associated with the operation of the Project. Agency approval for the draft survey methods were approved in February 2016, and the final agency approval of the full BBCS document occurred in May 2016.

The BBCS details post-construction monitoring to be conducted and the data analysis and reporting processes that will be implemented by NextEra Blythe Solar in collaboration with the CEC, USFWS, CDFW, and BLM. As identified in the BBCS, the goals are:

1. Estimate overall annual avian fatality rate and species composition associated with the Project infrastructure. This estimate will include mortality associated with solar arrays, overhead lines including the gen-tie line, perimeter fence and other features of the Project that may result in injury and fatality.
2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with project infrastructure (e.g., different fatality rates near panels on the edge of the arrays vs. the interior area of the arrays).
3. Provide information that will assist the BLM and CEC, in consultation with the USFWS and CDFW, in understanding which species and potentially which regional populations are at risk.

4. Collect data in such a way that the BLM and CEC, in consultation with the USFWS and CDFW, may make comparisons with other solar sites.

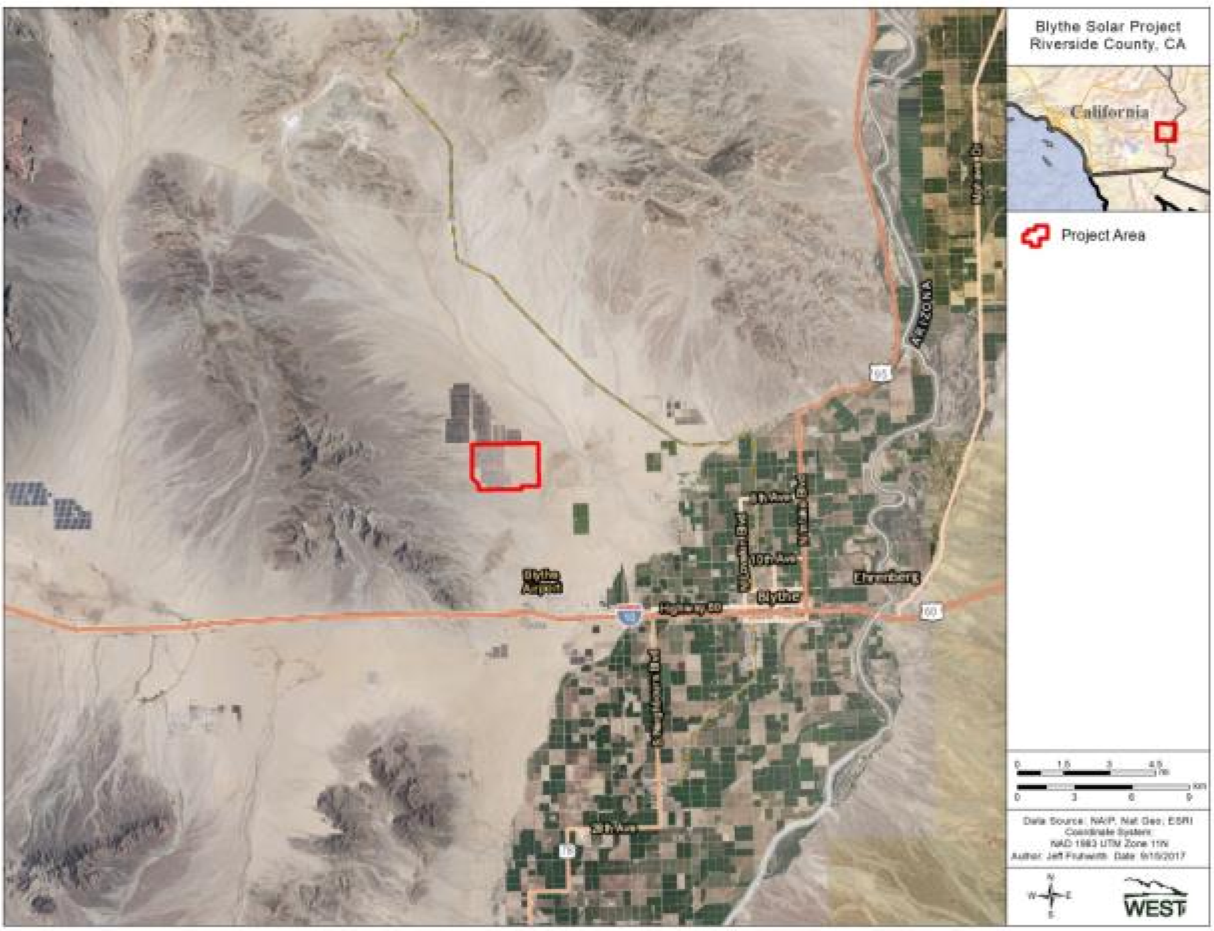



**Figure 1. Blythe Solar Power Project vicinity map, Riverside County, California.**

### 1.3 Purpose of This Report

This report summarizes the methods and results for the second quarter (summer) of the Year 1 monitoring effort. Requirements specified in the BBCS are provided including documentation of all avian and bat mortalities and injuries and bias trials completed. This quarterly report and the two subsequent quarterly reports will be considered preliminary summaries of data and information. A comprehensive annual report will be prepared at the end of the Year 1 monitoring period that combines data and information from the four quarterly monitoring periods.

This quarterly report covers the summer 2016 period from June 1 through September 3, 2016. All carcasses and injuries that were discovered by observers (or other site personnel) are referred to as “detections”. Provided in the report is information relevant to each detection, including species, location, and nearest Project infrastructure, suspected cause of death, and time since death. As stated in the approved BBCS (WEST 2016b), detections were classified as resident, overwintering, or whether they were diurnal or nocturnal migrants (or both). Additionally, data about taxonomic family and ecological guild are provided. This report presents information related to the spatial distribution of detections, but no formal statistical analysis of the spatial distribution of carcasses will be conducted until the end of the monitoring year, given the limited data presently available. This report also provided information related to the bias trials. This information includes the locations, size classes/species, and number of trial carcasses placed, as well as the results of the trials.

## 2.0 METHODS

The BBCS describes the monitoring and analysis methods implemented at the Project. Below is an abridged description (see BBCS Section 4.0 for detailed methods; WEST 2016b).

### 2.1 Standardized Carcass Searches

This section describes areas surveyed, search schedule, and the standardized search methods conducted to identify dead/injured birds and bats at the Project. This section also describes the methods for the carcass removal and searcher efficiency trials, how data were reported and analyzed, and the methods for producing fatality estimates for the Project.

#### 2.1.1 *Areas Surveyed*

Standardized carcass searches were conducted at defined sample units within the Project’s solar arrays (Tables 1 and 2; Figure 2); along the fence line for the Project (Table 2, Figure 2); and along the gen-tie line (from the Project fence line to the CRS on the south side of Interstate-10; Table 2, Figure 3). As the Project was still under construction, the entire facility was not searched; only solar blocks that were operational were searched. Table 1 below lists the construction to operations turn-over dates for each block and the first search date for each operational block. Detailed maps of detections along the gen-tie are presented in Appendix A. Overhead lines that occur within the solar array field (medium voltage overhead lines [MVOH]) were not specifically sampled as part of the monitoring plan. The MVOH were only part of standardized carcass searches to the extent that they co-occurred with solar arrays included in the sample units.

**Table 1. Block turnover and first search date during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project.**

| Block Identification | Turnover Date | First Search Date | Survey Events |
|---|---|---|---|
| 1 | 3/8/16 | 3/8/16 | 5 |
| 2 | 4/18/16 | 4/27/16 | 5 |
| 3 | 4/28/16 | 5/12/16 | 5 |
| 4 | 7/19/16 | 7/25/16 | 3 |

**Table 2. Areas included in standardized carcass searches at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**

| Project Component | Total Size | Units | % of Available Component Searched (available) |
|---|---|---|---|
| Solar arrays (available) | 380[A] | Hectares | 37.0 |
| Fence line | 11.5 | Kilometers | 89.0[B] |
| Gen-tie | 18.5 | Kilometers | ~50.0[C] |

A = Total size for the solar arrays only includes areas that were turned over and available for search during the summer 2016 period (Blocks 1, 2, 3, and 4).

B = Approximately percent searched; two sections were inaccessible along the fence line due to a seasonal restriction for a kit fox den and an environmentally sensitive area (total length approximately 1,250 m [4,101 ft]); kit fox area was observed with binoculars.

C = Project and McCoy gen-tie data were pooled for this report; each project is responsible for surveying 25%

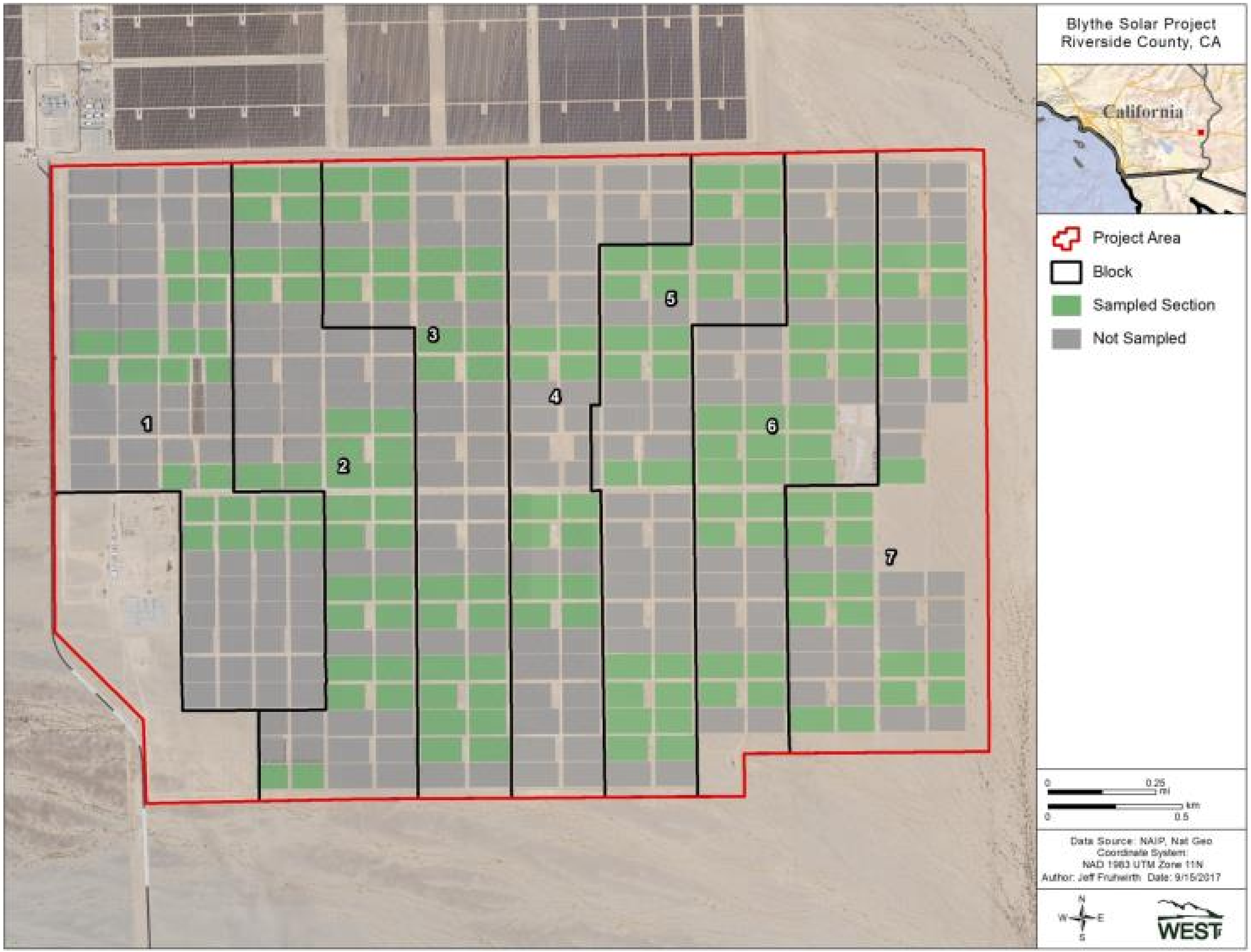



**Figure 2. Areas of standardized searches at the Blythe Solar Power Project during summer (June 1 – September 3) 2016. Blocks 5, 6, and 7 were not surveyed in summer 2016.**

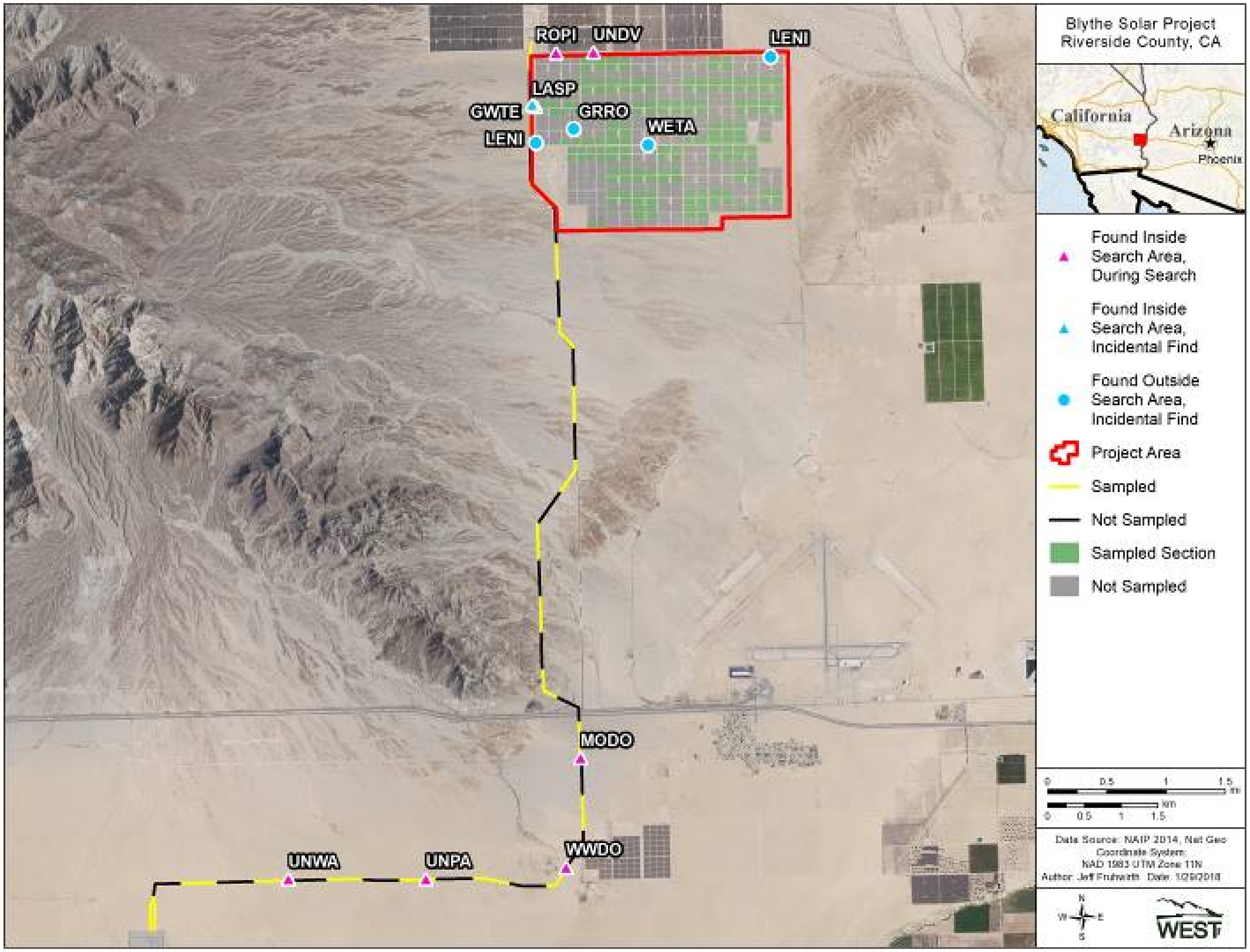



**Figure 3. Areas of standardized searches and detections (those located during searches and as incidental detections) at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring. Detailed maps of detections along the gen-tie are presented in Appendix A.**

Prior to initiating the study, USFWS recommended changes to the monitoring protocol based on information gathered at other solar facilities (e.g., Desert Sunlight) and the recently published US Geological Survey's (USGS) solar fatality monitoring protocols (Huso et al. 2016). These changes included an increase to observers' viewsheds during the transect surveys by modifying the distance sampling transect layout and increasing the percent area of the solar field to be searched. The reason for the recommendation was that the searcher efficiency rates were shown to be high for medium and large birds. It was determined that precision of fatality estimates could be increased for the same or less effort for medium to large birds (e.g. water-associated birds) by covering more arrays overall, but with less effort per sample unit (larger viewsheds). It was also expected that precision of fatality estimates for small birds would be reasonable under the proposed changes to search methods. This approach works for the Project because of the openness of the viewsheds at the site resulting from limited vegetation and little topography.

Sample units at the Project were defined as an area that spanned between 42 and 63 rows of PV panels on the east/west axis, and 190 meters (m; 623 feet [ft]) on the north/south axis. To complete the survey, a biologist drove along the road that bisects the sample unit (Figure 4), providing a 95-m (312-ft) viewshed in each direction. Due to the variations in the solar array layout, some discrepancies among sample units exist, but the searcher viewshed never exceeded 95 m. The percent area sampled in summer 2016 was approximately 41% of the available solar array area. The BBCS states approximately 40% of the total solar array area will be sampled; however, only four of the seven blocks were operational (i.e., available for surveys) during the summer season. Approximately 40% of the entire solar array area will be surveyed once all arrays are accessible for surveys.

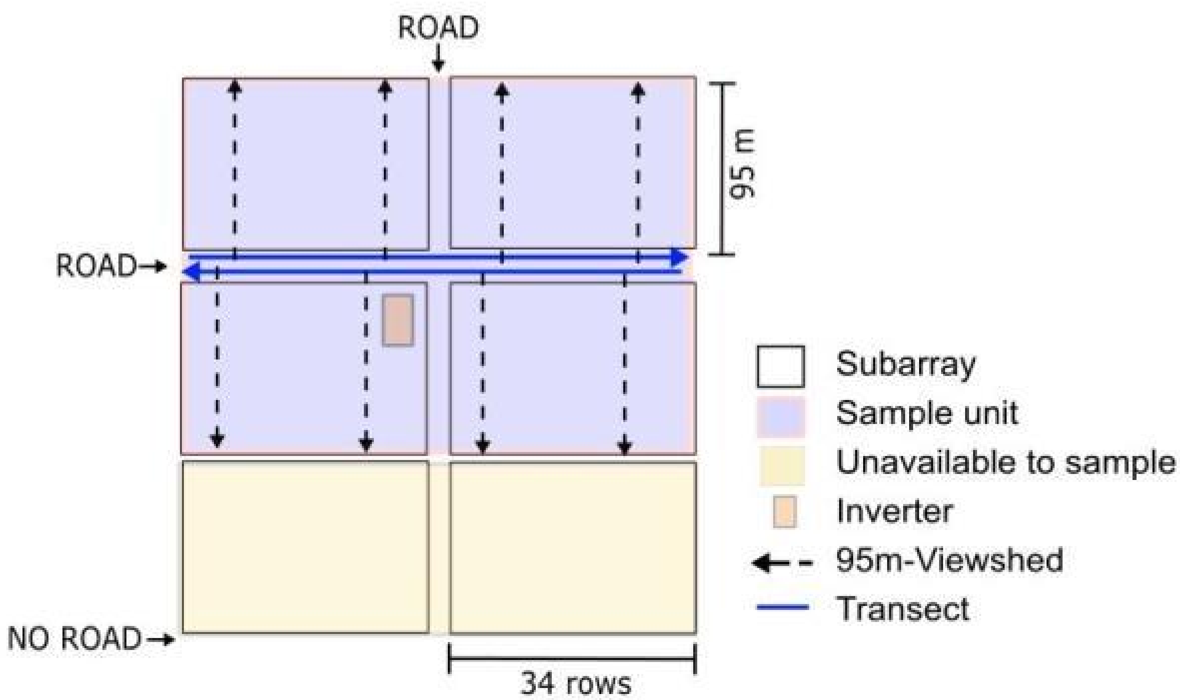



**Figure 4. Survey method at the Blythe Solar Power Project.**

### 2.1.1 *Search Frequency and Timing*

Standardized searches occurred during the second quarter (summer) of the Year 1 monitoring. This quarter included the period from June 1 through September 3, 2016. The fence line and gen-tie were surveyed five times during summer. Blocks 1, 2, and 3 in the solar arrays were surveyed five times, whereas Block 4 was surveyed three times (Table 1) due to the timing of transitioning the blocks from construction to operations.

As specified in the approved Blythe BBCS, the average search interval for all Project components included in standardized carcass searches during summer was 21 days. Slight variation in search intervals occurred due to the weather and logistic schedule.

### 2.1.2 *Search Methods*

Standardized carcass searches were performed by CEC and BLM-approved biologists, in accordance with methods outlined in the BBCS.

Within the Project boundaries (inside the fence line), arrays of solar panels were surveyed by observers from a vehicle travelling less than five miles per hour (eight kilometers [km] per hour). Sampling units were surveyed from roads aligned along the edge of continuous solar panel rows and scanned between each row for potential mortalities, with each side-specific survey covering half the width of the sampling unit (Figure 4). An observer drove along east-west roads that bisect sampling units and scanned left (out of the driver's window), and then turned around at a main road where space allowed. The observer looked left on the return trip, searching the opposite side of the unit. The observer scanned out to a maximum perpendicular distance of approximately 95 m from the transect. Observers carried binoculars to allow them to verify a detection. Once a detection was confirmed, the distance of the detection to the transect line was estimated using laser range finders.

When a carcass was detected, it was photographed and data were recorded following the specifications outlined in Section 4.2.5 of the approved Blythe BBCS. Carcasses were then retrieved from their location on the ground, placed in sealed bags, labeled, and placed in a freezer on site.

The majority of the fence line (approximately 7.5 miles [12 km]; Figure 2) was searched from a vehicle using the standard protocol. Biologists searched a 6-m (20-ft) wide strip transect centered on the fence line from the inner perimeter. Approximately four km of the fence line along the south McCoy Project boundary is shared between Blythe and McCoy. Detections that occurred along the shared fence line were documented based on the side of the fence they were found. One small section of the fence line could not be accessed for surveys. The section was approximately 950 m (3,117 ft) long on the eastern fence line. This area was designated an environmentally sensitive area with no access allowed. A second section was a 300-m (1,148-ft) section near the southwest corner. This section was not accessible due to a seasonal kit fox (*Vulpes macrotis*) den buffer; however, surveys were able to inspect the area with binoculars.

The gen-tie was searched using a 30-m (98-ft) wide strip transect (i.e., 15 m [49 ft] of ground on either side of the overhead line). Sample units along the gen-tie were chosen by dividing the total length of line from the Project fence line south to the CRS into 500-m (1,640-ft) segments. Every other 500-m segment was included in the sampled areas. The Project was responsible for half of the sample segments (25% of the total line). Since the gen-tie is shared infrastructure, the McCoy Solar Energy Project (McCoy) was also responsible for surveying 25%, resulting in approximately 50% of the total gen-tie length surveyed (Figure 3). Biologists slowly walked the 500-m segments of the line, meandering the width of the strip transect, scanning for dead or injured birds or bats within 15 m of the overhead line.

For each detection, a suspected cause of death or injury was assigned based on evidence available from the detection, evidence available on Project infrastructure, and proximity of the detection to Project infrastructure. If sufficient evidence to make a determination was unavailable (e.g., detection was a feather spot), the detection was assigned an "unknown" value. Detections that were intact with signs of trauma (e.g., broken beak) and located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines) had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is substantial uncertainty associated with cause of death assignments because no events were directly observed. Detections assigned to the "unknown" category were included in fatality estimates if they were located within standardized carcass search areas. All detections recorded during the summer season are reported here.

## 2.2 Carcass Persistence Trials

Carcass persistence trials were conducted throughout the summer period. Carcasses from three size classes (small [0-100 grams (g)], medium [101-999], and large [1,000+]) were used for trials. The small size class comprised of 2- to 3-week old Coturnix quail (*Coturnix coturnix*); the medium size class comprised of northern bobwhite quail (*Colinus virginianus*); and the large size class comprised of hen mallard (*Anas platyrhynchos*) and hen ring-necked pheasant (*Phasianus colchicus*).

### 2.2.1 *Carcass Persistence Data Collection*

To quantify carcass persistence rates, 30 small, 20 medium, and 11 large trial carcasses were randomly placed and monitored within the solar arrays (including the fence line) during summer 2016. Along the gen-tie, 25 small, 15 medium, and 10 large trial carcasses were placed. Trials carcasses placed along the gen-tie were pooled between the Blythe and McCoy projects (i.e., 50 total along the gen-tie). A total of 111 carcass persistence trial carcasses were placed at the Project during the summer 2016 season, as specified in the approved Blythe BBCS (see WEST 2016b). By placing carcasses inside (within arrays and along inner perimeter of the fence line) and outside (along the gen-tie) the Project fence line, the possibility that there are different carcass persistence rates inside and outside the Project fence line was accounted for. Thirty-nine carcasses within the Project fence line (within solar arrays and along the fence line) and two carcasses along the gen-tie were monitored using motion-triggered digital trail cameras, while the remaining carcasses were visited on foot for 30 days or until the carcass had deteriorated to a condition at which it would no longer qualify as a documentable mortality.

Carcasses without trail cameras were visited and photographed once per day for the first four days, and then every three to five days until the end of the monitoring period. To avoid training scavengers to recognize cameras as “feeding stations”, trail cameras were installed five days before specimens were placed, and at least two fake cameras without bias trial carcasses were also placed within the Project fence line. Periodic ground-based checking of carcasses with trail cameras also occurred to guard against misleading indicators of carcass removal, such as wind blowing the carcass out of the camera’s field of view. To minimize potential bias caused by scavenger swamping (Smallwood 2007, Smallwood et al. 2010), carcass-persistence specimens were distributed across the entire Project, not just in areas subject to standard searches, and trials were initiated in smaller numbers on three different dates throughout the summer season.

#### 2.2.2 *Estimating Carcass Persistence Times*

Measurements of carcass persistence rates were subject to censoring. In this context, censoring refers to the instance when a value (e.g. days a carcass is present before being removed) may not be known exactly, but is known to be within a finite range. For example, if a carcass was checked on day 7 and was present, and was checked again on day 10, but was found to be missing the exact time of removal is unknown. However, it is known that the carcass became unavailable at some point between 7 and 10 days. This carcass would be considered “interval censored”. Similarly, if a carcass lasts the entire 30-day trial period, that carcass is “right censored”, as it is known that the carcass lasted at least 30 days, but it may have persisted longer. Because carcass persistence data were censored, persistence was analyzed using methods that can accommodate censored data and still produce unbiased estimates of the probability of persistence (Therneau and Lumley 2015, Therneau and Grambsch 2000). It is beyond the scope of this document to provide statistical foundations of censored-data survival models but functions identical to those provided with the USGS-developed fatality estimator software (Huso et al. 2015) were used to fit survival models to the censored carcass persistence data, and some background is available in the documentation provided with that software.

The USGS software used to estimate carcass persistence calculates the period over which there is less than a 1% chance for a carcass to persist. The “effective search interval' is defined as the shorter of: a) the length of time beyond which there is less than a 1% probability that a carcass persists, and b) the actual search interval (Huso 2011). The probability of persistence is given for the effective search interval, and the probability that a carcass persists through the actual search interval is equal to *p* (persist through effective search interval) * effective search interval / actual search interval.

There were four distributions implemented in the survival models used to estimate the probability that a trial carcass is unscavenged and available to be found at the end of the search interval (*r)*: exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying degrees of flexibility in order to model a wide variety of distributions of persistence time. Akaike’s Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model with combinations of the covariates carcass size, and season to the observed carcass persistence data. The AICc score provides a relative measure of model fit and parsimony among a selection of candidate models, and provides a framework for testing hypotheses regarding which factors contribute to carcass persistence rates. The model with the lowest AICc score is typically chosen as the “most supported” model relative to other models tested; however, any model within two AICc points of the most supported model is considered competitive with the most supported model (Burnham and Anderson 2004). Carcass persistence trial from spring and summer were used to inform the carcass persistence models.

## 2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the summer period. Carcasses from three size classes (small, medium, and large) were used for trials. The small size class comprised house sparrows (*Passer domesticus*) and 2- to 3-week old Coturnix quail, the medium size class comprised northern bobwhite quail, and the large size class comprised hen mallards and hen ring-necked pheasants.

### 2.3.1 *Searcher Efficiency Data Collection*

To quantify searcher efficiency, 26 small carcasses, 15 medium, and 12 large were placed within the solar array, while 15 small, 10 medium, and 10 large carcasses were placed along the fence line and 15 small, 10 medium, and 10 large carcasses were placed along the gen-tie sampling areas (pooled between Blythe and McCoy given the gen-tie is a shared feature). During summer 2016, a total of 123 searcher efficiency trial carcasses were placed at the Project.

Searcher efficiency trial carcasses were placed at random locations within the search areas prior to the actual search effort that same day by the biologist designated as the “experimenter.” Prior to placement in the field by the experimenter, all trial carcasses were marked with an inconspicuous piece of black tape around the leg, so that they could be clearly identified as experimental trial carcasses, but not be visible as such from a distance. Trial carcasses were placed by dropping the carcasses from waist height or higher, in order to simulate natural positioning of fallen carcasses, and to avoid placement bias. A global positioning system (GPS) was used by the experimenter to record the location of each trial carcass placed. After the search effort was completed, the number and location of searcher efficiency trial carcasses found during the carcass survey were recorded. The number of trial carcasses available for detection during each trial was determined after the trial by the experimenter, who returned to the location of any undiscovered trial carcasses to document whether they were still available. Trial carcasses were collected either as they were detected by a searcher, or by the experimenter shortly after the search occurred, but always within a few hours of the completion of a search. It is possible that carcasses that were missed by a searcher were scavenged soon after the search was conducted, but before the experimenter returned to retrieve the trial carcass. However, this potential source of bias is minimal as collection occurs as soon after the search as possible within logistical constraints.

### 2.3.2 *Estimating Searcher Efficiency*

Searcher efficiency at the Project was estimated separately for linear features (the Project fence line and the gen-tie) and the solar arrays, reflecting the different search methods used on arrays and linear features. For linear features, logistic regression models were fit to searcher efficiency data and AICc was used to compare models including the effects of carcass size (three classes). Model selection indicated that the most supported model included main effects of Project component and carcass size. Once the most supported model was chosen and appropriate classes identified, searcher efficiency, or the proportion of carcasses detected, *p*, was calculated for each class using the following equation:

$$\hat{p}_i = \frac{Number\ of\ Carcasses\ Found\ in\ catagory\ i}{Number\ of\ Carcasses\ Available\ in\ catagory\ i}$$

The data for this analysis included all searcher efficiency trial carcasses from the summer 2016 season.

For the solar arrays, searcher efficiency was evaluated using a distance sampling approach (Buckland et al. 1993). Distance sampling assumes perfect detection on the transect line (at a distance equal to zero), an assumption that is likely valid in the solar arrays given the relatively flat and vegetation-free nature of the soil surface. A curve was fitted to the observed carcass data that predicted the probability of detection as a function of distance from the transect line. The mean value of this function over a specified distance, *w,* is equal to the average searcher efficiency for a transect of width *w*. The mean value of the detection curve is the integral of the detection function calculated between zero m and the maximum survey distance (*w;* half the width of the solar array row), divided by the maximum survey distance:

$$p = \frac{\int_0^w f(x)dx}{w}$$

where *f(x)* is the detection function evaluated at distance, *x*.

One departure in the methods used here, relative to the methods presented in Buckland et al. (1993), was that the detection function was estimated using trial carcasses for this study, which meant that there were both presence (detected) and absence (not detected) data available to fit the detection function. The availability of both presence and absence data means that the detection function can be estimated using only trial carcasses whose distribution is known. Therefore the detection function, the average searcher efficiency among the arrays, and the final fatality estimate within the arrays are all insensitive to the spatial distribution of carcasses within individual arrays, and the overall searcher efficiency estimate is valid even if the distribution of carcasses among the arrays is not uniform.

Distances of trial carcasses (carcasses both found and missed) from the transect line were used to fit half-normal, exponential, and hazard rate distribution detection functions for searches among the arrays, which are all commonly used functions for distance sampling surveys

(Buckland et al. 1993). The searcher efficiency trial data from spring 2016 were also used to inform models. Searcher efficiency was modeled separately for small, medium, and large birds. The fit of detection functions were compared using AICc. The most supported detection function for small and medium bird size classes had an exponential distribution. The most supported detection function for large bird size classes had a half-normal distribution.

Because the solar arrays were surveyed by a searcher who drove down one side of the rows of panels, the width of the search transect was specified as the width of the rows of panels. For larger birds, there is almost certainly a non-zero detection probability beyond this distance, but the bias that occurs by ignoring this non-zero detection probability is conservative (i.e. the searcher efficiency is underestimated).

## 2.4 Fatality Estimator

Fatality rate estimation is a complex task due to several variables inherent to every fatality monitoring study. Carcasses may persist for variable amounts of time due to local scavenger activity or environmental conditions leading to carcass degradation over time. Carcasses and feather spots are also detected with varying levels of success based on carcass characteristics and ground cover (e.g., vegetated areas underneath the gen-tie versus cleared areas beneath solar panels). For these reasons, it is generally inappropriate to draw conclusions based on the raw number of fatalities alone. The desire to estimate fatalities given these variables has driven the development of several statistical methods for estimating fatalities (e.g., Smallwood 2007, Huso 2011, Korner-Nievergelt et al. 2011). All of these fatality estimation methods share a similar underlying model based on a Horvitz-Thompson type estimator (Horvitz and Thompson 1952). Generally, the fatality estimation for a sample of a given site may be written as:

$$\hat{F} = C/\hat{r}\hat{p}a$$

where $\hat{F}$ is the total number of fatalities, *C* is the number of detections found and included in fatality estimation, $\hat{r}$ is the probability a carcass is unscavenged and available to be found at the end of the search interval, $\hat{p}$ is the probability of detecting a carcass, and *a* is the proportion of area searched (see Table 2 for proportions of areas searched by component; Huso 2011). The binomial carcass detection model was used to calculate fatality estimates at the Project fence line and gen-tie, and the average probability of detection based on distance sampling (described previously) was used to estimate probability of detection within the solar arrays.

All fatality estimates were calculated using the Huso estimator (modified to accommodate the distance-sampling based estimate of searcher efficiency in the solar arrays), as well as 90% confidence intervals (CIs) using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and CIs for complicated test statistics. A total of 1,000 bootstrap replicates were used for each variable, including searcher efficiency (*p*), probability of a carcass persisting to the next search ($\hat{r}$), adjusted search interval, and observed number of mortalities. From these bootstrap samples, the probability of available and detected was calculated and applied to the bootstrapped observed fatalities. The lower $5^{th}$ and upper $95^{th}$ percentiles of the 1,000 bootstrap estimates provide estimates of the lower limit and upper limit of an approximate 90% CI on all estimates. In some instances, a lower limit was not viable (i.e., zero) based on the sampled areas, so the actual number found was assumed to be the lower limit. This is identified in the text and Appendix E by a *[#]* character, where *[#]* represents the actual number found and used to inform the analysis.

Horvitz-Thompson estimators, such as the Huso estimator used to estimate mortality at solar-energy facilities, become unstable when carcass counts are low (Korner-Nievergelt et. al 2011). Precision for fatality estimates decreases rapidly as the number of carcasses found during standardized carcass searches decreases (Korner-Nievergelt et. al 2011). Confidence intervals calculated when carcass counts are low can be very wide and unreliable.

### 2.5 Incidental Reporting

Some detections were recorded outside standardized search areas, or were within search areas but were not observed during standardized searches. Such detections were found by WEST avian biologists and operational personnel and were considered “incidental” detections. When found by operational personnel, these detections were reported to WEST avian biologists for documentation. Data on incidental detections are reported here, as well as in the Project Special Purpose Utility (SPUT) Avian Injury and Mortality Report Forms. All detections made in search areas during the reporting period were included in fatality estimates, regardless of whether they were detected incidentally or during searches.

## 3.0 MONITORING RESULTS

### 3.1 Summary of Avian Detections

During summer 2016, a total of 12 avian detections (including incidental detections) of eight identified species were recorded in the Project sample units (Figure 3; Table 3). Three unidentified detections also occurred. The most common identified species was lesser nighthawk (*Chordeiles acutipennis*) with two detections. All other species had one detection. Detections were spread across project components with four detections (33.3%) in the solar array, four detections (33.3%) along the gen-tie, and three detections (25.0%) along the fence line (Figure 3; Tables 3, 4, and 5). One detection occurred at other project infrastructure (interior overhead lines). Six (50.0%) of the 12 detections occurred during standardized carcass searches and six were documented as incidental detections. One live bird was found during the summer period. No bats were detected during the summer season. A detailed map of detections within the solar arrays and along the fence line is presented in Appendix B. For fresh carcasses, body weights and weather conditions the preceding nights are described in Appendix C. A summary of all avian guilds, migration behavior, four-letter species codes, scientific names, and sizes represented by detections found during summer 2016 can be found in Appendix D

An additional three detections occurred along the McCoy gen-tie sample units. The BBCS assumes gen-tie mortality data will be pooled between the two facilities and a single fatality estimate will be produced. The data presented below are specific to the Project (including the

Project gen-tie sample units), unless noted otherwise. For specific details on the McCoy specific detections, please see the McCoy summer report (WEST 2016a).

**Table 3. Number of individual bird detections, by species, found during scheduled searches and incidentally during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California.**

| Common Name | Fence Line | Gen-tie* | Solar Arrays | Other | Total |
|---|---|---|---|---|---|
| greater roadrunner | 0 | 0 | 1 | 0 | 1 |
| green-winged teal | 1 | 0 | 0 | 0 | 1 |
| lark sparrow | 0 | 0 | 1 | 0 | 1 |
| lesser nighthawk | 0 | 0 | 2 | 0 | 2 |
| mourning dove | 0 | 1 | 0 | 0 | 1 |
| rock pigeon | 1 | 0 | 0 | 0 | 1 |
| unidentified dove | 1 | 0 | 0 | 0 | 1 |
| unidentified warbler | 0 | 1 | 0 | 0 | 1 |
| unidentified passerine | 0 | 1 | 0 | 0 | 1 |
| western tanager | 0 | 0 | 0 | 1 | 1 |
| white-winged dove | 0 | 1 | 0 | 0 | 1 |
| **Total** | **3** | **4** | **4** | **1** | **12** |

*Only includes detections (during searches or incidentally) located during Blythe gen-tie specific searches

**Table 4. Total avian detections by Project component and detection category during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California. Only carcasses found within search areas were included in fatality estimates.**

| | Inside Carcass Search Area | | Outside Carcass Search Area | |
|---|---|---|---|---|
| **Project Component** | **Carcass Search** | **Incidental** | **Carcass Search** | **Incidental** |
| Fence line | 2 | 1 | 0 | 0 |
| Gen-tie | 4 | 0 | 0 | 0 |
| Solar arrays | 0 | 1 | 0 | 3 |
| Other | 0 | 0 | 0 | 1 |
| **Total** | **6** | **2** | **0** | **4** |

**Table 5. Total avian detections (including incidental detections) by Project component and suspected cause of death during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California.**

| | Suspected Cause of Death or Injury* | | |
|---|---|---|---|
| **Project Component** | **Collision** | **Unknown** | **Percent of Total** |
| Fence line | 0 | 3 | **25.0** |
| Gen-tie | 1 | 3 | **33.3** |
| Solar arrays | 2** | 2 | **33.3** |
| Other | 1*** | 0 | **8.3** |
| **Percent of Total** | **33.3** | **66.7** | **100** |

*Suspected cause of death or injury was assigned based on evidence available from the detection, evidence available on Project infrastructure, and proximity of the detection to Project infrastructure. Detections that had evidence of scavenging and lacked evidence on Project infrastructure were assigned “unknown” cause of death. Detections that were relatively intact (i.e., with minimal evidence of scavenging) and located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines) had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed.

**One of the two detections found in the solar array was found alive and had injuries that were believed to have been due to collision with a truck (not solar panel; see section 3.4).

***This detection was attributed to collision with an overhead line.

## 3.2 Temporal Patterns of Avian Detections

The number of detections recorded daily during the reporting period at the Project ranged from zero to three, with most of the detections occurring during the last week of summer surveys (Figure 5). Daily detections peaked on August 28 and September 1, 2016. The number of detections per day represents those discovered during standardized carcass searches and incidentally.

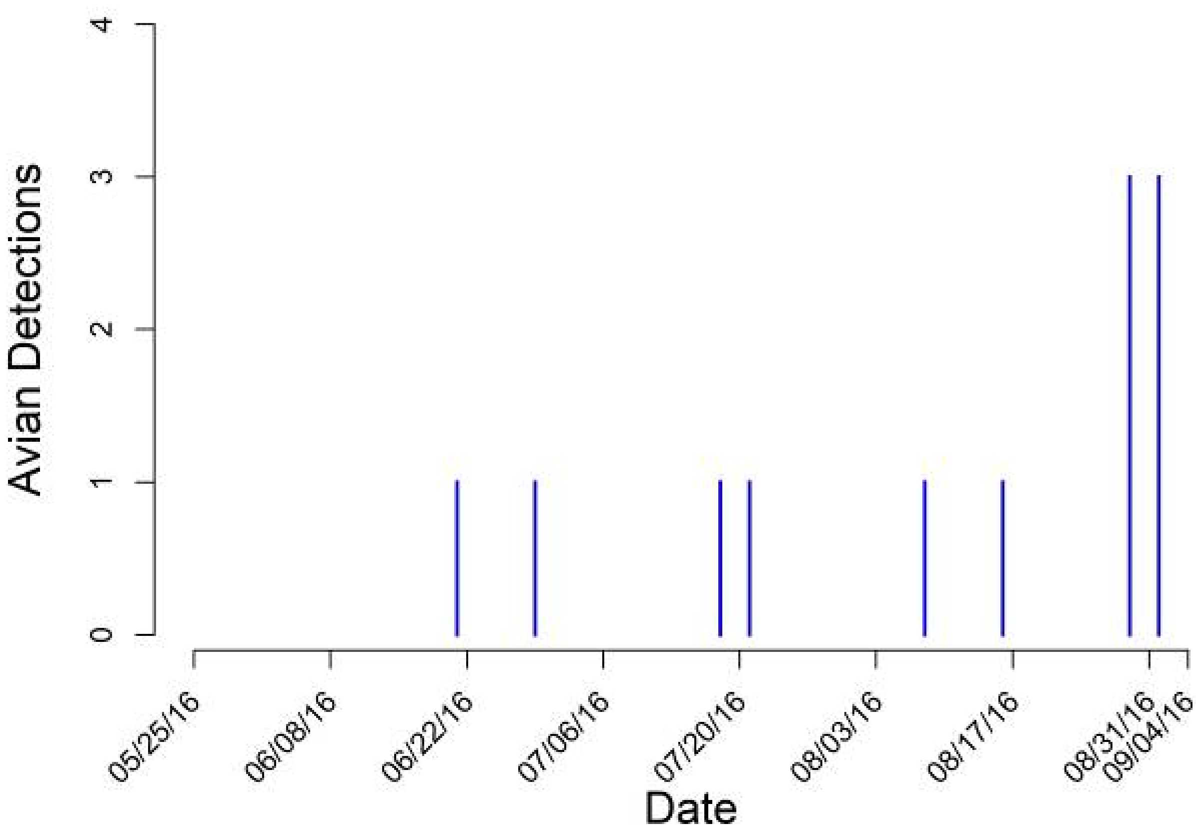



**Figure 5. Total count of detections (including incidental detections) by date during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California. Three detections found along the McCoy gen-tie sections are included on the graph (June 14, Aug 28, and Sept 1, 2016).**

## 3.3 Spatial Distribution of Avian Detections

### 3.3.1 *Detections by Project Component*

During the reporting period, detections were documented near the solar arrays, gen-tie, and fence line (Tables 3, 4, and 5). Four detections occurred in the solar array, four detections occurred along the gen-tie, and three along the fence line. One detection occurred at other project infrastructure.

### 3.3.2 *Feather Spot or Partial Detections*

Six (50.0%) of the 12 detections recorded during the summer period consisted of partial bird carcasses (e.g., wing) or feather spots. This included three along the gen-tie and three along the fence line.

## 3.4 Detections of Injured or Stranded Birds

One detection of an injured bird occurred incidentally during the summer period at the Project. The injured bird was a lark sparrow (*Chondestes grammacus*) found on August 28, 2016. The bird was observed flying under a truck, then under a solar panel. The bird appeared injured when it flew from under the truck and was captured near a pylon in the solar array (sample unit). The bird died shortly after capture.

## 3.5 Summary of Bat Detections

No bats were detected during the summer 2016 season.

## 3.6 Carcass Persistence Trials

A total of 111 carcass persistence trial carcasses were placed at the solar field and gen-tie during summer 2016. Models were fitted separately for each size class for relative quality using the corrected AICc score, as suggested in Huso (2011). The AICc score provides a relative measure of model fit and parsimony among a selection of candidate models, and provides a framework for testing hypotheses regarding which factors contribute to carcass persistence rates. Modeling was split between project components due to Blythe and McCoy gen-tie being pooled between the two projects. Additionally, spring 2016 carcass persistence data were used to further inform the models.

The model with lowest AICc score is typically chosen as the “most supported” model relative to other models tested; however, any model within two AICc points of the most supported model is considered competitive with the most supported model (Burnham and Anderson 2004). The most supported model for all birds, modeled separately for each size class and location (solar field or gen-tie), was an intercept-only model. The best model for large birds in the solar array was a lognormal distribution, while large birds along the gen-tie followed a Weibull distribution. The best models for medium and small birds in the arrays followed a lognormal distribution. The best models for medium birds along the gen-tie followed a loglogistic distribution. The best models for small birds along the gen-tie followed a lognormal distribution. All gen-tie estimates include pooled carcass persistence trial data from Blythe and McCoy. Estimates of carcass removal time and persistence probabilities from the most supported model are reported in Table 6, and estimates of proportion of carcasses remaining as a function of days since carcass placement are provided in Figure 6. Detailed estimates of carcass removal and associated CIs are provided in Appendix E.

Carcass persistence was influenced by carcass size and Project component. Small carcasses (0-100 g) in the arrays and along the fence (combined) had a 42% chance (90% confidence interval [CI]: 33-50%) of persisting through the effective search interval, medium carcasses (101 – 999 g) had a 48% (90% CI: 38-57%) chance, and large carcasses (1,000+ g) had an 87.0% chance (90% CI: 78-93%). Median removal time within the arrays for small, medium, and large carcasses was 5.0, 6.8, and 47.6 days, respectively. Along the gen-tie (pooled data from Blythe and McCoy), chances of persistence for small, medium, and large carcasses were 11.0% (90%

CI: 9-14%), 22% (90% CI: 13-32%), and 32% (90% CI: 19-44%) respectively; median removal time for small, medium, and large carcasses was 1.6, 1.7, and 3.2 days, respectively.

In general, removal times were shorter for gen-tie components when compared to solar array and fence line components. The median large bird persistence was 47.6 days within the solar array and fence line. The probability of persistence was greater than 48% for large and medium birds in the solar arrays and 42% for small birds inside the fence.

**Table 6. Median carcass removal time and probability of a carcass persisting through the effective search interval during the summer 2016 (June 1 – September 3) season at the Blythe Solar Power Project, Riverside County, California.**

| Carcass Size | Project Component* | Median Removal Time (Days) | Probability of Persistence |
|---|---|---|---|
| Small | Arrays/fence line | 5.0 | 42.0 |
| Small | Gen-tie | 1.6 | 11.0 |
| Medium | Arrays/fence line | 6.8 | 48.0 |
| Medium | Gen-tie | 1.7 | 22.0 |
| Large | Arrays/fence line | 47.6 | 87.0 |
| Large | Gen-tie | 3.2 | 32.0 |

*Gen-tie data includes pooled data from Blythe and McCoy

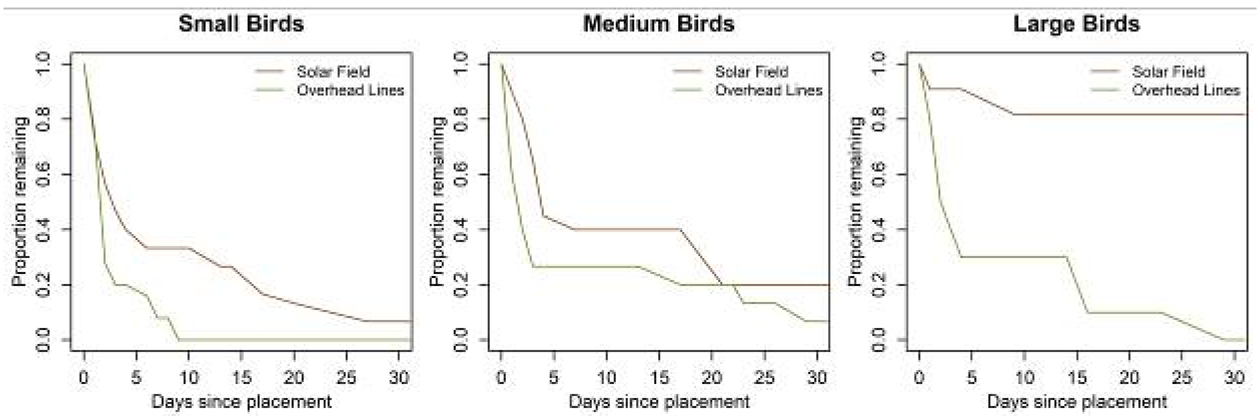



**Figure 6. Proportion of trial carcasses remaining as a function of days since placement and carcass size class (55, 35, and 20 carcasses for small, medium, and large size classes, respectively) during the summer 2016 (June 1 – September 3) monitoring season at the Blythe Solar Power Project, Riverside County, California. These data include spring 2016 trial data.**

## 3.7 Searcher Efficiency Trials

During the reporting period, a total of 123 searcher efficiency trial carcasses were placed at the Project. Most trial carcasses were available to be found, but some disappeared before or during the trial. Overall, 53 trial carcasses were placed in the solar arrays and 50 were available to be found; 35 trial carcasses were placed along the fence line (inner perimeter only) and 35 were available to be found; and 35 trial carcasses were placed along the gen-tie and 34 were available to be found. Only one observer conducted searches at the Project during summer;

therefore, no individual searcher rates were calculated. All available trials were included in estimation of searcher efficiency. Spring 2016 searcher efficiency data were also included. Gen-tie trial data were pooled for Blythe and McCoy.

For trial carcasses placed in the solar arrays, searcher efficiency was modeled separately for small, medium, and large birds. The best model for all bird size classes was an exponential distribution. Within the solar arrays, searcher efficiency was: 80.0% (90% CI: 65-94%) for large birds; 56.0% (90% CI: 40-72%) for medium birds; and for small birds, 49.0% (90% CI: 39-59%; Figure 7; Appendix E).

For linear Project components, the distance sampling approach was not implemented; therefore, the searcher efficiency rates were calculated based on the number available and number found along the fence line and gen-tie. Along the fence line, searcher efficiency was 100% for large and medium size class trials. Searcher efficiency for small birds was 93% (90% CI: 85-100%). Along the gen-tie, searcher efficiency was 100% for large birds (no CI), 89.0% (90% CI: 78-100%) for medium birds, and 78.0% (90% CI: 65-91%) for small birds. The gen-tie includes pooled trial data for Blythe and McCoy. Detailed estimates of searcher efficiency specific to each component and carcass size are reported in Appendix E.

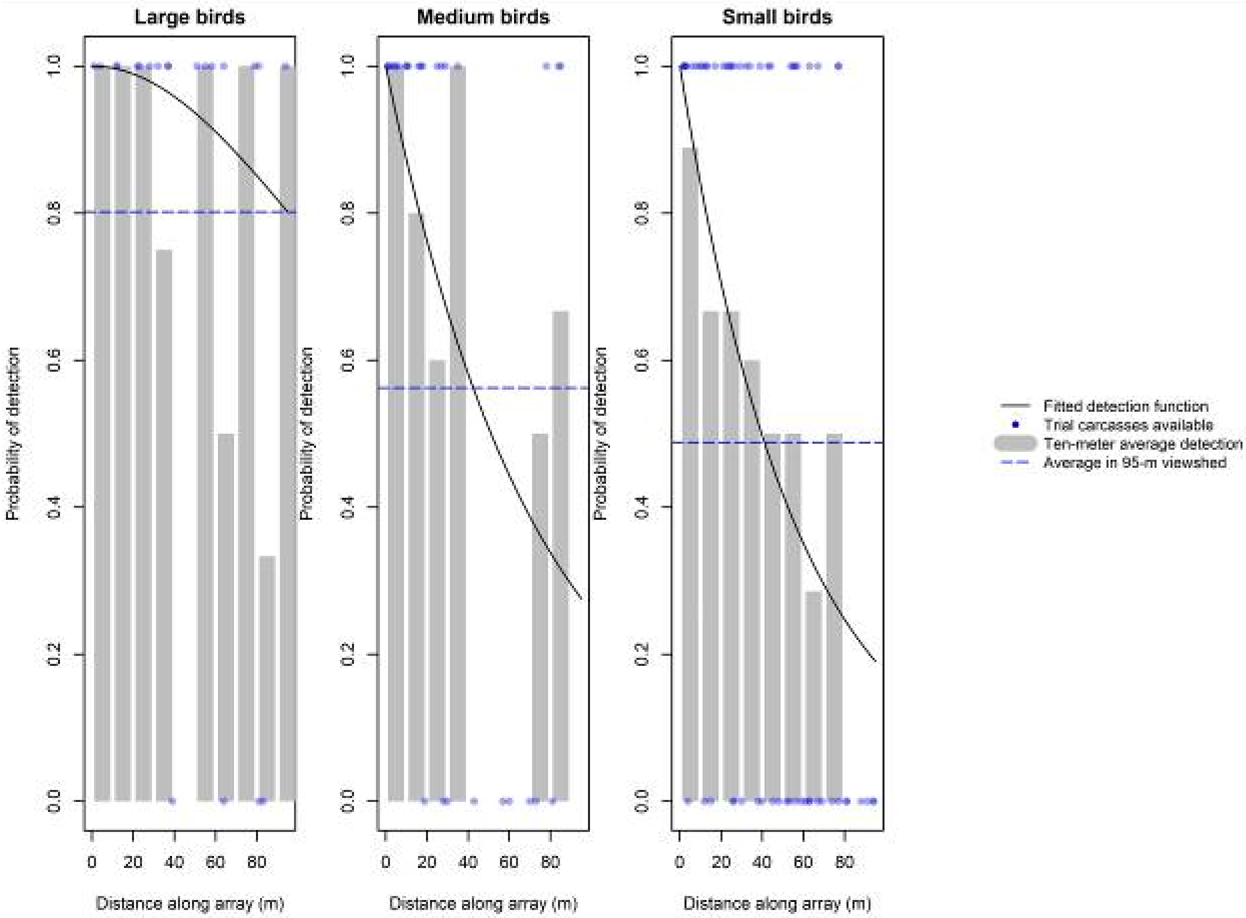



**Figure 7. Estimated detection probabilities for bird carcasses by size class during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California. Distance sampling was used when searching solar arrays only. Average probability of detection at 95-m panel rows in solar arrays are presented. Estimates are informed by 71, 30 and 22 small, medium and large bird carcass trials, respectively.**

### 3.8 Fatality Estimates

Fatality estimates were calculated separately for each component (solar arrays, fence line, and gen-tie). Gen-tie estimates include pooled data from Blythe and McCoy. Ultimately, three detections located in the solar array were excluded from the fatality analysis because they were found outside standardized search areas (Appendix E). All 12 detections that were documented at the Project (including the Project gen-tie sections) during summer are reported in Table 3.

The adjusted fatality estimate for summer in the solar array was modeled at approximately eleven (90% CI: *[1]* – 26) small bird fatalities and zero medium and large bird fatalities. The total estimate was 11 (90% CI: *[1]* – 26) fatalities in the solar array during the summer season or 0.047 fatalities per MW (*this values assumes 235 MW*). These estimates are based on one small bird detection in the solar array during summer searches. The estimates were adjusted based on searcher efficiency and carcass removal rates.

The adjusted fatality estimate for summer along the fence line was modeled at approximately three (90% CI: *[1]* – 6) small bird fatalities and four (90% CI: *[2]* – 7) medium bird fatalities. This estimate was based on one small bird and two medium bird detection along the fence. No large birds were detected along the fence line during the summer period.

Gen-tie fatality estimates were informed by pooling McCoy and Blythe data. The adjusted fatality estimate along the gen-tie was modeled at 45 small bird fatalities (90% CI: *[2]* – 57) and 47 medium bird fatalities (90% CI: *[5]* – 91). These estimates were informed by two small bird detections within Blythe gen-tie sample units and five medium bird detections within Blythe (n=2) and McCoy (n=3) gen-tie sample units. Assuming each project is responsible for half of the gen-tie, an estimate for the Blythe Project gen-tie would equate to approximately 23 small bird fatalities and 24 medium bird fatalities for a total of 47 fatalities. A complete list of estimates for each Project component and carcass size class with Cis is presented in Appendix E.

# 4.0 DISCUSSION

The 2016 summer season represented the second season of standardized Year 1 monitoring at the Project. Searcher efficiency and carcass persistence trials were conducted concurrently at the solar arrays, fence line, and along the gen-tie. Data from the spring and summer trials were used to produce fatality estimates adjusted for searcher efficiency and carcass persistence bias. These results should be considered preliminary because carcass persistence, searcher efficiency, and adjusted numbers of fatalities were only informed by two seasons of data. A total of one detection (one small bird) was used to inform estimates within the solar arrays, three detections (one small and two medium birds) were used to inform estimates along the fence line and seven detections (two small and five medium) were used to inform estimates along the gen-tie. As more surveys are completed, we assume the estimates will be informed by more data and a higher level of confidence can be derived from the models.

It is also worth noting that the Project was not fully constructed and operational; therefore, sampled areas did not fully represent those proposed in the BBCS once the facility is operational. Some sample units had more or less survey events due to varied turn-over dates. As more data are collected throughout the monitoring year (and additional quality assurance/quality control measures occur), data from all seasons may be pooled. At that time, data will be tested for seasonal differences retrospectively, but because seasonal estimates will be produced from the much larger annual data set, they may differ from what is reported here because they are based on a larger, more informative sample.

## 4.1 Carcass Persistence and Searcher Efficiency Trials

The degree to which carcasses persist on the landscape depends on a variety of factors reflecting seasonal and inter-annual variation in habitat, climate, and the scavenger community. The composition and activity patterns of the scavenger community often vary seasonally as bird scavengers migrate, new juvenile birds and mammalian scavengers join the local population, and mammalian scavengers variably hibernate or estivate. The scavenger community may also vary substantially from year to year because of variation in annual reproduction and survival related to changes in landscape condition. Climatic conditions that vary seasonally and annually also may contribute to variation in carcass decay and removal rates due to variation in temperatures, solar insolation, wind patterns, and the frequency of flooding events. Thus, rates of carcass persistence reported here should be interpreted cautiously as they may change over the year-long period.

Fatality estimates are influenced by the relationship between carcass removal dynamics and search intervals. In practical terms, longer search intervals reduce the average probability that a carcass persists until the next search. In terms of the analysis, this can manifest as a lower probability of persistence through the effective search interval, or an effective search interval that is shorter than the nominal search interval. In either case, the adjustment to carcass counts due to carcass removal dynamics is calculated as:

$$\frac{length\ of\ effective\ search\ interval}{length\ of\ nominal\ search\ interval * average\ probability\ of\ persistence\ through\ the\ effective\ search\ interval}$$

The adjustment to estimated fatality for carcass removal increases with longer search intervals, and the variance in the estimate may also increase.

Carcass persistence at the Project is clearly influenced by whether a carcass is located in the solar field (inside the fence line) or along the gen-tie (outside the fence line), with shorter removal rates occurring along the gen-tie. Although the same scavenger species may occur at both locations, a difference in scavenger density or activity could possibly be responsible for the different rates of carcass persistence. If there are differences in scavenging rates between the trial carcasses and naturally-occurring carcasses, it is possible that the high scavenging rates observed along the gen-tie have resulted in inflated fatality estimates. This hypothesis may be evaluated in the annual report by comparing persistence rates of trial carcasses to the age of carcasses detected by observers. Given the very high scavenging rates along the gen-tie, fatality estimates for the gen-tie may have greater uncertainty (i.e. wider confidence intervals) due to high carcass removal rates along that Project component. Additionally, the Project was an active construction site. This may have also had an effect on the presence/absence of scavengers in and around the site.

Searcher efficiency rates within the solar arrays varied based on trial carcass size; small birds 49.0%, medium birds 56.0%, and large birds 80.0%. The sample area may have a greater effect on the searcher efficiency rates, as the gen-tie has a sample area width of 30 m and the fence line has sample area width of six m. Conversely, the solar array has viewsheds extending up to 95 m. A much higher searcher efficiency rate was observed along the gen-tie and fence line across all size classes.

## 4.2 Distribution of Fatalities and Fatality Estimates

Detections were distributed throughout the summer season with no clear temporal trend. This is not surprising given the small number of detections. Detections were spread among the various

Project components with three detections (25.0%) along the fence line, four detections (33.3%) along the gen-tie, and four detections (33.3%) in the solar array. One detection (8.3%) occurred at other project infrastructure

Composition of detections during summer 2016 included seven avian guilds. Doves and pigeons (four) were the most detected guild. All other guilds were represented by one detection. One waterbird (green-winged teal) was detected as a partial bird along the fence line. No bats were detected during the summer 2016 period. Species migration behaviors for the summer detections were represented by resident, nocturnal, diurnal, and diurnal/nocturnal species. No clear association was evident between migration behavior and project level impacts.

Detections attributed to an unknown cause (n = 8) accounted for 66.7% of all detections during the reporting period. Collision (n = 4) was suspected as the cause of death for 33.3% of detections. Two of the collisions appeared to result from overhead lines (one along gen-tie and one at the interior overhead lines in the solar field),one was attributed to solar array structures, and one that occurred near the solar arrays was attributed to a vehicle. The presence of multiple project components in localized areas (e.g., roads, overhead lines, fences, and solar arrays) can result in uncertainty when assigning the component at fault.

The adjusted fatality estimate in the solar arrays was 11 carcasses for the summer season. This equates to 0.047 fatalities per MW (assuming 235 MW). This estimate was informed by one small bird detection.

## 5.0 LITERATURE CITED

Akaike, H. 1973. Information Theory as an Extension of the Maximum Likelihood Principle. Presented at the Second international symposium on information theory. B. N. Petrov and F. Csaki, eds. Pp. 267-281. Akademiai Kiado. 1973.

Ammon, E. M. and W. M. Gilbert. 1999. Wilson's Warbler (*Cardellina pusilla*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/478; doi: 10.2173/bna.478

Birds of North America (BNA). 2016. The Birds of North America Online. Cornell Lab of Ornithology and the American Ornithologists' Union. Accessed June and July 2016. BNA homepage at: http://bna.birds.cornell.edu/bna

Bowman, R. 2002. Common Ground-Dove (*Columbina passerina*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/645; doi: 10.2173/bna.645

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.

Burnham, K. P. and D. R. Anderson. 2004. Multimodel Inference: Understanding AIC and BIC in Model Selection. Sociological Methods and Research 33(2): 261-304.

Chilton, G., M. C. Baker, C. D. Barrentine, and M. A. Cunningham. 1995. White-Crowned Sparrow (*Zonotrichia leucophrys*). A. Poole, ed. Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/183; doi: 10.2173/bna.183

Evers, D. C., J. D. Paruk, J. W. Mcintyre, and J. F. Barr. 2010. Common Loon (*Gavia immer*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/313; doi: 10.2173/bna.313

Gardali, T. and G. Ballard. 2000. Warbling Vireo (*Vireo gilvus*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/551; doi: 10.2173/bna.551

Gilbert, W. M., M. K. Sogge, and C. Van Riper III. 2010. Orange-Crowned Warbler (*Oreothlypis celata*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/101; doi: 10.2173/bna.101

Huso, M. 2011. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22(3): 318-329. Doi: 10.1002/env.1052.

Huso, M., N. Som, and L. Ladd. 2015. Fatality Estimator User's Guide. US Geological Survey (USGS) Data Series 729. Version 1.1. December 2015. Available online at: http://pubs.usgs.gov/ds/729/pdf/ds729.pdf

Huso, M, Dietsch, T, and Nicolai, C, 2016, Mortality monitoring design for utility-scale solar power facilities: U.S. Geological Survey Open-File Report 2016-1087, 44 p., http://dx.doi.org/10.3133/ofr20161087.

Korner-Nievergelt, F., P. Korner-Nievergelt, O. Behr, I. Niermann, R. Brinkmann, and B. Hellriegel. 2011. A New Method to Determine Bird and Bat Fatality at Wind Energy Turbines from Carcass Searches. Wildlife Biology 17: 350-363.

Lowther, P. E. and J. M. Williams. 2011. Nashville Warbler (*Oreothlypis ruficapilla*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/205; doi: 10.2173/bna.205

Manly, B. F. J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. 2nd Edition. Chapman and Hall, London.

Murray, J. M. 2004. Nocturnal Flight Call Analysis as a Method for Monitoring Density and Species Composition of Migratory Songbirds (Order Passeriformes) across Southern Vancouver Island, British Columbia, 2004. Available online at: http://rpbo.org/acousticmonjjm.pdf

National Geographic Society (National Geographic). 2016. World Maps. Digital Topographic Map.

Newton, I. 2008. The Migration Ecology of Birds. Academic Press, London.

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

Otis, D. L., J. H. Schulz, D. Miller, R. E. Mirarchi, and T. S. Baskett. 2008. Mourning Dove (*Zenaida macroura*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/117; doi: 10.2173/bna.117

Pitocchelli, J. 2013. MacGillivray's Warbler (*Geothlypis tolmiei*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/159; doi: 10.2173/bna.159

Schwertner, T. W., H. A. Mathewson, J. A. Roberson, M. Small, and G. L. Waggerman. 2002. White-Winged Dove (*Zenaida asiatica*). A. Poole, ed. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/710; doi: 10.2173/bna.710

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

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel Scavenger Removal Trials Increase Wind Turbine-Caused Avian Fatality Estimates. Journal of Wildlife Management 74: 1089-1097. Doi: 10.2193/2009-266.

Therneau, T. and T. Lumley. 2015. A Package for Survival Analysis in S. Version 2.38. Information available at: http://CRAN.R-project.org/package=survival

Therneau, T. M. and P. M. Grambsch. 2000. Modeling Survival Data: Extending the Cox Model. Summerer-Verlag, New York.

US Department of Agriculture (USDA). 2014. Imagery Programs – National Agriculture Imagery Program (NAIP). USDA – Farm Service Agency (FSA). Aerial Photography Field Office (APFO), Salt Lake City, Utah. Last updated September 2015. Information available online at: http://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/index

US Geological Survey (USGS). 2016. The National Map/US Topo. Last updated January 2016. Homepage available at: http://nationalmap.gov/ustopo/index.html

Western EcoSystems Technologies, Inc. (WEST). 2016a. Post-Construction Monitoring at the McCoy Solar Energy Project, Riverside County, California. 2016 Summer Quarterly Interim Report. Prepared for McCoy Solar, LLC, Juno Beach, Florida. Prepared by WEST, Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2016b. Bird and Bat Conservation Strategy, Blythe Solar Energy Project, Riverside County, California. 57 pp.

# Appendix A. Detailed Areas of Detection Locations along the Gen-Tie of the Blythe Solar Power Project during Summer 2016 (June 1 – September 3) Monitoring


**Appendix A-1. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.** *Note: Detections shown were associated with fence line and solar array components.*

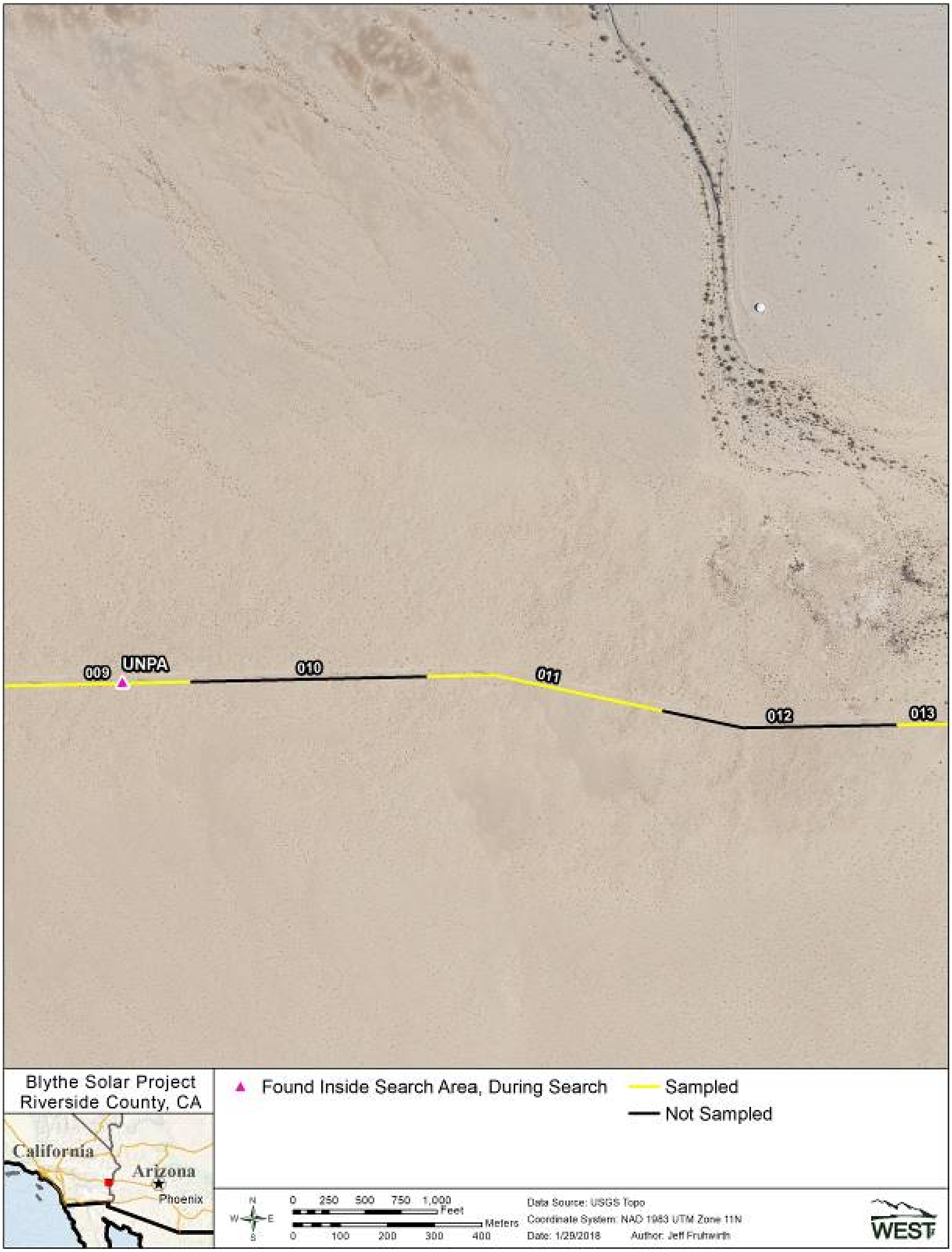

**Appendix A-2. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-3. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-4. Detailed map of detection locations along the gen-tie at the Blythe Solar Ppwer Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-5. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-6. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**

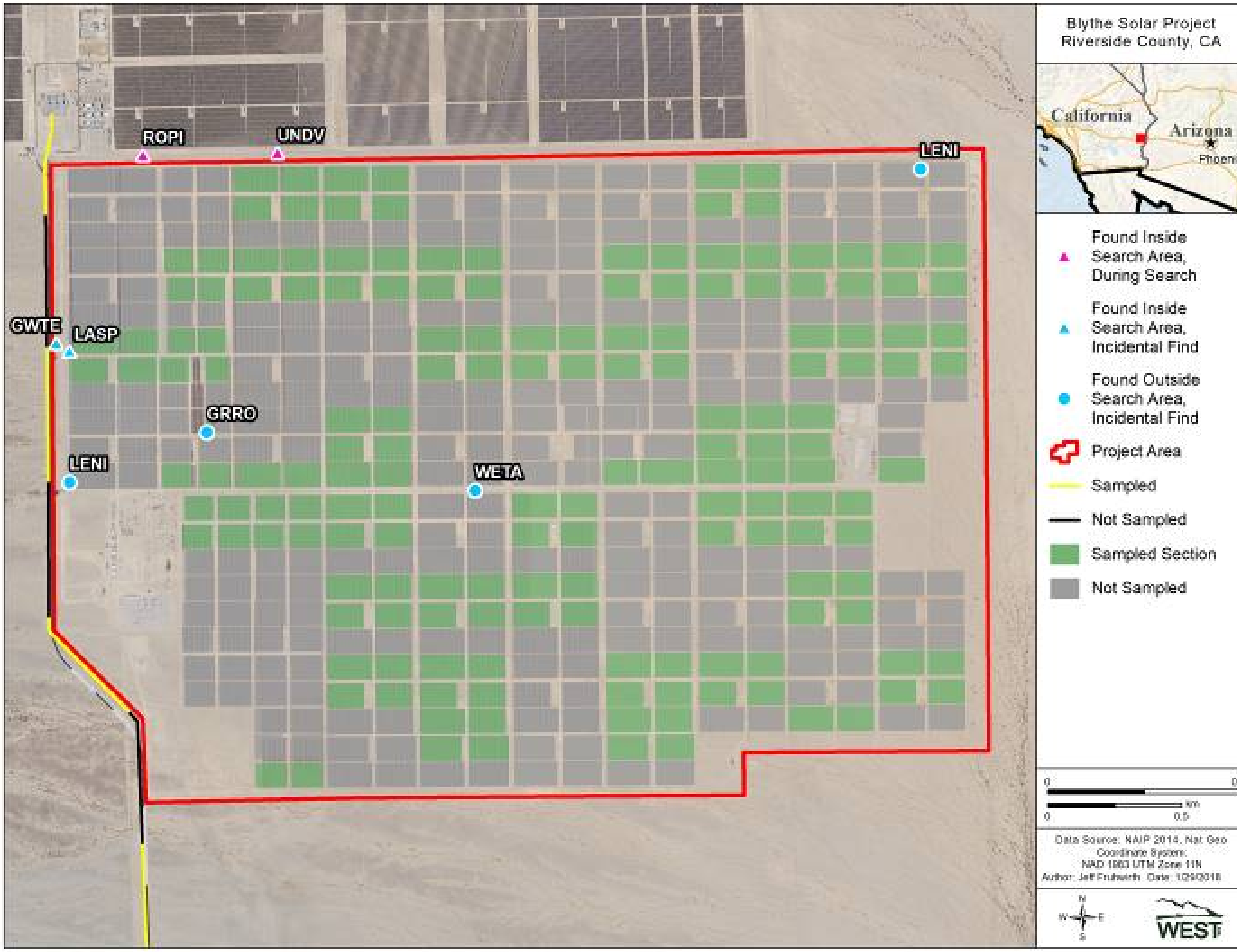



**Appendix A-7. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-8. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**


**Appendix A-9. Detailed map of detection locations along the gen-tie at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**

# Appendix B. Detailed Areas of Detection Locations within the Solar Arrays and along the Fence Line of the Blythe Solar Power Project during Summer 2016 (June 1 – September 3) monitoring




**Appendix B. Detailed map of detection locations along the solar arrays and fence line at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**

# Appendix C. Weather Conditions and Body Weights Associated with Avian Detections Estimated to be Less Than 24 Hours Old during Summer 2016 (June 1 – September 3) Monitoring at the Blythe Solar Power Project

**Appendix C. Weather conditions and body weights associated with detections estimated to be less than 24 hours old during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California.**

| Carcass ID | Date | Estimated time since death (hrs) | Species | Weight (g)[1] | Weather | Wind Direction | Wind Speed Avg. | Wind Speed Maximum |
|---|---|---|---|---|---|---|---|---|
| 062916-JKP-01 | 6/29/2016 | 8-24h | greater roadrunner | 110 | wind | S | 12 | 13 |
| 090116-JKP-04 | 9/1/2016 | 0-8h | green-winged teal | NA | clear | S | 7 | 16 |
| 082916-AKW-03 | 8/29/2016 | 0-8h | lark sparrow[2] | 21 | clear | SW | 4 | 5 |
| 062116-JKP-01 | 6/21/2016 | 8-24h | lesser nighthawk | NA | wind | NW | 9 | 22 |
| 071816-JKP-01 | 7/18/2016 | 8-24h | lesser nighthawk | 27 | wind | S | 7 | 10 |
| 090116-JKP-01 | 9/1/2016 | 0-8h | mourning dove | 100 | clear | S | 9 | 13 |

[1] Weight recorded only for intact carcasses with no evidence of scavenging.

[2]Bird found alive, but died shortly after capture

# Appendix D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for All Avian Detections Made during Standardized Carcass Searches and Incidentally, by Species, during Summer 2016 (June 1 – September 3) Monitoring at the Blythe Solar Power Project

**Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during summer 2016 (June 1 – September 3) monitoring at the Blythe Solar Power Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird**

| Common Name | 4-Letter Species Code | Scientific Name | Guild | Migration Behavior* | Size |
|---|---|---|---|---|---|
| greater roadrunner | GRRO | *Geococcyx californianus* | Cuckoos | resident | MB |
| green-winged teal | GWTE | *Anas crecca* | Waterbirds/Waterfowl | nocturnal | MB |
| lark sparrow | LASP | *Chondestes grammacus* | Grassland/Sparrow | resident | SB |
| lesser nighthawk | LENI | *Chordeiles acutipennis* | Goatsuckers | diurnal | SB |
| mourning dove | MODO | *Zenaida macroura* | Doves/Pigeons | diurnal/nocturnal | MB |
| rock pigeon | ROPI | *Columba livia* | Doves/Pigeons | resident | MB |
| unidentified dove | UNDV | *Columbina* spp | Doves/Pigeons | na | SB |
| unidentified warbler | UNWA | na | Warblers | na | SB |
| unidentified passerine | UNPA | na | Na | na | SB |
| western tanager | WETA | *Piranga ludoviciana* | Tanagers | nocturnal | SB |
| white-winged dove | WWDO | *Zenaida asiatica* | Doves/Pigeons | diurnal/nocturnal | MB |

*See literature cited for bird migration behavior references; information for most bird species was taken from the respective species accounts found in Birds of North America Online (BNA 2016 [Ammon 1995; Ammon and Gilbert 1999; Chilton et al. 1995; Conway 1995; Gilbert et al. 2010; Hughes 2011; Johnson et al. 2002; Ortega and Hill 2010; Rotenberry et al. 1999; Schwertner et al. 2002]); where information on migration behavior was lacking in BNA accounts, Newton (2008) or Murray (2004) was used.

# Appendix E. Correction Factors and Bird Fatality Rates at the Blythe Solar Power Project during Summer 2016 (June 1 – September 3) Monitoring

**Appendix E-1. Correction factors and bird fatality rates at the Blythe Solar Power Project during summer 2016 (June 1 – September 3) monitoring.**

| Parameter | Small Birds Mean | Small Birds 90% CI | Medium Birds Mean | Medium Birds 90% CI | Large Birds Mean | Large Birds 90% CI |
|---|---|---|---|---|---|---|
| **Proportion of Area Searched** | | | | | | |
| Solar array | 0.37 | - | 0.37 | - | 0.37 | - |
| Fence line | 0.90 | - | 0.90 | - | 0.90 | - |
| Gen-tie | 0.49 | - | 0.49 | - | 0.49 | - |
| **Searcher Efficiency (no variance – all large birds at the fence line and gen-tie line were found)** | | | | | | |
| Solar arrays | 0.49 | 0.38 – 0.59 | 0.56 | 0.41-0.73 | 0.80 | 0.65 – 0.94 |
| Fence line | 0.93 | 0.85 – 1 | 1 | - | 1 | - |
| Gen-tie* | 0.78 | 0.65 – 0.91 | 0.89 | 0.78 – 1 | 1 | - |
| **Average Probability of Carcass Persistence through the Effective Search Interval** | | | | | | |
| Solar arrays and fence line | 0.42 | 0.33 – 0.50 | 0.48 | 0.38 – 0.57 | 0.87 | 0.78 – 0.93 |
| Gen-tie* | 0.11 | 0.09 – 0.14 | 0.22 | 0.13 – 0.32 | 0.32 | 0.19 – 0.44 |
| **Carcass Counts by Component** | | | | | | |
| Solar arrays | *1* | *(1)-3* | 0 | - | 0 | - |
| Fence line | *1* | *(1)-3* | *2* | *(2)-4* | 0 | - |
| Gen-tie* | *2* | *(2)-4* | *5* | *2 – 8* | 0 | - |
| **Average Probability of Carcass Availability and Detected (searcher efficiency * average probability of carcass persistence)** | | | | | | |
| Solar array | 0.20 | 0.15 – 0.26 | 0.27 | 0.18 – 0.37 | 0.69 | 0.54 – 0.84 |
| Fence line | 0.38 | 0.30 – 0.47 | 0.47 | 0.38 – 0.57 | 0.87 | 0.78 – 0.93 |
| Gen-tie | 0.09 | 0.06 – 0.12 | 0.20 | 0.11 – 0.29 | 0.31 | 0.19 – 0.44 |
| **Total Overall Detectability (Average Probability of Carcass Availability and Detected * Proportion of Area Searched)** | | | | | | |
| Solar array | 0.08 | 0.05 – 0.10 | 0.10 | 0.07 – 0.14 | 0.26 | 0.20 – 0.31 |
| Fence line | 0.35 | 0.27 – 0.42 | 0.43 | 0.34 – 0.51 | 0.78 | 0.70 – 0.84 |
| Gen-tie | 0.04 | 0.03 – 0.06 | 0.10 | 0.05 – 0.14 | 0.15 | 0.09 – 0.22 |
| **Adjusted Fatality Estimates (Fatalities/Season/Project Component; values in italics are considered unreliable due to low counts of carcasses: carcass count / (proportion of area searched * average probability of carcass availability and detected))** | | | | | | |
| Solar array | *11.43* | *(1) – 26.04* | 0 | - | 0 | - |
| Fence line | *2.52* | *(1) – 6.06* | *3.78* | *(2) – 7.27* | 0 | - |
| Gen-tie | *44.78* | *(2) – 57.35* | *46.94* | *(5) – 91.30* | 0 | - |
| Overall | *58.72* | *(4) – 71.73* | 50.72 | 21.47 – 94.40 | 0 | - |

**For adjusted fatalities, lower bounds in parentheses are actual counts; bootstrap analysis indicated a lower bound of zero.

**Appendix E-2. Detections excluded from the summer 2016 fatality analysis at the Blythe Solar Power Project due to: 1) having been detected outside of a regular search area, or 2) having an estimated carcass age that is greater than twice the actual search time interval and hence violating assumptions of the Huso estimator.**

| Parameter | Small Birds | Medium Birds | Large Birds |
|---|---|---|---|
| Solar arrays | 0 | 3 | 0 |
| Fence line | 0 | 0 | 0 |
| Gen-tie | 0 | 0 | 0 |
| Other | 1 | 0 | 0 |