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IVANPAH SOLAR ELECTRIC GENERATING SYSTEM
AVIAN & BAT MONITORING PLAN

2016 SUMMER REPORT

Prepared for:

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Executive Summary

Avian and bat monitoring surveys were conducted from 25 May 2016 – 17 August 2016 (the summer season) at the Ivanpah Solar Electric Generating System facility (referred to in this report as "Ivanpah" or "Project") in accordance with the Project's Avian & Bat Monitoring and Management Plan (Plan) as revised November 2015.

Per the revised Plan, potential flux effects are investigated by surveying 100 percent of the tower area in all three units, and collisions with facility structures (towers and heliostats) are evaluated by systematic sampling of 100% of the tower areas (154 acres) in each of the three units, and 20% of Unit 2 heliostat field (240 acres) as representative of the facility. The "tower area" consists of the power block and inner high-density (HD) heliostats surrounding each power block on approximately 154 acres; and 2) the "heliostat area" consists of the inner and outer heliostat segments outside of the inner HD heliostats on approximately 2,991 acres. Searches were conducted within the summer season at intervals of approximately 21 days.

All bird and bat fatalities and injuries, referred to as "detections" in this report, including those found incidentally and during standardized facility searches, were documented and categorized as singed, collision, other project causes or unknown based on examination with a binocular microscope and evidence collected from the location of the detection. During the period 25 May - 17 August 2016, 3 bat detections and 112 avian detections (including 2 injured birds) were found.

According to the specifications of the revised Plan, the number of avian detections was categorized by facility structure and cause. These avian fatality search results, along with searcher efficiency and carcass removal rates from trials conducted onsite, were input into a fatality estimator model (Huso 2010) to provide an estimate of the fatalities for the facility.

Using the fatality estimator model, during the period 25 May – 17 August 2016, there were an estimated 262 fatalities (45.1%) from known causes and 319 fatalities (54.9%) from unknown causes. Of the known causes, 245 fatalities (93.5%) were estimated for the 154-acre tower area; an estimate is not provided for the 2,991 acre heliostat area as no known cause detections were found in the Unit 2 heliostat area. Of the unknown causes, 65 fatalities (20.4%) were estimated for the tower area, and 5 or fewer detections occurred in the heliostat area; thus, an estimate is not provided. Overall, based on the monitoring results and estimates for known causes for the 2016 summer season, the effect of the Project on birds is "low" as defined in the Plan.

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Section 1.0 Introduction

1.1 Project Background

The Ivanpah Solar Electric Generating System (referred to in this report as "Ivanpah" or "Project") consists of three solar power electrical generating facilities (Units 1, 2, and 3) with a combined net capacity of 377 megawatts. Each unit includes a central power tower with an air cooled condenser (ACC) and associated electrical generating equipment, surrounded by a heliostat array that reflects sunlight to a boiler at the top of the power tower. Ivanpah is located on approximately 1,457 hectares (3,600 acres) of Bureau of Land Management (BLM) land west of Interstate 15 near the town of Nipton in San Bernardino County, California (Figure 1). Construction was initiated in 2010 and completed in late 2013.

1.2 Monitoring Plan Overview and Goals

An Avian & Bat Monitoring and Management Plan (Plan) was prepared by the Project proponent in collaboration with the Technical Advisory Committee (TAC) made up of the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), California Energy Commission (CEC), and Bureau of Land Management (BLM) to guide comprehensive monitoring of impacts to birds and bats associated with the operation of the Project. Revision 12 of the Plan (2013) was accepted by the TAC in November 2013 and required two years of monitoring, which were completed at the end of October 20, 2015. As determined by the TAC, the goals of the Plan (2013) were met, and in November 2015, the TAC-approved Revision 13 to the Plan (2015) to require a third year of monitoring to provide collision and flux mortality estimates. Revision 13 of the Plan (2015) reflects reduced monitoring requirements as informed by the first two years of intensive monitoring. Specifically, the Plan (2015) details the onsite and offsite surveys to be conducted and the data analysis and reporting processes that will be implemented by Ivanpah in collaboration with the USFWS, CDFW, CEC, and BLM and provides the following goals and objectives as excerpted from the Plan (2015):

Plan Goals

1. Provide Collision Mortality Estimates: Estimates of avian mortality from collision will be calculated from data obtained by monitoring and identifying avian mortality and injury associated with facility structure collisions.
2. Provide Solar Flux Mortality Estimates: Estimates of avian mortality from flux effects will be calculated from data obtained by monitoring and identifying avian mortality and injury associated with solar flux generated by the facility.
3. Provide a Framework for Management and Response to Risks**:** The designation and description of the functioning of the TAC provides a management and decision framework for the identification and implementation of potential adaptive management measures.

Plan Objectives

The first two years of monitoring documented that the mortality associated with the perimeter fences, transmission lines, and offsite transects was generally less than 5 detections per season. Additionally, the patterns associated with avian use have been consistent over the seasons and documented in the annual reports. Therefore, as revised, this Plan has the following goals:

1. Estimate collision-related avian mortality and injury with the following facility structures (Figure 2), using empirical data to calculate facility-wide mortality and injury rates:

   a. Power towers
   b. Heliostats

2. Estimate flux-related avian mortality and injury using empirical data to calculate facility-wide mortality and injury rates.
3. Document patterns of collision or flux-related mortality and injury associated with species, age/sex, season, weather, and visibility.
4. Document spatial patterns associated with collision- or flux-related mortality and injury.
5. Provide quantitative information for developing and implementing adaptive management responses commensurate with identified impacts.

The revised Plan (2015) continues to: 1) satisfy the BLM Right-of-Way (ROW) Permit requirement that the proponent develop an avian plan as well as a Migratory Bird Treaty Act (MBTA) Conservation Agreement; 2) satisfy the requirements for the Avian & Bat Monitoring and Management Plan approved by the CEC for Ivanpah per CEC Condition of Certification BIO-21; and 3) achieve the avian and bat protection objectives of the USFWS in relation to the MBTA, Bald and Golden Eagle Protection Act (Eagle Act), and Federal Endangered Species Act (FESA), including preparing written records of the actions that have been taken to avoid, minimize, and compensate for potential adverse impacts to avian and bat species. By developing a proactive management plan in close consultation with the USFWS and other relevant state and federal agencies, Project proponents can effectively comply with the intent of the federal MBTA, Eagle Act, FESA, and relevant state regulations (USFWS 2012).

1.3 Purpose of This Report

This report represents the third "quarterly" (i.e., seasonal) report for the third year of monitoring (or, the eleventh quarterly report) summarizing monitoring methods and results for avian and bat fatalities and injuries based on the procedures and requirements specified in the USFWS-accepted Plan and as required by CEC Condition of Certification BIO-21. This report covers the summer 2016 season, which includes the period from 25 May – 17 August 2016.

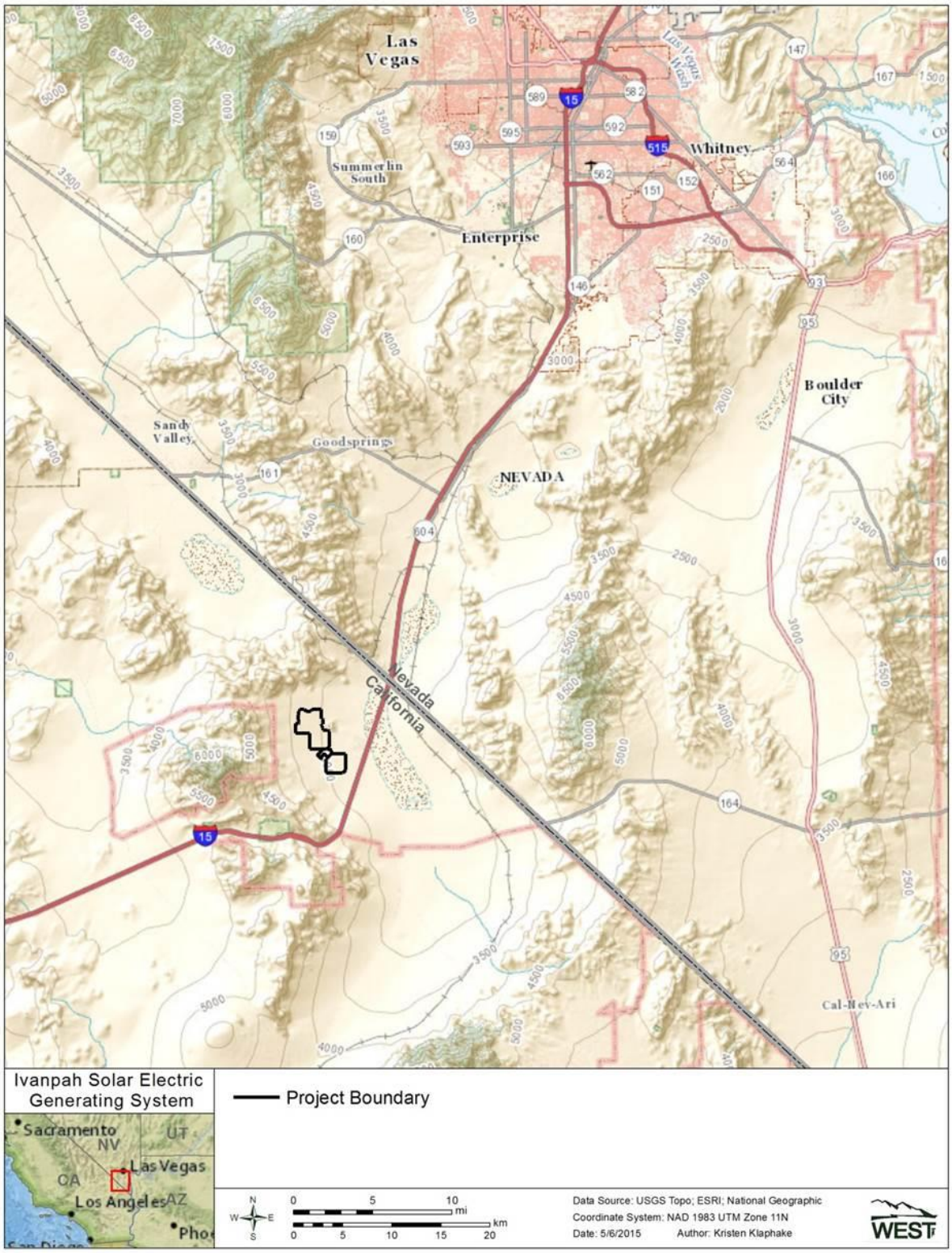

Figure 1. Ivanpah Vicinity Map.

Section 2.0 Methods

The Plan (2015) describes the methods by which monitoring and certain analyses, including compilation of the overall fatality estimate, will occur. Below is an abridged description (see Plan (2015) for detailed methods), with greater detail provided when methods differ from original Plan (2013).

2.1 Facility Monitoring

This section describes areas surveyed, the timing and frequency of the searches, and the methods by which standardized searches were conducted to identify dead/injured birds and bats (hereafter detections) at the Project. This section also describes the methods for conducting carcass removal and searcher efficiency trials; how data were reported and analyzed for incidental detections; and the methods for producing fatality estimates for the Project.

2.1.1 Standardized Searches

2.1.1.1 Areas Surveyed

Per the Plan (2015), monitoring was conducted in the "tower area" and a sample of the "heliostat area". The tower area is defined as the power block (the area consisting of the tower, the ACC unit, the associated control building, and immediately adjacent areas defined by the ring road and berm/slopes surrounding these facilities) and inner high-density (HD) heliostats surrounding each power block. The heliostat area is defined as the inner and outer heliostat segments outside of the inner HD heliostats. For year 3, 100% of the tower area at each unit was surveyed and 20% of the Unit 2 heliostat area (8% of the total heliostat area) was surveyed. Table 1a provides the acreage searched within each of the survey areas, as well as the percent of the facility comprised by these search areas. Overall, approximately 12.9% of the Project was searched (Figure 2).

To ensure a balanced distribution of heliostat field survey plots, Unit 2 was divided into inner and outer heliostat fields, and approximately 20% of each sub-area was randomly selected for monitoring. Arc plots used for monitoring in Unit 2 were the same as previous years. This stratified random sampling design ensures that survey plots will not be clustered or biased in any distance or direction from the tower.

Table 1a. Monitoring Areas, 2016 Spring Season.

Area	Facility Locations Included	Acreage Searched	Percent of Facility
Tower Area	ACC, Power Block, Inner HD	154	4.80%
Heliostat Area	Unit 2 Inner and Outer Heliostat Segments	240	8.09%
Total		394	12.89%

*NA = Not applicable as offsite survey areas are located outside of the facility

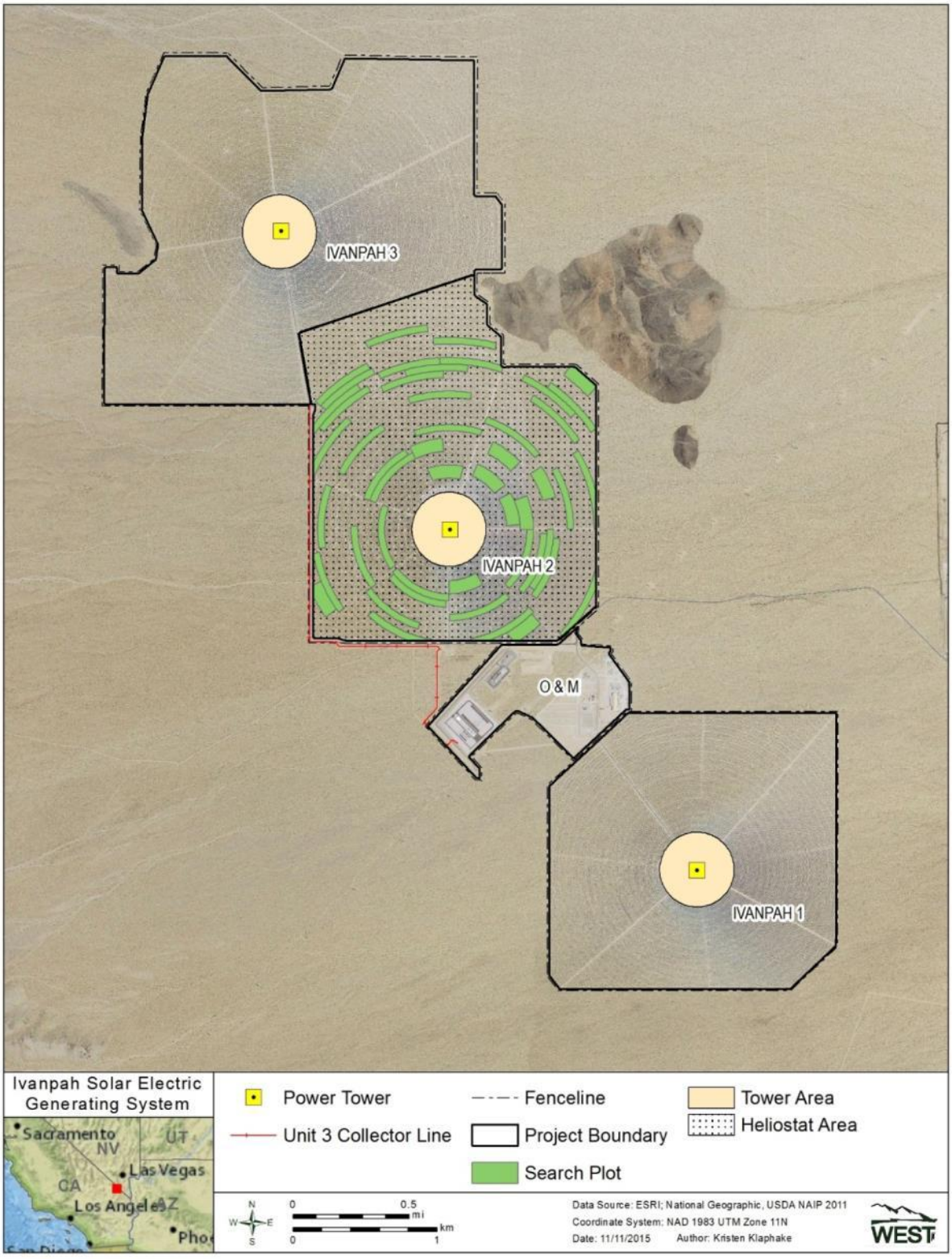

Figure 2. Ivanpah Search Areas.

2.1.1.2 Search Frequency and Timing

Consistent with the first two years of monitoring, standardized searches occurred at each unit on a nominal 21-day interval through the 2016 summer season. Variation in search interval and number of visits to each unit was anticipated to occur due to the transition between 21-day search and 7-day search intervals between seasons of differing length. The tower areas of Units 1, 2 and 3 were visited a total of four times, and the inner and outer heliostat segments of Unit 2 were visited four times.

2.1.1.3 Search Methods

Biologists performed surveys in the tower area, and plots in the heliostat area. Standardized walking surveys for fatalities were performed by biologists approved by CEC and BLM, in accordance with the methods outlined in the Plan (2015). In the heliostat area, a pair of biologists walked a total of four transects oriented longitudinally along the complete length of each arc-plot, with the ring roads serving as the outer boundaries of each arc plot (Figure 3). While walking each transect, biologists walked a narrow search section approximately 10 meters (m) wide. Within the power block, biologists walked through and around the power tower and ACC unit looking for dead and injured birds and bats, and walked transects through the gravel surrounding the structures to achieve 100% coverage within physically accessible areas. Within the inner HD heliostats surrounding each power block, biologists walked transects to ensure 100% coverage. Thus, the tower area, comprising the area within 260 m of each tower, was completely covered during each survey, excepting any areas that were physically inaccessible or unsafe to survey. Inaccessible areas were, to the extent possible, scanned using binoculars.

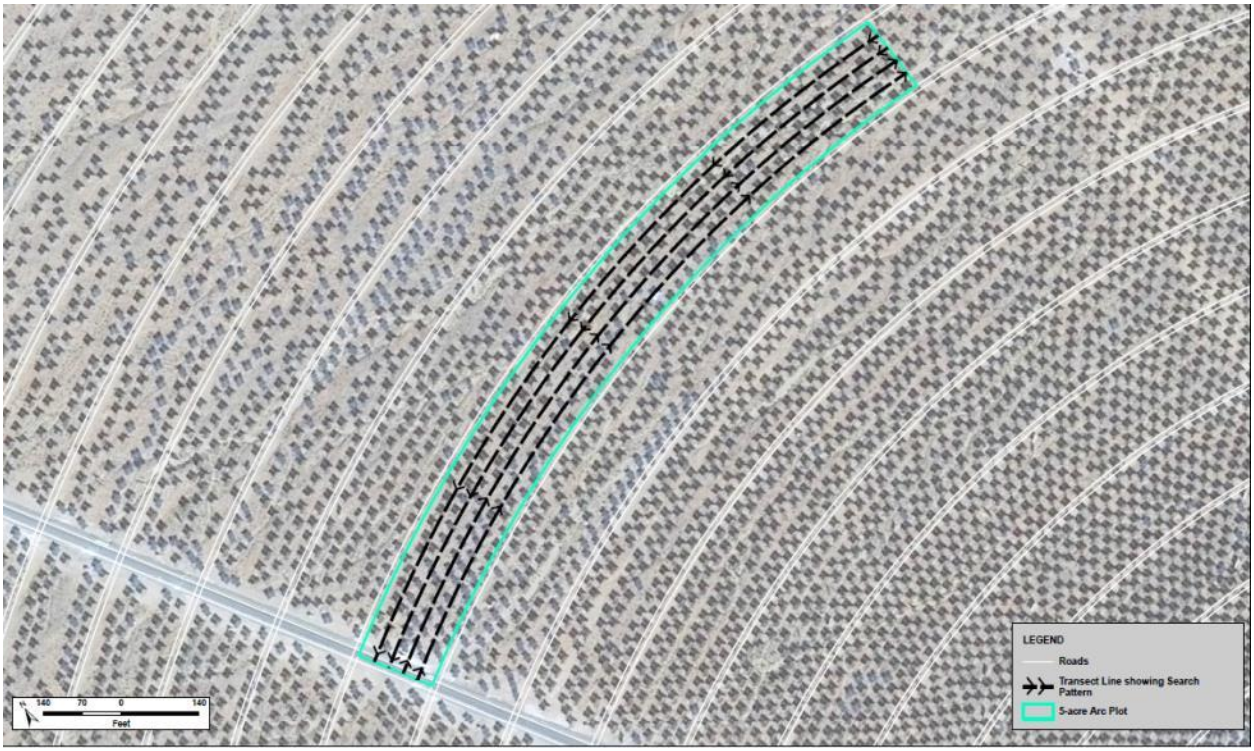

Figure 3. Monitoring Search Pattern for Arc Plots.

Carcass and Feather Spot Examination. Every carcass and feather spot was examined visually by a biologist approved by the CEC and BLM for evidence of singeing or collision. Singeing to feathers can occur when a bird enters the flux around the power tower. When no obvious evidence of singeing or collision were evident to the naked eye, the carcass or feather spot was then examined using an AmScope SE306R-AZ-E2 20X-40X-80X Digital Binocular Stereo Microscope. When singed detections involving carcasses (as opposed to only feather spots) were found, the singeing was assigned a grade based on Kagan et al. (2014), as follows.

- Grade 1 – curling of less than 50% of the flight feathers
- Grade 2 – curling of 50% or more of the flight feathers
- Grade 3 – curling and visible charring of contour feathers

Kagan et al. (2014) originally found no singeing of contour feathers in the absence of curling of 50% or more of the flight feathers. In contrast, we have found singeing of contour feathers with curling of less than 50% of flight feathers, and in the absence of curling or singeing of any flight feathers. We therefore assigned grade 3 independent of grades 1 and 2.

When a carcass was detected, biologists looked for evidence of collision, including obvious physical trauma or detection adjacent to a heliostat with a bird-strike imprint, smudge mark, and/or feathers on or near the surface of the mirror. If there was no evidence of collision or singeing (e.g., charring, curling, or melting of feathers), as confirmed through microscopic examination, the cause of injury or fatality was listed as "unknown".

For the purpose of these surveys, feather spots were considered detections when they met the following definition:

> At least two or more primary flight feathers, 5 or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1-m^2 or smaller (Smallwood 2007), without any bone, beak, or significant amounts of flesh or skin.

In some cases, an individual detection was broken up into aggregations of feathers that would meet the criteria for a feather spot, but with pieces of the carcass that contained bone or significant amounts of flesh or skin also present. In these cases, the detection was categorized as a partial carcass (rather than a feather spot), per the "feather spot" definition above.

2.1.2 Carcass Persistence Trials

Carcass persistence trials were performed throughout the 2016 summer monitoring season. A total of 21 small bird carcass trials were conducted. The TAC approved discontinuing large bird carcass trials at the conclusion of the 2015 summer season due to the consistency of large bird persistence times collected over the previous seasons. In response to the previous TAC request of increased sample size, the number of small bird trials was increased relative to the 2013 summer monitoring season.

The facility contains vegetated and unvegetated areas that could affect the ability to detect a carcass or the amount of time a carcass persists until it is scavenged. The tower area (power block and inner high density (HD) heliostat area, where most singed detections occur, is unvegetated; all other areas are considered vegetated. In order to examine carcass persistence times for vegetated and unvegetated areas, carcasses were also distributed through the facility, with 10 carcasses placed in the unvegetated tower area, and 11 carcasses placed in the vegetated heliostat arrays. Non-native house sparrows (*Passer domesticus*) were used for small carcass trials conducted during the 2016 summer monitoring season. A camera was placed at each carcass to record the time of scavenging and the scavenging species.

2.1.3 Searcher Efficiency Trials

A total of 63 searcher efficiency trials (21 small birds, 21 large birds, and 21 feather spots) were conducted during the 2016 summer monitoring season. Carcasses and feather spots were placed in various vegetation heights and in areas that had different soil and vegetation colors and values to represent the range of conditions under which searches occur. Trials were placed in the tower areas of all three units and in the heliostat area of Unit 2; however, no trials were placed in the ACC building since detection probability is assumed to be 100% in this area of the power block. Each trial carcass was placed by a designated biologist prior to a scheduled search without knowledge of the searchers. For trial carcasses that were not detected by searchers, the designated biologist returned to the trial location to determine if the trial carcass was still available to be found. If the trial carcass was absent, it was assumed to have been removed prior to the search, and thus not available to be detected.

Overall, 36 trial carcasses/feather spots were placed in the tower area and 35 trial carcasses were placed in vegetated areas in the inner/outer segments of the heliostat area. Of the 71 trial carcasses placed, 63 (21 small carcasses, 21 large carcasses, and 21 feather spots) were available to be found; 8 carcasses (4 small carcasses, 3 large carcasses, and 1 feather spot) were removed (scavenged) from the trial location before searchers had an opportunity to find them.

2.1.4 Incidental Reporting

Some detections were made outside standardized search areas, or were within search areas but not during standardized searches. Detections at locations not searched under the Plan (2015) such as the fenceline and heliostat areas of Unit 1 and Unit 3, are considered incidental detections for this report. These detections were reported in accordance with the facility's Wildlife Incident Reporting System (described in Section 3.4 of the Plan) and were considered "incidental" detections. Data on these incidental detections were reported in the SPUT permit database. As described in Section 2.2.5, incidental data could be included in the fatality estimates when they were found in areas covered during standardized surveys (e.g., tower area or heliostat area of Unit 2). Incidental detections from outside the survey areas were not included in the fatality estimates as discussed in Section 2.2.5; however, all detections regardless of the method or source of detection are reported in the SPUT permit database.

2.1.5 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 heliostats versus cleared areas around towers). 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 2010, Korner-Nievergelt 2011). All of these fatality estimation methods share a similar underlying model. Generally, the fatality estimation for a given site may be written as:

$$F=C/rp,$$

where F is the total number of fatalities, C is the number fatalities detected and included in fatality estimation, r is the probability a carcass is available to be found at the end of the search interval, and p is the probability of detecting a carcass (Huso 2010).

The bias correction factors r and p are estimated by covariates that may influence the detectability and persistence of each carcass, such as carcass size, presence of vegetation, and stage of decay or scavenging (i.e., feather spot versus carcass). For this study, the Huso estimator was used to correct for detection and scavenging bias; the estimator was demonstrated to perform well under a variety of conditions (Huso 2010). The Huso model was developed in the context of estimating fatalities for post-construction fatality studies at wind energy facilities; however, the Huso estimator is suitable for other sources of anthropogenic avian mortality, including power lines and utility scale solar facilities (Huso 2010).

All fatality estimates were calculated using the Huso estimator, as well as 90% confidence using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates were used. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates provide estimates of the lower limit and upper limit of an approximate 90% confidence interval on all estimates.

Estimating Carcass Persistence Times. Measurement of carcass persistence time is often subject to censoring. In this context, censoring refers to the fact that a value (e.g., days a carcass is present before being removed) may not be known exactly, but within a finite range. For example, suppose 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 until removal is unknown; however, it is known that the carcass was available to be found for between 7 and 10 days. This carcass would be considered "interval censored". Similarly, if a carcass lasts the entire six-week trial period, that carcass is "right censored"—we know the carcass lasted at least six weeks, but it could have persisted longer. Due to the fact that camera traps (e.g., cameras that automatically document activity at the trial carcass) were used for carcass removal trials, the majority of scavenging times can be known precisely, and data are not censored. However, when cameras fail to record the moment of scavenging, trials are treated as interval censored between the last time the carcass was visible on the camera, and the earliest time at which it was known to be removed.

Survival regressions models are well-suited to accommodate censored carcass persistence data and are typically used to generate the average probability of persistence for fatality estimation (Huso et. al 2012). There are four commonly used distributions implemented in the survival models used to estimate the value of r : exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying

degrees of flexibility in order to model a wide variety of removal time distributions. Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model fit to carcass removal data. The exact time of death for detected fatalities is usually unknown, so the probability of persistence cannot be calculated exactly for each carcass; however, it can be estimated from the selected survival model and bootstrapped to obtain the variation of *r* for the observed detection data.

Estimating Searcher Efficiency. Searcher efficiency, or the proportion of carcasses detected, *p*, is represented most simply by the following equation:

$$p = \frac{Number\ of\ Carcass\ Observed}{Number\ of\ Carcasses\ available}$$

Model Selection for Searcher Efficiency Trials. The Plan states that searcher efficiency trials will be conducted during each season in which vegetation differs from the prior season, because changes in vegetative cover may affect carcass detectability. *A priori* decisions were not made regarding whether vegetative cover would differ between seasons, but rather, searcher efficiency trials were conducted in all season. Following the completion of fall searcher efficiency trials, there was sufficient cumulative data for the year to assess whether searcher efficiency differed significantly by Project area (e.g., unvegetated tower area versus vegetated heliostat fields), season, and/or carcass size. The nearly complete lack of vegetation cover in the tower area suggested that searcher efficiency may be higher in the tower area than in other Project areas. If this hypothesis were true, accounting for this difference in searcher efficiency across Project areas would be important for producing accurate fatality estimates.

To evaluate various hypotheses regarding differences in carcass detectability among Project areas, seasons, and/or carcass size, logistic regression models were fit to searcher efficiency data and corrected Akaike's Information Criteria (AICc) was used to compare models. The Project area was defined using two categories to reflect the suspected differences in searcher efficiency due to differences in vegetation cover: the tower area, which consists of the power block and the inner HD heliostats, and other areas, which consists of all other Project areas not included in the tower area. Models were constructed for all combinations of year, season, carcass size, Project area, and compared to the null model (Table 8). The data for this analysis included all human searcher efficiency trials of carcasses from the beginning of trials in the winter 2013 – 2014 season through the 2016 summer season.

Fatality Estimates. Estimates for the number of detections in the tower area components (i.e., the power block and inner HD heliostats) are reported combined, because 100% of these areas were searched. A separate estimate was produced for the heliostat area of all three Units (the inner and outer heliostat segments combined), in which 8% of the total area was searched. Fatality estimates reported in the inner/outer heliostat areas were adjusted to account for the unsearched area in the inner/outer heliostat areas (i.e., divided by 0.08).

The ACC buildings are only marginally accessible to scavengers from the outside; therefore, they act primarily as a closed system with a scavenging rate that approaches zero. Furthermore, carcasses are, generally, visible against the industrial backgrounds. Thus, the fatalities found in the ACC were not adjusted using the Huso estimator; rather, raw counts of ACC detections were added to fatality estimates for the tower area. All detections within the ACC buildings are considered facility related, whether or not

they showed evidence of singeing or collision; if there was no evidence of singeing or collision on a detection found in the ACC, the cause was assumed to be entrapment in some portion of the ACC unit.

Within the power block, during the 2016 summer season, incidental detections accounted for 42.0% of the detections recorded. Thus, as previously modeled, incidentals found within the power block were included in estimates, but treated differently from other fatalities. To reflect the high human activity in the power block—and frequent observation of the areas within the power block—the search interval for these detections was set to one day (Table 1b).

In previous seasons, incidental detections found outside of the power block but within standardized search areas were partially processed in the field and left in place to give searchers the opportunity to discover the carcass on the next scheduled search. As approved by the TAC, this method was discontinued in the 2015 fall season to prevent the scenario where an incidental detection is recorded, left in place, but scavenged before the next standard search and no carcass is associated with the data. In the 2015 fall season, incidental detections found outside of the power block, but within standardized search areas, were removed from field and included in fatality estimates under the conservative assumption that the search interval was the time between the last search of the area and the time of incidental discovery (Table 1b).

Table 1b. Treatment of Incidental Detections by Location

Location	Search Interval	Included in Analysis?
Power Block	1 Day	Yes, if carcass age is less than 24 hours
All Other Standardized Search Areas	Calculated days between date of detection and date of previous standard search in that location	Yes, if carcass age is less than calculated search interval

All fatality estimators have limitations, particularly when fatality counts are low. In particular, when detections are fewer than five, regardless of survey effort, estimates and confidence intervals can be unstable and must be interpreted with caution (Korner-Nievergelt et. al 2011). Rather than report estimates with little inferential value, no estimates were provided for combinations of covariates (e.g. size, location, cause) resulting in five or fewer detections.

The fatality estimator accounts for imperfect detection probability by using bias trials to estimate searcher efficiency. The Huso estimator is constructed under the assumption that searchers have a single opportunity to discover a carcass. Therefore, if a carcass is missed on the first search it was available, then found on the next search, it will effectively be over-counted. The method typically used to overcome multiple-detection-bias is to exclude any detection determined to be older than the search interval (Huso et. al 2016). Each detection made during the 2016 summer season was evaluated for exclusion from the estimator based on the observed time since death (i.e., the length of time between an animal's death and when the detection was discovered), and the search interval associated with that detection. For example, if a detection determined to have been on the ground for > 1 month was made in the inner HD of Unit 2, which had been searched seven days earlier, that carcass would be excluded from analysis.

Determining the age of a carcass was based on detailed qualitative analysis of every detection (carcasses and feather spots) recovered onsite. Qualitative analysis began with in situ aging analysis in the field by biologists approved by the CEC and BLM, followed by a more detailed analysis in the lab. In the field, biologists noted the presence of rigor mortis, condition of eyes and feathers, and condition of blood or viscera (if present). In the lab, each carcass was further examined and compared to photographs of decomposed test carcasses. The test carcasses were used to document decomposition over time at Ivanpah to better inform biologist of site-specific characteristics of avian decomposition that could be expected at the Project.

Decomposition test carcasses were placed in tamper-proof containers, exposed to onsite environmental conditions, and allowed to decompose. Carcasses used in decomposition tests were placed to account for variation in space (e.g. underneath fans in the ACC unit versus shaded under a heliostat) and time (e.g. ephemeral weather patterns). As the test carcasses aged, the biologists photographed and recorded the condition of body tissue and fluids, eyes, feathers, and indications of rigor mortis. All decomposition specimens were placed during the 2015 spring monitoring season.

To correctly account for searcher efficiency in the fatality estimate model, when partial carcasses are initially identified as feather spots by the observer in the field, they are modeled (in the fatality estimates) as a feather spot. In other words, the primary means of identification of the detection (feather spot, small carcass, or large carcass) is the appropriate classification to utilize in the modeled estimates. The primary identification approach is appropriate since different searcher efficiency rates are estimated for feather spots as opposed to carcasses. Because searcher efficiency is an important component of the fatality estimator, what the surveyors detect first (i.e., feather spot versus a complete or partial carcass) influences how that detection should be included in the model. Such detections are noted in Appendix A as "partial carcass + feather spot" in the "Description of Carcass/Injury" column.

2.2 Deterrence Measures

2.2.1 Avian Measures

Ivanpah commenced an investigation of the use of various deterrence measures to reduce avian mortality at the facility in 2013. These initial investigations combined with the results of the monitoring conducted during 2014 resulted in a list of potential deterrence measures for adaptive management. The list of deterrence measures has been updated, and progress reports towards deterrence implementation have been provided to the TAC on a periodic basis.

Several deterrence measures have been implemented at Unit 1 for birds at Ivanpah. Specifically, new ground-level LED lighting and spikes were installed 5 February 2015. As approved by the TAC, a chemosensory deterrence measure commercially known as BirdBuffer, was deployed on 12 October 2014, and a sonic deterrence measure commercially known as BirdGard, was deployed on 13 March 2015 at Unit 1. Bird Buffer was installed at Unit 2 and Unit 3 on 29 September 2015; BirdGard was installed at Unit 2 on 25 August 2015 and Unit 3 on 31 August 2015. The chemosensory deterrence measure is hypothesized to deter resident species, since the deterrent induces a conditioned response over time, and the sonic deterrence measure is hypothesized to deter transient and migrant species, as the sounds produced by the system are thought to startle and deter subjects. Together, the combination of

BirdBuffer and BirdGard systems are intended to deter avian species from entering this area associated with elevated flux mortality.

2.2.2 Bat Measures

Bat fatalities were detected primarily in the ACC, and as the ACC provides a roosting location, a Binary Acoustic Technology Ultrasonic Bat Deterrence was tested at Unit 3. The bat deterrence measure is not designed to elicit a fear response in bats, but is designed to interfere with the echolocation capabilities of bats. As bats navigate utilizing sonar, the method deployed "jams" the sonar signals and bats species avoid the area as a result of the inherent difficulties to navigate under these conditions. Although bats can adjust echolocation under jamming conditions, the use of broadband ultrasound requires bats to shift frequencies to avoid overlap that interferes with echolocation and therefore deters within the area subject to broadband ultrasound (Arnett, et al, 2013). As a result of the broadband ultrasonic signal and the inherent "jamming" effect, adaptation to the deterrence measure is minimal. The deterrence measure has been installed at all Units, and the installation dates are as follows: 10 September 2014 at Unit 1, 23 April 2015 at Unit 2, and 23 April 2015 at Unit 3. In November 2015, an ultrasonic testing protocol was initiated to ensure proper function of all deterrence units.

Section 3.0 Monitoring Results

3.1 Summary of Avian Detections

The average search interval was 20.4 days (range 5 to 34, median 22 days) during the 2016 summer season for the three solar units. Variation in search interval was anticipated to occur due to the transition between 7-day and 21-day search intervals associated with switching seasons, and several holidays during the summer season.

During the 2016 summer season, a total of 112 avian detections (including injured birds and incidentals) of 27 identified species (Table 2) were recorded. Approximately 65% of detections were songbirds, with 27% being other types of bird; 8% could not be identified to at least a species group. The most numerous detection of an identified species was tree swallow followed by cliff swallow and northern rough-winged swallow. Most detections occurred in the tower area (Figures 4, 5, 6, and 7), where approximately 154 acres were surveyed, representing 100% of the total tower area.

Table 2. Number of Individual Bird Detections, by Species, 2016 Summer Season.

Species	Scientific Name	Injuries	Fatalities	Songbird?
tree swallow	*Tachycineta bicolor*	1	14	Yes
cliff swallow	*Petrochelidon pyrrhonota*	0	11	Yes
northern rough-winged swallow	*Stelgidopteryx serripennis*	0	10	Yes
yellow warbler	*Setophaga petechia*	1	8	Yes
unidentified bird (small)		0	8	Unk
unidentified swallow		0	7	Yes
unidentified hummingbird		0	7	No
black-throated sparrow	*Amphispiza bilineata*	0	4	Yes
costa's hummingbird	*Calypte costae*	0	4	No
lesser nighthawk	*Chordeiles acutipennis*	0	3	No
verdin	*Auriparus flaviceps*	0	2	Yes
macgillivray's warbler	*Geothlypis tolmiei*	0	2	Yes
northern mockingbird	*Mimus polyglottos*	0	2	Yes
lucy's warbler	*Oreothlypis luciae*	0	2	Yes
black-tailed gnatcatcher	*Polioptila melanura*	0	2	Yes
killdeer	*Charadrius vociferous*	0	2	No
rufous hummingbird	*Selasphorus rufus*	0	2	No
greater roadrunner	*Geococcyx californianus*	0	1	No
mourning dove	*Zenaida macroura*	0	1	No
unidentified grebe		0	1	No
house finch	*Haemorhous mexicanus*	0	1	Yes
bullock's oriole	*Icterus bullockii*	0	1	Yes
loggerhead shrike	*Lanius ludovicianus*	0	1	Yes
brown-headed cowbird	*Molothrus ater*	0	1	Yes

Species	Scientific Name	Injuries	Fatalities	Songbird?
orange-crowned warbler	*Oreothlypis celata*	0	1	Yes
lazuli bunting	*Passerina amoena*	0	1	Yes
bank swallow	*Riparia riparia*	0	1	Yes
violet-green swallow	*Tachycineta thalassina*	0	1	Yes
western kingbird	*Tyrannus verticalis*	0	1	Yes
unidentified flycatcher		0	1	Yes
unidentified oriole		0	1	Yes
unidentified sparrow		0	1	Yes
unidentified warbler		0	1	Yes
long-billed curlew	*Numenius americanus*	0	1	No
white-throated swift	*Aeronautes saxatalis*	0	1	No
unidentified bird (unknown size)		0	1	Unk
unidentified large bird		0	1	Unk
Total		2	110	NA

*NA – Not Applicable

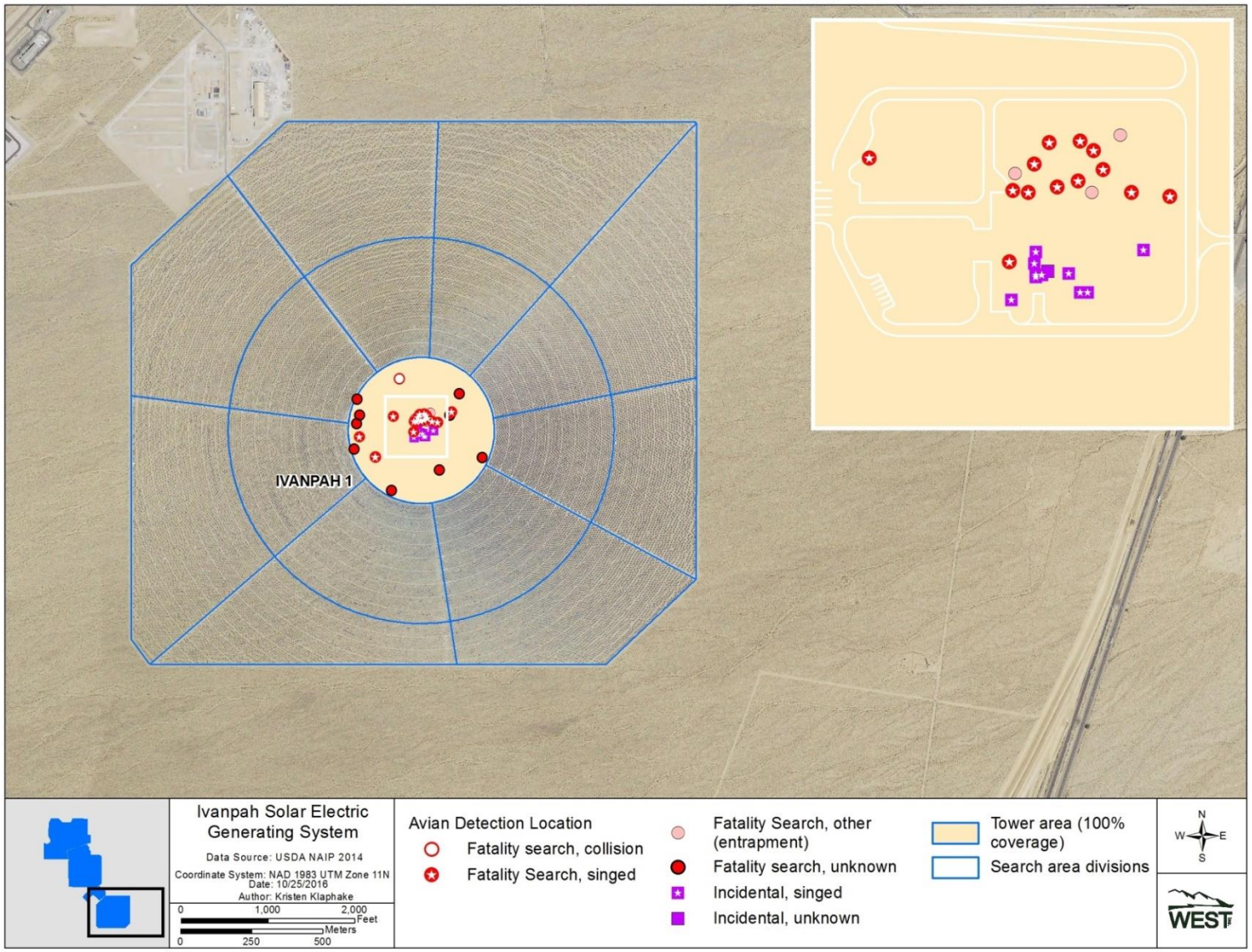

Figure 4. Ivanpah 1 Detections.

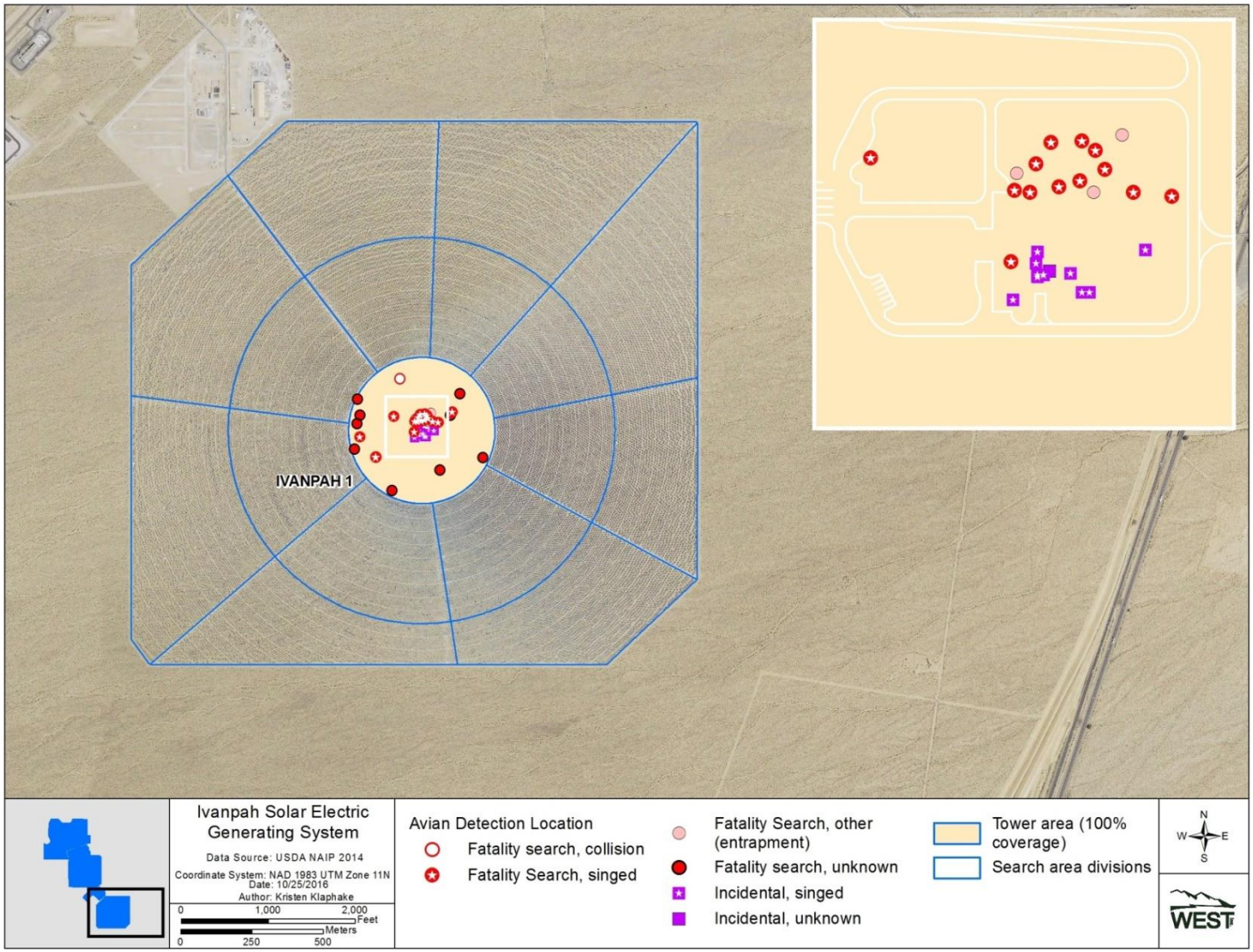

Figure 5. Ivanpah 2 Detections.

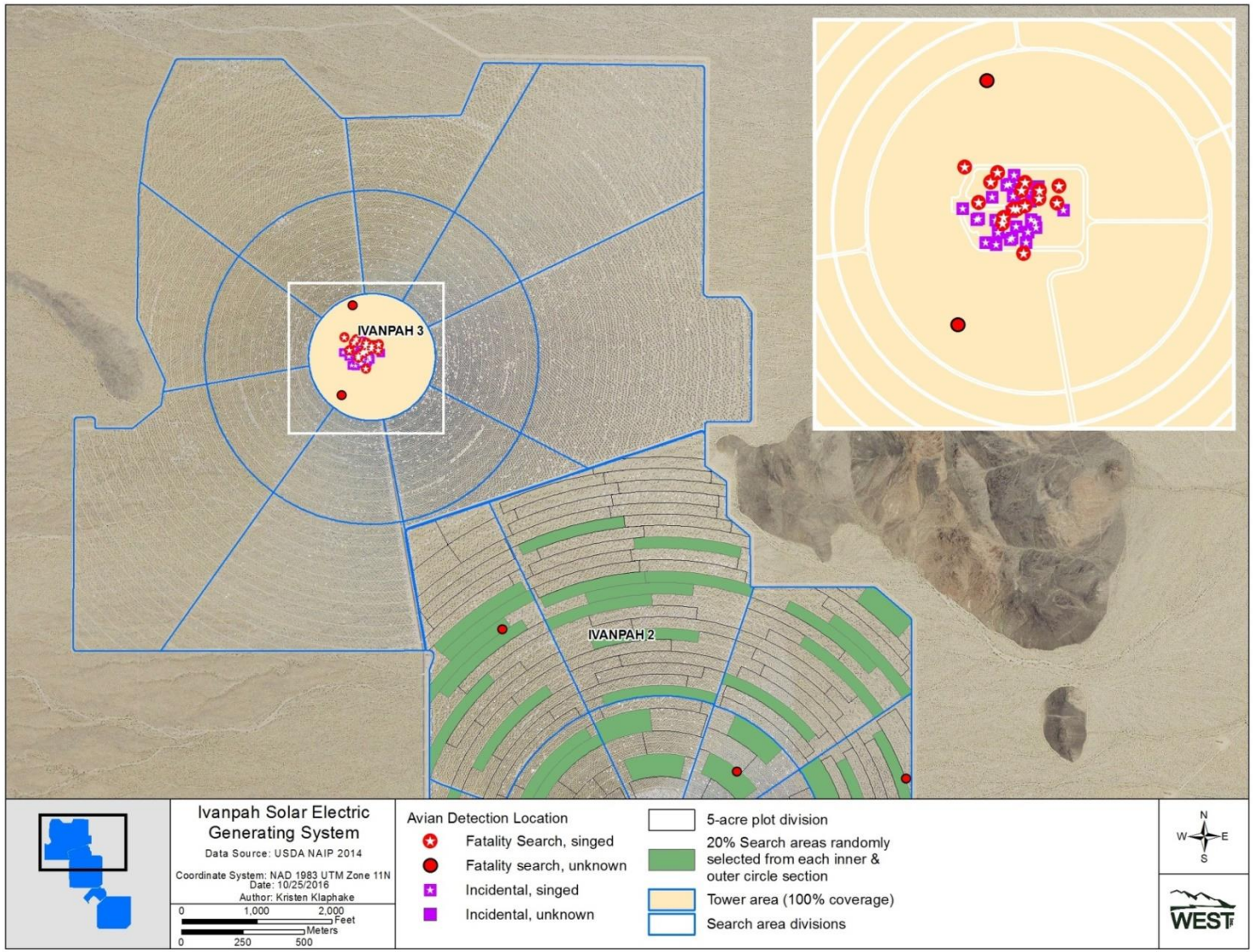

Figure 6. Ivanpah 3 Detections.

3.1.1 Temporal Patterns of Avian Detections

The number of detections reported per day was low throughout the 25 May 2016 – 17 August 2016 summer season (Figure 7). Unplanned forced outages occurred during a portion of the summer monitoring season. Unit 2 was offline from 6 April – 19 June, and Unit 3 was offline from 19 May – 24 June 2016. The patterns in the number of singed detections per day were likely influenced by the unplanned forced outages as only Unit 1 was fully operation though June. The number of detections per day represents the accumulation of detections over the search interval minus those detected incidentally and removed between searches. Peaks in the number of singed detections and overall detections per day relate to the day a tower area was searched.

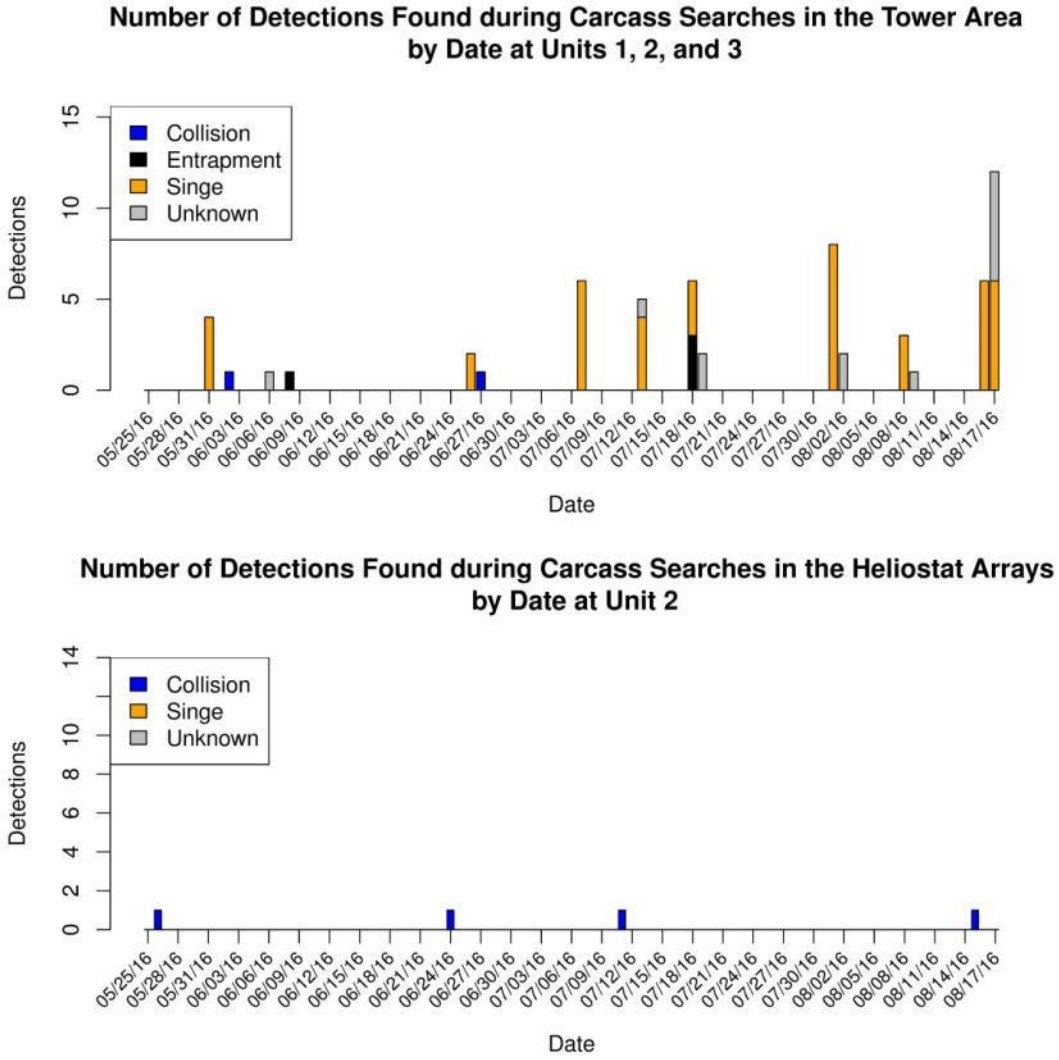

Figure 7. Number of Detections on Each Survey Date, 25 May – 17 August.

Two injured birds were detected during the 2016 summer season (Table 3); both succumbed to their injuries.

Table 3. Avian Injuries Detected 25 May – 17 August 2016.

Date	Species	Age	Sex	Cause of Injury	Flux Grade	Status
7/22/2016	Tree swallow	Adult	Male	Singed	2;3	Died at rehab
8/9/2016	Yellow warbler	Juvenile	Male	Singed	1	Died on-site

3.1.3 Summary of Bat Detections

Three bats representing two species and one unidentified species were detected during the 2016 summer season. A Mexican free-tailed bat and canyon bat were located in the Unit 1 ACC building and the Unit 3 power block, respectively; an unidentified bat was located in the Unit 3 power block. Given the few detections of bats, they are not discussed further.

3.2 Locations of Avian Detections

3.2.1 Detections by Project Area

During summer 2016, of the 112 total detections, 108 detections (96.4%) were recorded at the tower area and 4 detections (3.6%) were recorded over the heliostat area (Table 4). Of the 112 avian detections, 44 (39%) were detected in Unit 1, 21 (19%) in Unit 2, and 47 (42%) in Unit 3.

Table 4. Locations of Avian Detections, 25 May – 17 August 2016.

Location	Carcasses	Injuries	Percent of Total
Tower Area	106	2	96.4%
Heliostat Array	4	0	3.6%
Total	110	2	100.0%

3.3 Cause of Injury or Fatality

The following section describes the number of detections with evidence of singeing or collision; the number from other known causes; the number for which cause of injury or fatality is unknown; and the spatial distributions of detections with these causes. Figure 8 shows the distribution of detections by cause. Percent composition results should not be compared between years because of changes to the study design between the Plan Revision 13 (2012-2014) and Revision 14 (2015-2016).

3.3.1 Singeing Effects

Of the 112 avian detections during the 2016 summer season, 85 detections (75.9%) showed signs of singed feather damage, and 85 (100%) of singed detections were recorded in the tower area (Table 5).

3.3.2 Collisions

Of the 112 avian detections, evidence of collision was observed in the case of 2 (17.4%). Two detections (1.8%) with evidence of collision with heliostats were located in the tower area and 0 detections (0%) were located in the heliostat area. As described in Section 2.2.1.3, the evidence that was used to classify these detections as collisions was obvious physical trauma, proximity to heliostats that had smudge marks, body imprints, and/or feathers on or near the surface of the mirror (although birds that collide with structures do not always leave visible evidence).

3.3.2 Other Cause

Of the 112 avian detections, four (3.6%) were found within the ACC with no evidence of singeing or collision. Thus, consistent with previous cause assignments, these birds were determined to have been entrapped in the ACC, which resulted in fatality.

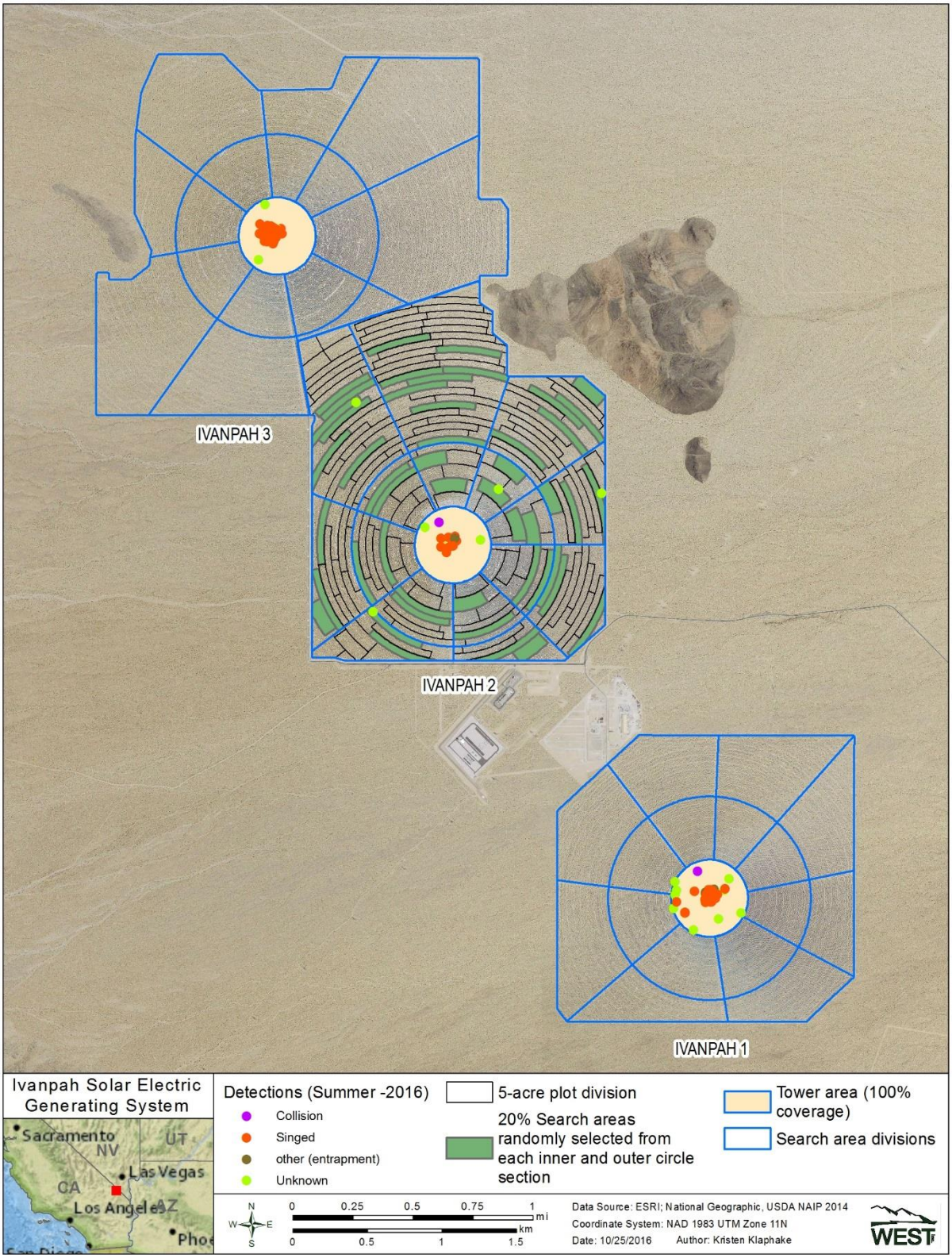

Figure 8. Locations of Singed and Unsinged Detections within Solar Units.

3.3.4 Detections of Unknown Cause

Of the 112 avian detections, evidence of singeing, collision, or other cause could not be assigned for 21 detections (18.8%; Table 5). Per the Plan section 2.1, these detections cannot be presumed with or presumed without a reasonable doubt to be caused by the facility; see Section 6.2 of this report for further discussion. Of the unknown cause detections, 4 (19%) were recorded in the heliostat area, and 17 (81%) were recorded in the tower area.

Table 5. Locations of Bird Detections, 25 May – 17 August 2016.

Location	Singeing	Collision	Other	Unknown	Total
Tower Area	85	2	4*	17	108
Heliostat Area	0	0	0	4	4
Total	85	2	4	21	112

*These carcasses were found in the ACC unit with no sign of collision or singe and are attributed to entrapment.

3.4 Types of Detections

Thirty (26.8%) of the 112 detections consisted only of feather spots (Table 6a). Feather spots accounted for 50% of detections in the heliostats area, and approximately 26% of detections in the tower area. Evidence of singeing was noted through direct and microscopic examination on 14 of these 30 feather spots; evidence of collision (i.e., an impact imprint on a nearby mirror) was noted in the case of two feather spots. Otherwise, the causes of the feather spots for the other 16 detections are unknown (Table 6b).

Table 6a. Percent Composition Feather Spots to Carcasses Relative to Site Locations.

Location	Carcasses	Feather Spot	Total	Percent Feather Spot
Tower Area	80	28	108	25.9%
Heliostat Area	2	2	4	50%
Total	82	30	112	26.8%

Table 6b. Percent Composition Feather Spots to Carcasses Relative to Cause.

Cause	Carcasses	Feather Spots	Total	Percent Feather Spot
Singed	71	14	85	16.5%
Collision	1	1	2	50%
Other	3*	1	4	25%
Unknown	7	14	21	66.7%
Total	82	30	112	26.8%

*These carcasses were found in the ACC unit with no sign of collision or singe and are attributed to entrapment.

Section 4.0 Fatality Estimation

This section utilizes the detection data as described in Section 3 to develop an overall fatality estimate in accordance with the Plan (2015). The total estimate for the entire facility is presented separately for fatalities with evidence of singeing or collision effects, or for detections in the ACC buildings, and fatalities of unknown cause. Following presentation of the total fatality estimates, estimates are provided separately for the tower area, and heliostat area.

4.1 Estimating Model Parameters

4.1.1 Carcass persistence Trials

A total of 20 small bird carcass persistence trials were conducted during the 2016 summer monitoring season. Trials were distributed throughout the facility. Consistent with previous seasons, scavengers included common raven (*Corvus corax*, N=8), desert kit fox (*Vulpes macrotis*; N=8), and white-tailed antelope squirrel (*Ammospermophilus leucurus*; N=2). In four instances the scavenger could not be identified. Small bird carcass persistence ranged from less than one day in the case of 8 carcass to over 42 days; one carcass lasted the full six-week trial period (Figure 9). Large bird carcass persistence trials were discontinued beginning fall 2015 per TAC approval because no seasonal effects were found in previous large bird models and most trial carcasses persisted at least 42 days (Figure 10).

In addition to the 2016 summer trials described above, carcass persistence trials from the first two years of monitoring, and prior seasons (winter and spring) of year 3 were also used in the model. Carcass persistence data from 21 small bird trials conducted during the 2016 spring season, 30 small bird trials conducted during the 2015-2016 winter season, 127 carcass persistence trials conducted during the 2014 - 2015 monitoring year (97 small birds and 30 large birds distributed throughout the facility) and data from 87 trials (57 small birds and 30 large birds distributed throughout the facility) performed during the 2013-2104 monitoring year were used to model carcass persistence time. Details on carcass persistence times can be found in each respective seasonal report.

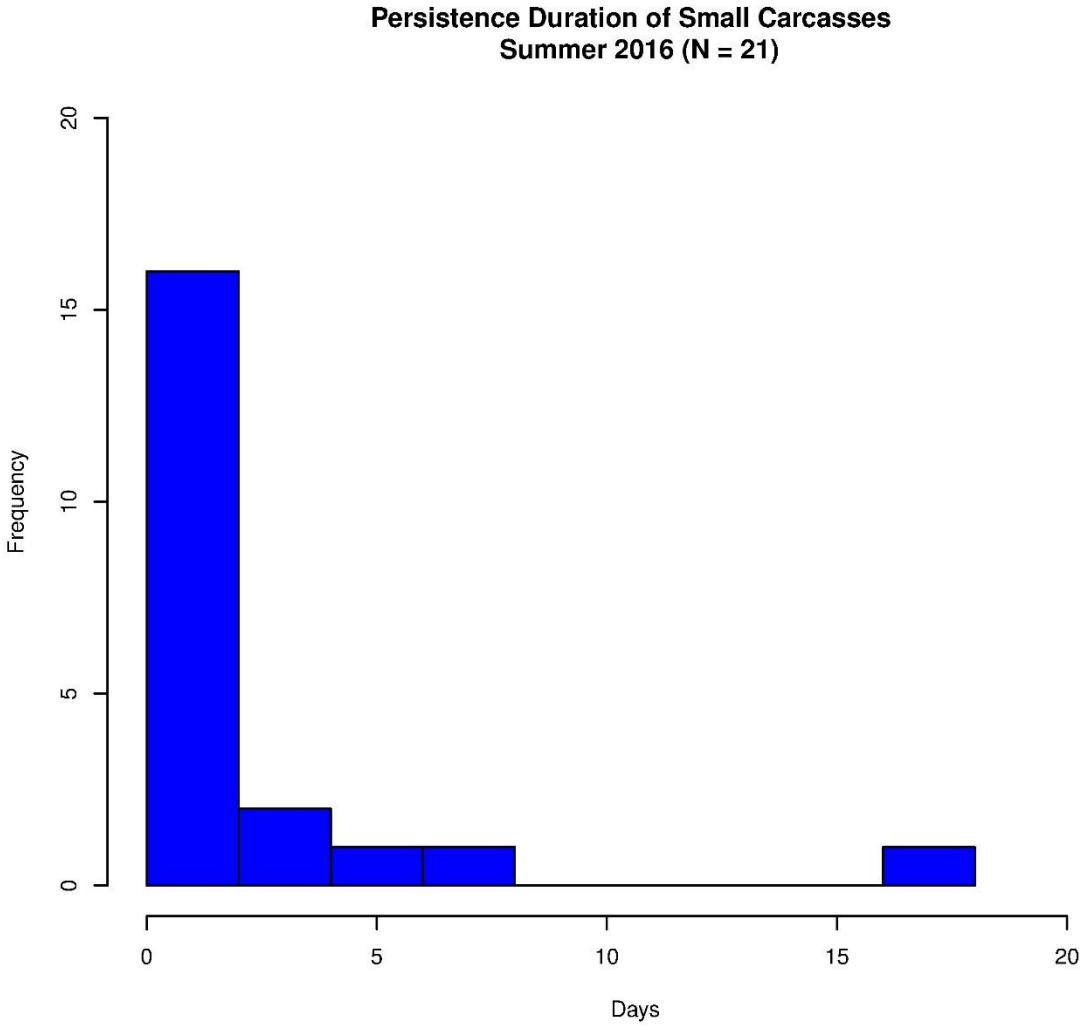

Figure 9. Persistence Durations for Small Carcasses Placed for 2016 Summer Carcass Persistence Trials (N = 21).

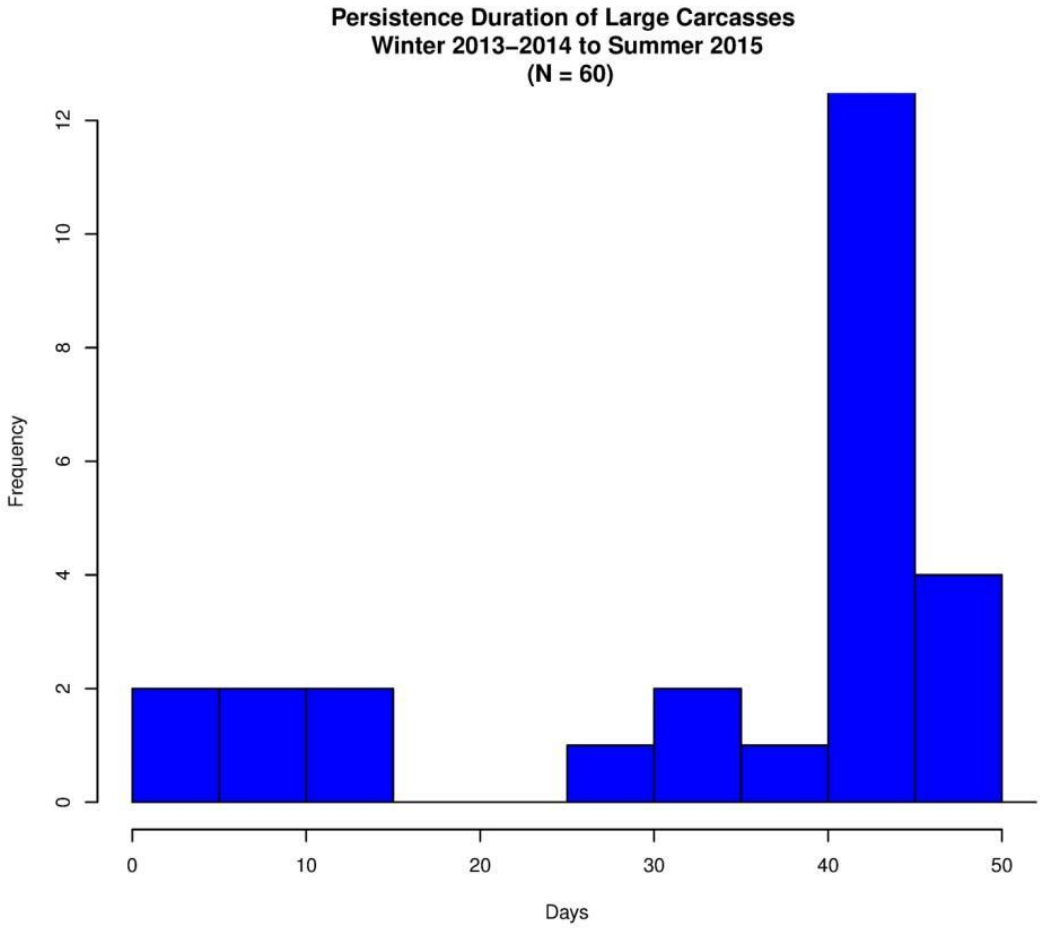

Figure 10. Persistence Durations for Large Carcasses Placed for All Carcass Persistence Trials.

4.1.2 Model Selection for Carcass Persistence Distribution

Consistent with the second year of monitoring and the findings that the removal process for small birds and large birds has been markedly different, two separate carcass persistence models were fit to this dataset: one for small birds and one for large birds. Specifically, large birds consistently persist for long periods of time (typically greater than six weeks), while small birds tend to be removed with days or hours, and exhibit seasonal variability. Fitting separate models by size allows for more flexibility, enabling different distributions with different shapes to be fit to the small bird and large bird data, respectively.

Based on the carcass persistence data from the cumulative trials, 16 survival models were compared for the small bird and large bird datasets, respectively. Models were compared for relative explanatory power using the corrected Akaike information criterion (AICc) score (Akaike 1973), as suggested in Huso (2010). AICc provides a relative measure of model fit and parsimony among a selection of candidate models. Season was considered as a possible covariate due to cyclical variation in scavenging pressure and environmental conditions associated with seasons. Year was also incorporated as a potential covariate to assess whether respective seasons could be pooled across years (i.e. does persistence time vary by season *and* year, just year, just season, or neither). Finally, location (unvegetated tower area or the

vegetated heliostat area) was considered a potential covariate to understand if carcass persistence in the tower area and heliostat area was different.

The model with lowest AICc is typically chosen as the "best-fit" model relative to other models tested; however, any model within two AICc point of the best model is considered strongly supported (Burnham and Anderson 2004). For small birds the loglogistic and lognormal models that included season had ΔAICc values ≤ 2; for large birds, the exponential, Weibull, loglogistic, and lognormal models with intercept only had ΔAICc values ≤ 2 (Tables 7a and 7b). Ultimately, a loglogistic model with season covariate was chosen for small birds, and an exponential model with no covariates was chosen for large birds. Thus, the selected model for small birds can be interpreted to treat as separate the persistence probability for each season, with seasons pooled across years. For large birds, the top model does not have any temporal covariates, and thus uses all large bird data collected to date to estimate persistence probability. The chosen models predicted 96.5% of large carcasses persisted for the nominal search interval (21 days), and 17.7% of small bird carcasses persisted for the nominal search interval of during the 2016 summer monitoring season.

Table 7a. AICc Values for the Top 10 Small Bird Carcass Persistence Models

Small Bird Trials

Covariates	Distribution	AICc	Δ AICc
Season	loglogistic	1162.09	0
Season	lognormal	1164.02	1.93
Season + Project Area	loglogistic	1164.20	2.11
Year + Season	loglogistic	1164.21	2.12
Year + Season	lognormal	1165.95	3.86
Season + Project Area	lognormal	1166.13	4.04
Season + Year + Project Area	loglogistic	1166.24	4.15
Season + Year + Project Area	lognormal	1167.94	5.85
Season + Year + Project Area	Weibull	1168.35	6.26
Year + Season	Weibull	1169.79	7.70

Table 7b. AICc Values for All Large Bird Carcass Persistence Models

Large Bird Trials			
Covariates	Distribution	AICc	Δ AICc
Intercept	Exponential	97.00	0
Intercept	Weibull	97.96	0.96
Intercept	Loglogistic	98.03	1.03
Intercept	Lognormal	98.15	1.15
Season	Exponential	98.34	1.34
Season	Weibull	99.62	2.62
Year + Season	Exponential	99.64	2.64
Season	Loglogistic	99.75	2.75
Season	Lognormal	99.87	2.87
Year + Season	Lognormal	100.68	3.68
Year + Season	Loglogistic	100.98	3.98
Year + Season	Weibull	101.08	4.08
Year + Season + Year*Season	Exponential	107.36	10.36
Year + Season + Year*Season	Lognormal	108.69	11.69
Year + Season + Year*Season	Loglogistic	109.00	12.00
Year + Season + Year*Season	Weibull	109.09	12.09

4.1.3 Searcher Efficiency Trials

During the 2016 summer season, a total of 71 searcher efficiency trials (25 small birds, 24 large birds, and 22 feather spots) were placed. Trials were placed in locations with various vegetation heights and with a range of contrast between the soil and vegetation to represent the various conditions under which searches occur. Carcasses were placed in most areas where searches occurred (tower area and heliostat area). Four small bird trials, 3 large bird trials, and 1 feather spot trial, were removed (scavenged) prior to a searcher having the opportunity to detect the carcass.

A total of 69 searcher efficiency trials (26 small birds, 21 large birds, and 21 feather spots from the spring 2016 season and 83 searcher efficiency trials (33 small birds, 24 large birds, 26 feather spots) from the 2015-2016 winter monitoring seasons were included in the dataset used to fit a searcher efficiency model for the 2016 summer season. An additional 320 human searcher efficiency trials (129 small birds, 96 large birds, and 95 feather spots) from the 2014 - 2015 monitoring year used to fit a searcher efficiency model for the 2016 summer season. Of the 320 trial carcasses placed, 268 (129 small birds, 96 large birds, and 95 feather spots) were available to be found; 52 carcasses (42 small birds, 8 large birds, and 2 feather spots) were removed from the trial location before searchers had an opportunity to detect the carcass. Finally, 154 searcher efficiency trials (52 small birds, 44 large birds, 57 feather spots) from the first year of study were also included in searcher efficiency model building. Of 154 trials from the first year of monitoring, 144 (48 small birds, 39 large birds, and 57 feather spots) were not removed and thus

available to be found by a searcher. Details about searcher efficiency trials performed prior to the 2016 summer season can be found in the respective quarterly reports.

Searcher efficiency rates were generally higher in the unvegetated areas in the tower area. During the 2016 summer season, in unvegetated areas, human searcher efficiency was 78% for small birds, 90% for large birds, and 80% for feather spots. In the vegetated areas in the heliostat arrays, searcher efficiency was 48% for small birds, 71% for large birds, and 52% for feather spots.

Table 8. Covariates, AICc Values, and ΔAICc values for the top ten searcher efficiency models. Data consist of all human searcher efficiency trials for carcasses from the initiation of trials through March 25, 2016.

Covariates	AICc	Δ AICc
Size + Project Area + Year	734.06	0.00
Size + Project Area + Season + Year	734.72	0.66
Size*Project Area + Year	735.26	1.20
Size + Size*Project Area + Year	735.26	1.20
Project Area + Size*Project Area + Year	735.26	1.20
Size + Project Area + Size*Project Area + Year	735.26	1.20
Season + Size*Project Area + Year	735.80	1.74
Size + Season + Size*Project Area + Year	735.80	1.74
Project Area + Season + Size*Project Area + Year	735.80	1.74
Size + Project Area + Season + Size*Project Area + Year	735.80	1.74

The best model for searcher efficiency included carcass size, project area, and year with an AICc value 0.66 points lower than the second best model that included size, project area, season, and year (Table 8). Thus, the most supported searcher efficiency model produces searcher efficiency estimates based on carcass size, project area (unvegetated tower area and vegetated heliostat area), and year. Searcher efficiency values used to adjust detections to calculate a fatality estimate are provided in Table 9 and are based on all searcher efficiency data collected.

Table 9. Human Searcher Efficiency Sample Sizes Used for Modeling, and Model Predictions for Size and Project Area Categories Winter Year 1 – Summer Year 3.

Size	Location	Found	Available	Placed	Predicted Searcher Efficiency (90% CI)
Feather spot	Tower area (Unvegetated)	75	106	110	0.80 (0.74-0.86)
Large bird	Tower area (Unvegetated)	82	95	103	0.90 (0.86-0.94)
Small bird	Tower area (Unvegetated)	78	103	137	0.78 (0.71-0.84)
Feather spot	Heliostat area (Vegetated)	51	110	112	0.52 (0.44-0.61)
Large bird	Heliostat area (Vegetated)	62	96	105	0.71 (0.64-0.79)
Small bird	Heliostat area (Vegetated)	36	100	129	0.48 (0.40-0.57)

4.2 Fatality Estimates of Known Causes for 2016 Summer Monitoring

Fatality estimates were calculated separately for the tower area (power block and inner HD heliostats) and heliostat area. Note that estimates are not provided for factor combinations with five or fewer detections; thus, marginal totals (e.g. total singed, total known cause in the heliostat area, etc.) for the tables below may not reflect the sum of estimates within a given row or column (and are generally higher).

4.3.1 Total Fatality Estimates for Known Causes

There were 91 bird detections where the cause of death or injury could be determined and were facility related, of which 67 were included in the fatality estimate model (Tables 10a and 10b); of these 67 detections, 20 were from the ACC that were added unadjusted to the estimator output, to produce the total fatality estimate of known cause (Tables 11 and 12). There were 24 detections showing evidence of singeing or collision outside the ACC buildings that were not included in the fatality estimates; two were excluded because they were outside the standardized survey areas and 22 were excluded because they were determined to be older than the search interval.

Table 10a. Number of Bird Detections Based on Known Causes in Each Project Element Included or Excluded from Fatality Estimates, by Cause.

	Included			Excluded			
Location	Collision	Singed	Other	Collision	Singed	Other	Total
Tower Area	2	61	4*	0	24	0	91
Total	2	61	4	0	24	0	91

*These carcasses were found in the ACC unit with no sign of collision or singe and are attributed to entrapment.

Table 10b. Number of Bird Detections Based on Known Causes in Each Project Element Included or Excluded from Fatality Estimates, by Carcass Size.

	Included			Excluded			
Location	Large Birds	Small Birds	Raptors*	Large Birds	Small Birds	Raptors*	Total
Tower Area	1	66	0	1	23	0	91
Total	1	66	0	1	23	0	91

* All raptors are considered "Large Birds", therefore the number of raptor detections in a row or column is not added to the total.

Table 11. 2016 Summer Season Avian Fatality Estimates by Cause and Project Element (with Lower and Upper 90% Confidence Intervals) Based on Detections of Known Causes Included in the Model.

Location	Collision	Singed	Other*	Total Known Cause
Tower Area	N ≤ 5	245 (203-309)	4	262 (217-330)
Heliostat Area	0	0	0	0
Total	N ≤ 5	245 (203-309)	4	262 (217-330)

*These carcasses were found in the ACC unit with no sign of collision or singe and are attributed to entrapment.

** N ≤ 5 indicates 5 or fewer detections and no fatality estimate is provided

Table 12. 2016 Spring Season Avian Fatality Estimates by Carcass Size and Project Element (with Lower and Upper 90% Confidence Intervals) Based on Detections of Known Causes Included in the Model.

Location	Large Birds	Small Birds	Raptors	Total
Tower Area	N ≤ 5	258 (216-329)	0	262 (217-330)
Heliostat Area	0	0	0	0
Total	N ≤ 5	258 (216-329)	0	262 (217-330)

* N ≤ 5 indicates 5 or fewer detections and no fatality estimate is provided

4.3.2 Fatality Estimate for Tower Area and Heliostat Area

Tables 11 and 12 present the fatality estimates for known causes within the tower area, broken down by cause or carcass size, respectively. A subset of the incidental detections in the power block were included within the tower area total estimate, due to the assumption of a daily search interval; those incidental detections in the power block which were determined to be older than 24 hours were not included in the fatality estimator. Estimates from the tower area should be interpreted with caution due to the inclusion of numerous incidental discoveries in the power block.

During the period 25 May 2016 – 17 August 2016 (85 days of monitoring), there were an estimated 262 fatalities (90% confidence interval 217-330) based on detections from known causes (i.e., singeing, collision; Table 11). All fatalities of known cause occurred in the tower area. There were 258 estimated small bird fatalities (90% confidence interval 216-329; Table 12).

4.4 Fatality Estimates from Unknown Causes

Per Section 3.1 of the Plan, fatality estimates are also to be provided based on detections of birds that were injured or that died of unknown causes. Because no observable evidence of known causes (i.e., singeing, collision, entrapment, or predation) was noted in the case of these unknown detections, they cannot be clearly included in an estimate attributed to a specific cause. The methods for determining fatality estimates for these unknown detections are the same as those described in Section 5.2 for detections with direct evidence of the cause of the fatality (i.e., singeing, collision, or other).

There were 21 detections where the cause of death could not be determined, of which 29 were included in the fatality estimator (Tables 13a and 13b). Of the 5 detections of unknown cause excluded from the fatality estimator, all detections were determined to be older than the search interval.

Table 13a Number of Detections from Unknown Causes in Each Project Element, and Number Included in Fatality Estimates, by Cause.

Location	Included	Excluded	Total
Tower Area	12	5	17
Heliostat Area	4	0	4
Total	16	5	21

Table 13b. Number of Detections from Unknown Causes in Each Project Element, and Number Included in Fatality Estimates, by Carcass Size.

	Included			Excluded			
Location	Large Birds	Small Birds	Raptors*	Large Birds	Small Birds	Raptors*	Total
Tower Area	4	8	0	0	5	0	17
Heliostat Area	2	2	0	0	0	0	4
Total	6	10	0	0	5	0	21

* All raptors are considered "Large Birds", therefore the number of raptor detections in a row or column is not added to the total.

4.4.1 Total Fatality Estimates from Unknown Causes

During the period of 25 May 2016 – 17 August 2016, the total estimate of fatalities from unknown cause was 319 (90% confidence interval 110-651; Table 14). A total of 71 (90% confidence interval 57-92) were in the tower area. There were only 4 detections of unknown cause in the heliostat area, therefore no estimate is presented; however, the contribution of fatalities is included in the overall unknown cause estimate since there were greater than 5 detections of unknown cause, overall. Of the estimated unknown cause fatalities, small birds accounted for 85% of the estimated fatalities (Table 15).

Table 14. Site-Wide Fatality Estimates from Unknown Causes by Location, 25 May – 17 August.

Project Area	Estimate (90% CI)
Tower Area	71 (57-92)
Heliostat Area	N ≤ 5
Total	319 (110-651)

Table 15. Site-Wide Fatality Estimates from Unknown Causes by Size and Location, 25 May – 17 August 2016.

Location	Large Birds	Small Birds	Raptors	Total
Tower Area	N ≤ 5	65 (52-87)	0	71 (57-92)
Heliostat Area	N ≤ 5	N ≤ 5	0	N ≤ 5
Total	49 (5-108)	270 (66-597)	0	319 (110-651)

* N ≤ 5 indicates 5 or fewer detections and no fatality estimate is provided

4.6 Regional Awareness Monitoring

During the 2016 Summer season, no injured birds were taken to rehab. Neither the facility nor its designated biologist were contacted by any veterinarian or rehab center about singed birds brought in by non-project staff. In addition, Dr. Craig Himmelwright, who performs periodic raven surveys across the Ivanpah Valley has not reported signed detections occurring outside of the Project.

Section 5.0 Discussion

The 2016 summer season represented the continuation of standardized monitoring of avian and bat detections and avian use of the Ivanpah site as revised per the Avian & Bat Monitoring and Management Plan (2015).

5.1 Temporal Patterns in Detections

The number of detections reported per day was low throughout the 2016 summer season. A tower area search during the 2016 summer season is a look back over approximately 21 days, so it would be expected that the tower searches would reflect the accumulation of carcasses over that time span. The patterns in the number of singed detections per day were likely influenced by the unplanned forced outages at Units 2 and 3 until the end of June; from June 24 to the end of the summer period all units were operational.

5.2 Spatial Patterns in Detections and Fatality Estimates

The distribution of known cause detections varied by facility area. No known cause detections were found in the Unit 2 heliostat area. Thus, all known cause detections were found in the tower area.

Unknown cause detections accounted for approximately 18.8% of all detections during the 2016 summer season. Of the unknown cause detections, 66.7% were feather spots or partial carcasses that showed signs of scavenging. Determining a cause of mortality from a feather spot or partial carcass is challenging because sources of mortality such as collision or predation would rarely leave visible evidence on the feathers as would flux effects. Thus, feather spots with an unknown cause of mortality could be encountered anywhere birds occur, and an unknown cause of mortality is not unique to the Project. Further, the large proportion of feather spots among the detections for the Project as a whole may inflate the fatality estimate when unknown cause detections are included based on the potential for multiple feather spots resulting from one fatality, feather spots resulting from predation not associated with the facility, or other causes.

Section 6.0 Framework for Management and Risk Response

According to Section 5.3 of the Plan, migratory bird mortality at Ivanpah is categorized as high, medium, or low to provide an appropriate biological basis for TAC review and decision making, based on the following definitions:

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."

Only limited conclusions can be drawn from the 2016 summer season fatality data owing to the low numbers of detections within "a particular species or group of species"; however, the results indicate that the potential migratory bird mortality by species or groups of species from this project would be categorized as low. A more complete analysis will be conducted for the annual report. Approximately 65% of the detections were songbirds, and in general songbirds are short-lived, have high reproductive output, and their population growth rates are less sensitive to changes in survival rates than to changes in reproductive rates (Stahl and Oli 2006). Therefore, mortality of most songbird species is expected to have negligible effects on population dynamics.

None of the nine species represented by more than three detections is particularly rare locally, regionally, or nationally. Rather, all nine species are relatively abundant and widespread. Thus, the magnitude of detections of these species at Ivanpah during the 2016 fall season does not rise above the "low" category. Special-status species recorded as detections were nine yellow warbler (California species of special concern) and one crissal thrasher (California species of special concern).

Yellow warblers are one of the most abundant warblers in North America and occur as both migrants and summer residents in California (Shuford and Gardali 2008). Yellow warblers occur in the Mojave Desert as common migrants, but they typically do not breed there and thus, there is no local population for evaluation. An estimated 600,000 yellow warblers occur regionally within California and an estimated 34,000,000 occur nationally in the United States (Partners in Flight Science Committee 2013). The nine yellow warblers detected represented a very small proportion of these populations; thus, the estimated yellow warbler fatalities during the 2016 summer season does not rise above the "low" category, as loss of this magnitude would have a minimal effect on populations at all geographic scales (local, regional, national or global).

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Appendix A. Individual Avian Detections.

USFWS #	Common Name	Species Code	How Found	Detection Date	Collection Date	Condition	Time Since Death/Injury	Description of Carcass/Injury	Cause of Death/Injury	Burn Grade	Unit	Nearest Project Feature	UTM Coordinates	SPUT Revisions
2016_189_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	5/26/2016	5/26/2016	Broken up	3-6 days	Broken up. Partial right wing with connective tissue at the base. No evidence of singe.	Unknown	NA	2	Heliostat	639651, 3936194	NA
2016_190_ISGES	Unknown Small Bird	UNID	Carcass Survey	5/31/2016	5/31/2016	Mummified	2 weeks	Mummified broken up carcass consisting of whole bird minus head. Evidence of singe to entire body with wings and tail singed off.	Scorched or singed	3-Feb	3	ACC Building	637454, 3937968	NA
2016_191_ISEGS	Unknown Warbler	UNWA	Carcass Survey	5/31/2016	5/31/2016	Broken up	2 weeks	Exposed skeleton including rib cage, skull, neck and legs with most of flight feathers attached to wings, 2 secondaries, 5 loose primaries, and 84 body feathers. Evidence of curling to primaries and secondaries in both wings.	Scorched or singed	2	3	Powerblock	637442, 3937928	NA
2016_192_ISEGS	Cliff Swallow	CLSW	Carcass Survey	5/31/2016	5/31/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass, missing leg. Evidence of curling and singeing to all flight feathers.	Scorched or singed	3-Feb	1	ACC Building	640396, 3933533	NA
2016_193_ISEGS	Orange-crowned Warbler	OCWA	Carcass Survey	5/31/2016	5/31/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling on flight feathers in both wings and in retrices, singeing on head, nape, back, and right flank.	Scorched or singed	3-Feb	1	Powerblock	640431, 3933519	NA
2016_194_ISEGS	MacGillivray's Warbler	MGWA	Carcass Survey	6/2/2016	6/2/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. Evidence of probable collision with placement of fresh carcass in proximity of heliostat.	Collision with solar panel/heliostat	Unk	2	Heliostat	638564, 3936002	NA
2016_195_ISEGS	Unknown Grebe	UNGR	Carcass Survey	6/6/2016	6/6/2016	Feather spot	3-6 days	Feather spot size large, consisting of 3 secondaries, 50+ body feathers. No evidence of collision or singe.	Unknown	NA	1	Heliostat	640587, 3933395	NA
2016_196_ISEGS	Unknown Large Bird	UNLB	Carcass Survey	6/8/2016	6/8/2016	Broken up	2 weeks	Broken up carcass consisting (originally) of a pellet comprised of 200 contour feathers and 5 pieces of bone. No evidence of singe or collision.	Unknown	Unk	2	ACC Building	638667, 3935895	NA
2016_197_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/24/2016	6/24/2016	Broken up	2 weeks	Broken up carcass consisting of a partial left wing with dried flesh and 5 clumps of body feathers comprising of 120 feathers. No evidence of collision or singe.	Unknown	Unk	2	Heliostat	638962, 3936223	NA
2016_198_ISEGS	Cliff Swallow	CLSW	Incidental	6/24/2016	6/24/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to all major flight feathers, singeing present	Scorched or singed	3-Feb	3	Powerblock	637459, 3937894	NA

								on head, back, and rump.						
2016_199_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	6/26/2016	6/26/2016	Mummified	2 weeks	Whole Carcass. All flight feathers curled or singed off. Singe present on over 90% of carcass	Scorched or singed	3-Feb	1	ACC Building	640411, 3933521	NA
2016_200_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	6/26/2016	6/26/2016	Broken up	2 weeks	Broken up (detached head). Primaries, Secondaries and retricies curled. Singe present on head and neck.	Scorched or singed	3-Feb	1	ACC Building	640360, 3933536	NA
2016_201_ISEGS	Unknown Small Bird	UNID	Carcass Survey	6/27/2016	6/27/2016	Feather spot	0-8 hours	Featherspot size large comprised of 50+ crown/body feathers. All feather stuck to mirror with visible imprint indicating a collision.	Collision with solar panel/heliostat	NA	1	Heliostat	640296, 3933673	NA
2016_202_ISEGS	Black-tailed Gnatcatcher	BTGN	Carcass Survey	7/7/2016	7/7/2016	Mummified	2 weeks	Whole carcass with all tail feathers showing signs of singe.	Scorched or singed	1	3	ACC Building	637449, 3937956	NA
2016_203_ISEGS	Verdin	VERD	Carcass Survey	7/7/2016	7/7/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Primaries, secondaries, retrices curled. Most of upperparts singed.	Scorched or singed	3-Feb	3	Powerblock	637454, 3937933	NA
2016_204_ISEGS	Unknown Swallow	UNSW	Carcass Survey	7/7/2016	7/7/2016	Feather spot	3-6 days	Featherspot size small comprised of 3 primaries and 10+ body feathers. 1 primary curled, 2 singed and several singed body feathers.	Scorched or singed	Unk	3	Powerblock	637437, 3937928	NA
2016_205_ISEGS	Tree Swallow	TRES	Carcass Survey	7/7/2016	7/7/2016	Mummified	2 weeks	Whole Carcass, four primaries curled the majority of all other flight feathers singed. Singe also present on both sides of face.	Scorched or singed	3-Feb	3	Powerblock	637422, 3937916	NA
2016_206_ISEGS	Costa's Hummingbird	COHU	Carcass Survey	7/7/2016	7/7/2016	Dead, fresh (eyes moist)	0-8 hours	Whole Carcass, Tail feathers partially curled. Singe present on nape, back and rump.	Scorched or singed	3-Jan	3	Powerblock	637475, 3937944	NA
2016_207_ISEGS	Costa's Hummingbird	COHU	Carcass Survey	7/7/2016	7/7/2016	Mummified	2 weeks	Whole carcass, Retricies and throat singed.	Scorched or singed	1	3	Powerblock	637403, 3937969	NA
2016_208_ISEGS	Long-billed Curlew	LBCU	Carcass Survey	7/11/2016	7/11/2016	Broken up	3-6 days	Broken up carcass consisting of partial right wing, 9 primaries, 6 secondaries, and 35 contour feathers. No evidence of collision or singe.	Unknown	NA	2	Heliostat	638122, 3935403	NA
2016_209_ISEGS	Black-Throated Sparrow	BTSP	Incidental	7/12/2016	7/12/2016	Mummified	3-6 days	Whole carcass. Evidence of curling to all flight feathers, with the majority of the upperparts of breast singed.	Scorched or singed	3-Feb	3	Powerblock	638656, 3935877	NA
2016_210_ISEGS	Black-tailed Gnatcatcher	BTGN	Incidental	7/12/2016	7/12/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to flight feathers on	Scorched or singed	3-Feb	1	Powerblock	640378, 3933479	NA

								left wing and in tail, singeing to head, neck, chest, and belly.						
2016_211_ISEGS	Unknown Hummingbird	UNHU	Incidental	7/12/2016	7/12/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of singe on rump, flanks, and entire ventral portion of body, with majority of flight feathers singed off.	Scorched or singed	3-Feb	1	Powerblock	640384, 3933469	NA
2016_212_ISEGS	Rufous Hummingbird	RUHU	Incidental	7/12/2016	7/12/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of singe on several retrices.	Scorched or singed	2	1	Powerblock	640388, 3933469	NA
2016_213_ISEGS	Unknown Hummingbird	UNHU	Incidental	7/12/2016	7/12/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to all flight feathers, singeing to majority of upperparts, right side of head and right side of body.	Scorched or singed	3-Feb	1	Powerblock	640348, 3933465	NA
2016_214_ISEGS	Lucy's Warbler	LUWA	Carcass Survey	7/13/2016	7/13/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass with singe on primaries, secondaries, and retrices curled/singed off. Part of cap, back, rump singed.	Scorched or singed	3-Feb	2	ACC Building	638669, 3935881	NA
2016_215_ISEGS	Unknown Small Bird	UNID	Carcass Survey	7/13/2016	7/13/2016	Feather spot	2 weeks	Feather spot size large, consisting of 14 secondaries, 14 primaries, and 75 body feathers. Evidence of singe on the tips of primaries and secondaries.	Scorched or singed	Unk	2	Powerblock	638679, 3935877	NA
2016_216_ISEGS	White-throated Swift	WTSW	Carcass Survey	7/13/2016	7/13/2016	Broken up	3-6 days	Feather spot size = large. With intact flesh. 8 primaries, 4 secondaries, 1 retrix, 8+ contour, 4 wing coverts. Singe on majority of collected feathers.	Scorched or singed	Unk	2	Powerblock	638658, 3935845	NA
2016_217_ISEGS	Lesser Nighthawk	LENI	Carcass Survey	7/13/2016	7/13/2016	Feather spot	2 weeks	Feather spot size = large. 3 primaries, 3 retrices, 2 secondaries, 1 tertial, 100+ body feathers. No singe.	Unknown	Unk	2	Heliostat	638469, 3935966	NA
2016_218_ISEGS	Rufous Hummingbird	RUHU	Carcass Survey	7/13/2016	7/13/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass with singe on right side of face, partial retrices (singed, not curled)	Scorched or singed	3-Jan	2	Powerblock	638575, 3935838	NA
2016_219_ISEGS	Tree Swallow	TRES	Incidental	7/13/2016	7/13/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to primaries, secondaries, retrices, and wing coverts, singeing to top of head and left side of face.	Scorched or singed	3-Feb	3	Powerblock	637431, 3937966	NA
2016_220_ISEGS	Cliff Swallow	CLSW	Incidental	7/14/2016	7/14/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling to primaries, secondaries, retrices, and head, face, nape, back, rump, and throat.	Scorched or singed	3-Feb	3	Powerblock	637361, 3937929	NA
2016_221_ISEGS	Tree Swallow	TRES	Incidental	7/15/2016	7/15/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling to both wings and tail, singeing to top of head.	Scorched or singed	3-Jan	3	Powerblock	637395, 3937878	NA

2016_222_ISEGS	Cliff Swallow	CLSW	Incidental	7/15/2016	7/15/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling to primaries, secondaries; singeing to rump, back, and top of head.	Scorched or singed	3-Feb	3	Powerblock	637427, 3937964	NA
2016_223_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/15/2016	7/15/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of slight singeing on tips of primaries.	Scorched or singed	1	3	Powerblock	637512, 3937927	NA
2016_224_ISEGS	Unknown Hummingbird	UNHU	Incidental	7/15/2016	7/15/2016	Broken up	3-6 days	Broken up carcass consisting of all pieces of body and ran over by a vehicle. Evidence of singe on tips of primaries.	Scorched or singed	1	3	Powerblock	637411, 3937875	NA
2016_225_ISEGS	Cliff Swallow	CLSW	Carcass Survey	7/18/2016	7/18/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. No evidence of collision or singe.	Unknown	Unk	1	ACC Building	640390, 3933521	NA
2016_226_ISEGS	Bank Swallow	BANS	Carcass Survey	7/18/2016	7/18/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to primaries, secondaries, coverts in wings, tail singed off, singeing to lower left flank.	Scorched or singed	3-Feb	1	ACC Building	640383, 3933527	NA
2016_227_ISEGS	Cliff Swallow	CLSW	Carcass Survey	7/18/2016	7/18/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. No evidence of collision or singe.	Unknown	Unk	1	ACC Building	640350, 3933531	NA
2016_228_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	7/18/2016	7/18/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to primaries, secondaries in both wings, tail singed off, singeing to both sides of face, rump, right and left lower flanks.	Scorched or singed	3-Feb	1	ACC Building	640384, 3933548	NA
2016_229_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	7/18/2016	7/19/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. No evidence of singe or collision.	Unknown	Unk	1	ACC Building	640405, 3933551	NA
2016_230_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	7/18/2016	7/18/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of singeing to every feature of carcass, with wings and tail feathers singed off.	Scorched or singed	3-Feb	1	Powerblock	640347, 3933485	NA
2016_231_ISEGS	Tree Swallow	TRES	Incidental	7/18/2016	7/18/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to retrices and along wings coverts, singe on left side of rump and nape.	Scorched or singed	3-Jan	3	Powerblock	637458, 3937955	NA
2016_232_ISEGS	Costa's Hummingbird	COHU	Incidental	7/18/2016	7/18/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to both wings and in tail, sineging to right side of face, right flank, and rump.	Scorched or singed	3-Feb	3	Powerblock	637469, 3937909	NA
2016_233_ISEGS	Tree Swallow	TRES	Incidental	7/18/2016	7/18/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to primaries and coverts in both wings, singeing to tail and left upper back.	Scorched or singed	3-Jan	3	Powerblock	637435, 3937885	NA
2016_234_ISEGS	Loggerhead Shrike	LOSH	Carcass Survey	7/19/2016	7/19/2016	Feather spot	2 days	Feather spot size = large. 7 retrices, 12 remiges found in 2 clumps. No singe	Unknown	NA	1	Heliostat	640136, 3933425	NA

2016_235_ISEGS	Unknown Swallow	UNSW	Carcass Survey	7/19/2016	7/19/2016	Broken up	3-6 days	Feather spot size = small. Partial right wing (outer primaries) with flesh at base, holding primaries together. No singe.	Unknown	NA	1	Heliostat	640437, 3933352	NA
2016_236_ISEGS	Black-Throated Sparrow	BTSP	Incidental	7/21/2016	8/2/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole bird. Evidence of curling to all tail feathers, singeing to primaries and belly.	Scorched or singed	3-Jan	2	Powerblock	638651, 3935846	NA
2016_237_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/21/2016	7/21/2016	Broken up	2 days	Broken up carcass consisting of partial right wing, 4 primaries connected by dried tissue. Evidence of singeing to primaries, secondaries and coverts in both pieces of wings.	Scorched or singed	1	2	Powerblock	638626, 3935901	NA
2016_238_ISEGS	Costa's Hummingbird	COHU	Incidental	7/21/2016	7/21/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to several outer retrices, singeing to lower right flank and right side of face.	Scorched or singed	3-Jan	2	Powerblock	638613, 3935801	NA
2016_239_ISEGS	Tree Swallow	TRES	Incidental	7/22/2016	7/22/2016	alive, injured	0-8 hours	Alive when collected with singe present of right side of face. Curling and Singeing present on primaries, secondaries and retricies. Died in office of injuries later the same day of injuries.	Scorched or singed	3-Feb	2	Powerblock	638627, 3935833	NA
2016_240_ISEGS	Bullok's Oriole	BUOR	Incidental	7/25/2016	7/25/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass, Primaries and secondaries on right wing curled. Head and left side singed.	Scorched or singed	3-Feb	3	Powerblock	637456, 3937878	NA
2016_241_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/25/2016	7/25/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass with no evidence of singe or collision.	Unknown	NA	3	Powerblock	637474, 3937961	NA
2016_242_ISEGS	Cliff Swallow	CLSW	Incidental	7/25/2016	7/25/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. All primaries, secondaries and tail feathers curled. Sides, back, head and underparts singed.	Scorched or singed	3-Feb	3	Powerblock	637438, 3937979	NA
2016_243_ISEGS	Tree Swallow	TRES	Incidental	7/25/2016	7/25/2016	Mummified	2 weeks	Whole carcass, all secondaries, 80% of retricies and 60% of primaries curled. Rump and left side of head show signs of singeing.	Scorched or singed	3-Feb	3	Powerblock	637436, 3937948	NA
2016_244_ISEGS	Verdin	VERD	Incidental	7/25/2016	7/25/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Retricies and primary flight feathers curled. Back feathers singed.	Scorched or singed	3-Feb	3	Powerblock	637414, 3937905	NA
2016_245_ISEGS	Tree Swallow	TRES	Incidental	7/25/2016	7/25/2016	Mummified	2 weeks	Whole carcass, with all flight feathers curled or singed off. All parts on upperside of body show signs of singe.	Scorched or singed	3-Feb	3	Powerblock	637414, 3937893	NA

2016_246_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/25/2016	7/25/2016	Mummified	2 weeks	Whole carcass. All flight feathers curled or singed off. Singeing on the right and left side of body. Left side of face is singed.	Scorched or singed	3-Feb	3	Powerblock	637471, 3937901	NA
2016_247_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/25/2016	7/25/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Singeing present on primaries, secondaries and retricies. Left & Right Side of body singed	Scorched or singed	3-Feb	2	Powerblock	638653, 3935852	NA
2016_248_ISEGS	Unknown Hummingbird	UNHU	Incidental	7/28/2016	7/28/2016	Broken up	3-6 days	Broken up carcass. Mostly intact but head is detached from body. Tail feathers curled. Rump and secondaries singed.	Scorched or singed	1	3	Powerblock	637432, 3937883	NA
2016_249_ISEGS	Unknown Swallow	UNSW	Incidental	7/28/2016	7/28/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole Carcass. All primaries & secondaries curled. Head, upperparts and underparts singed. Tail singed off.	Scorched or singed	3-Feb	3	Powerblock	637434, 3937925	NA
2016_250_ISEGS	Tree Swallow	TRES	Incidental	7/29/2016	7/29/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of singe on primary 9 of left wing.	Scorched or singed	1	3	Powerblock	637385, 3937914	NA
2016_251_ISEGS	Violet-green Swallow	VGSW	Carcass Survey	8/1/2016	8/1/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of singeing to ends of primaries and tail.	Scorched or singed	1	3	Powerblock	637421, 3937907	NA
2016_252_ISEGS	Cliff Swallow	CLSW	Carcass Survey	8/1/2016	8/1/2016	Broken up	2 weeks	Body cavity and head with right wing attached. Evidence of curling to primaries and secondaries on wing, singeing to head and left side of body.	Scorched or singed	3-Feb	3	Powerblock	637385, 3937938	NA
2016_253_ISEGS	Yellow Warbler	YWAR	Carcass Survey	8/1/2016	8/1/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of singe on left side of nape.	Scorched or singed	1	3	Powerblock	637413, 3937983	NA
2016_254_ISEGS	Unknown Oriole	UNOR	Carcass Survey	8/1/2016	8/1/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to primaries, secondaries, and in retrices, singeing to top of head.	Scorched or singed	3-Jan	3	Powerblock	637502, 3937937	NA
2016_255_ISEGS	Unknown Swallow	UNSW	Carcass Survey	8/1/2016	8/1/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. Evidence of curling to all flight feathers in both wings and in tail, singe to rump, upper back, and nape.	Scorched or singed	3-Feb	3	ACC Building	637476, 3937956	NA
2016_256_ISEGS	Cliff Swallow	CLSW	Carcass Survey	8/1/2016	8/1/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. Evidence of curling to several tertials in right wing.	Scorched or singed	1	3	ACC Building	637505, 3937963	NA
2016_257_ISEGS	House Finch	HOFI	Carcass Survey	8/1/2016	8/1/2016	Broken up	2 weeks	2 partial wings with the keel attached to the right wing. Evidence of curling present in flight feathers in both wings.	Scorched or singed	NA	3	Powerblock	637452, 3937862	NA
2016_258_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	8/1/2016	8/1/2016	Mummified	2 weeks	Whole carcass. Evidence of curling to primaries, secondaries, and in tail, singe present in top of	Scorched or singed	3-Feb	3	Powerblock	637364, 3937991	NA

								head and upperparts.						
2016_259_ISEGS	Unknown Swallow	UNSW	Carcass Survey	8/2/2016	8/2/2016	Broken up	2 weeks	Broken up carcass consisting of 4 primaries held together by a piece of dried flesh, 10 individual primaries, 12 secondaries, and 5 body feathers. No evidence of collision or singe.	Unknown	NA	3	Heliostat	637397, 3938121	NA
2016_260_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	8/2/2016	8/2/2016	Broken up	3-6 days	Broken up carcass consisting of 3 primaries and 4 secondaries held together by flesh, 6 individual primaries, 7 secondaries, and 3 tertials. No evidence of singe or collision.	Unknown	NA	3	Heliostat	637353, 3937755	NA
2016_261_ISEGS	Cliff Swallow	CLSW	Incidental	8/3/2016	8/3/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. No evidence of singe or collision.	Unknown	Unk	2	Powerblock	638584, 3935887	NA
2016_262_ISEGS	Cliff Swallow	CLSW	Carcass Survey	8/8/2016	8/8/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. All flight and tail feathers curled. Head, dorsal, and breast singed.	Scorched or singed	3-Feb	2	Powerblock	638663, 3935864	NA
2016_263_ISEGS	Lucy's Warbler	LUWA	Carcass Survey	8/8/2016	8/8/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. All flight feathers (excepting one right wing primary) singed to point of severe damage. Head, flanks, rump with singe.	Scorched or singed	3-Feb	2	ACC Building	638671, 3935907	NA
2016_264_ISEGS	Tree Swallow	TRES	Carcass Survey	8/8/2016	8/8/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. All primaries, secondaries, and tail feathers curled and singed. Rump, and flanks, and top of head with singe.	Scorched or singed	3-Feb	2	Powerblock	638575, 3935893	NA
2016_265_ISEGS	Unknown Bird	UNBD	Carcass Survey	8/9/2016	8/9/2016	Broken up	3-6 days	Broken up carcass consisting of 10 contour feathers attached by skin. No evidence of collision or singe.	Unknown	NA	2	Heliostat	638842, 3935883	NA
2016_266_ISEGS	Yellow Warbler	YWAR	Incidental	8/9/2016	8/9/2016	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Evidence of curling to tail feathers and in right wing, singeing to left primaries and rump.	Scorched or singed	2	3	Powerblock	637441, 3937902	NA
2016_267_ISEGS	Yellow Warbler	YWAR	Incidental	8/9/2016	8/9/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. Evidence of curling to primaries, secondaries, and in retrices, singeing to top of head.	Scorched or singed	1	3	Powerblock	637410, 3937912	NA
2016_268_ISEGS	Black-Throated Sparrow	BTSP	Incidental	8/9/2016	8/9/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to all remaining flight feathers, singeing to head and upper parts.	Scorched or singed	3-Feb	3	Powerblock	637451, 3937947	NA

2016_269_ISEGS	Yellow Warbler	YWAR	Incidental	8/9/2016	8/9/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of singeing to head, face, nape, back, rump, and left axillary with all flight feathers in both wings and tail singed off.	Scorched or singed	3-Feb	3	Powerblock	637442, 3937958	NA
2016_270_ISEGS	Yellow Warbler	YWAR	Incidental	8/9/2016	8/9/2016	alive, injured	0-8 hours	Whole Carcass. Evidence of curling to secondaries in left wing, singeing to primary coverts in right wing and in tail.	Scorched or singed	1	3	Powerblock	637463, 3937913	NA
2016_271_ISEGS	Tree Swallow	TRES	Incidental	8/10/2016	8/10/2016	Mummified	1 month +	Whole carcass. Evidence of curling on primaries and secondaries of left wing, singeing to upper parts of body.	Scorched or singed	1	3	Powerblock	637382, 3937913	NA
2016_272_ISEGS	Unknown Sparrow	UNSP	Carcass Survey	8/15/2016	8/15/2016	Broken up	3-6 days	Broken up carcass consisting of partial left wing. No evidence of collision or singe.	Unknown	NA	2	Heliostat	638006, 3936802	NA
2016_273_ISEGS	Tree Swallow	TRES	Incidental	8/15/2016	8/15/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass. Evidence of curling to secondaries and tertials in both wings and in tail, singeing to rump and left lower flank.	Scorched or singed	3-Jan	1	Powerblock	640417, 3933491	NA
2016_274_ISEGS	Mourning Dove	MODO	Incidental	8/15/2016	8/15/2016	Broken up	2 weeks	Broken up carcass consisting of body without head. Evidence of singeing to body feathers.	Scorched or singed	3	1	Powerblock	640361, 3933477	NA
2016_275_ISEGS	Tree Swallow	TRES	Incidental	8/15/2016	8/15/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling to left side of rump, singeing to edges of secondaries, tertials in left wing.	Scorched or singed	3-Jan	1	Powerblock	640361, 3933490	NA
2016_276_ISEGS	Unknown Flycatcher	UNFL	Incidental	8/15/2016	8/15/2016	Feather spot	3-6 days	Feather spot size large, consisting of 2 primaries, 3 rectrices, 3 secondaries, 5 flight feathers, and 6 body feathers. Evidence of singe on all the flight feathers.	Scorched or singed	Unk	1	Powerblock	640364, 3933478	NA
2016_277_ISEGS	Unknown Small Bird	UNID	Incidental	8/15/2016	8/15/2016	Feather spot	3-6 days	Feather spot size large, consisting of 6 retrices, 5 contour feathers. Evidence of curling to all retrices.	Scorched or singed	Unk	1	Powerblock	640361, 3933478	NA
2016_278_ISEGS	Northern Mockingbird	NOMO	Incidental	8/15/2016	8/15/2016	Feather spot	3-6 days	Feather spot size large consisting of 4 primaries, 1 secondary, 1 retrix, 10 body feathers. No evidence of collision or singe.	Unknown	NA	1	Powerblock	640367, 3933480	NA
2016_279_ISEGS	Unknown Small Bird	UNID	Incidental	8/15/2016	8/15/2016	Broken up	3-6 days	Broken up carcass consisting of partial left wing. Evidence of curling to all major flight feathers, singeing to coverts.	Scorched or singed	Unk	1	Powerblock	640360, 3933484	NA
2016_280_ISEGS	Unknown Swallow	UNSW	Incidental	8/15/2016	8/15/2016	Feather spot	3-6 days	Feather spot size small, consisting of 2 primaries. Evidence of curling to all feathers.	Scorched or singed	Unk	1	Powerblock	640364, 3933478	NA

2016_281_ISEGS	MacGillivray's Warbler	MGWA	Carcass Survey	8/16/2016	8/16/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of singeing to all upperparts and breast, all flight feathers in wings and tail singed off.	Scorched or singed	3-Feb	1	ACC Building	640372, 3933524	NA
2016_282_ISEGS	Yellow Warbler	YWAR	Carcass Survey	8/16/2016	8/16/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Evidence of curling to retrices, flight feathers in wings singed off, singeing to head, nape, and rump.	Scorched or singed	3-Feb	1	ACC Building	640357, 3933521	NA
2016_283_ISEGS	Brown-headed cowbird	BHCO	Carcass Survey	8/16/2016	8/16/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to all flight feathers (singed off), singeing to all upperparts of body.	Scorched or singed	3-Feb	1	ACC Building	640349, 3933522	NA
2016_284_ISEGS	Yellow Warbler	YWAR	Carcass Survey	8/16/2016	8/16/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to primaries, secondaries and retrices, singeing to head, neck, back, and rump.	Scorched or singed	3-Feb	1	ACC Building	640391, 3933543	NA
2016_285_ISEGS	Tree Swallow	TRES	Carcass Survey	8/16/2016	8/16/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling to all flight feathers in wing and tail, singeing to top of head and back.	Scorched or singed	3-Feb	1	ACC Building	640368, 3933547	NA
2016_286_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	8/16/2016	8/16/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of singeing to tips of primaries on left wing, and top of head.	Scorched or singed	NA	1	Powerblock	640274, 3933539	NA
2016_287_ISEGS	Western Kingbird	WEKI	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 4 retrices, 3 primaries, and 3 secondaries. No evidence of collision or singe.	Unknown	Unk	1	Heliostat	640507, 3933621	NA
2016_288_ISEGS	Unknown Swallow	UNSW	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size small, consisting of 4 primaires,1 secondary, 1 retrix, and 5 body feathers. Evidence of singe on all flight feathers.	Scorched or singed	Unk	1	Heliostat	640481, 3933555	NA
2016_289_ISEGS	Killdeer	KILL	Carcass Survey	8/17/2016	8/17/2016	Feather spot	2 weeks	Feather spot size large, consisting of 6 retrices, 30 body feathers. No evidence of collision or singe.	Unknown	Unk	1	Heliostat	640474, 3933545	NA
2016_290_ISEGS	Tree Swallow	TRES	Incidental	8/17/2016	8/17/2016	Dead, Semi-fresh (eyes desiccated, rigor mortis)	2 weeks	Whole carcass. Evidence of singe on primaries of left wing.	Scorched or singed	1	3	Powerblock	637405, 3937946	NA
2016_291_ISEGS	Lesser Nighthawk	LENI	Incidental	8/17/2016	8/17/2016	Mummified	2 weeks	Whole carcass. No evidence of collision or singe.	Unknown	NA	3	Powerblock	637462, 3937940	NA
2016_292_ISEGS	Unknown Small Bird	UNID	Carcass Survey	8/17/2016	8/17/2016	Broken up	2 weeks	Broken up carcass consisting of intact tail, sternum, 9 secondaries, 6 primaries, and 50 body feathers. No evidence of collision or singe.	Unknown	NA	1	Heliostat	640267, 3933279	NA
2016_293_ISEGS	Lazuli Bunting	LAZB	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 5 retrices, 9 primaries, 6 secondaries, and 50 body feathers.	Scorched or singed	Unk	1	Heliostat	640211, 3933397	NA

								Evidence of curling and singeing to secondaries and some body feathers.						
2016_294_ISEGS	Northern Mockingbird	NOMO	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size small, consisting of 3 primaries, 1 secondary. Evidence of curling on tips of flight feathers.	Scorched or singed	Unk	1	Heliostat	640212, 3933395	NA
2016_295_ISEGS	Yellow Warbler	YWAR	Carcass Survey	8/17/2016	8/17/2016	Feather spot	2 days	Feather spot size small, consisting of 1 primary, 2 flight feathers, and 16 body feathers. Evidence of curling to all flight feathers.	Scorched or singed	Unk	1	Heliostat	640212, 3933395	NA
2016_296_ISEGS	Unknown Small Bird	UNID	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 75 body feathers. Evidence of singe on several body feathers.	Scorched or singed	3	1	Heliostat	640156, 3933467	NA
2016_297_ISEGS	Killdeer	KILL	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 7 primaries, 2 secondaries, 30 body feathers. No evidence of collision or singe.	Unknown	NA	1	Heliostat	640144, 3933515	NA
2016_298_ISEGS	Lesser Nighthawk	LENI	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 8 primaries, 8 retrices, 6 secondaries, and 6 body feathers. No evidence of collision or singe.	Unknown	Unk	1	Heliostat	640155, 3933544	NA
2016_299_ISEGS	Yellow Warbler	YWAR	Carcass Survey	8/17/2016	8/17/2016	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. No evidence of collision or singe.	Unknown	Unk	1	Heliostat	640146, 3933600	NA
2016_300_ISEGS	Unknown Small Bird	UNID	Carcass Survey	8/17/2016	8/17/2016	Feather spot	3-6 days	Feather spot size large, consisting of 2 retrices, 2 primaries, 4 secondaries, and 2 tertials. Evidence of singe on retrices.	Scorched or singed	Unk	1	Heliostat	640211, 3933397	NA

Appendix B. Additional Detection Data for Fatality Estimates and Documentation of Fatality Estimates in Which Each Detection Was Included.

USFWS #	Species Code	Location	Distance from Tower (m)	Bird Size	Model Size	Cause of Death	How Found	Time Since Last Survey (days)	Used in Estimator	Tower Area	Power Block	Inner HD	Heliostat Area	Unit Fence	Collector Line	Estimator Notes
2016_189_ISEGS	NRWS	Outer Segment	1111	Small	Feather Spot	unknown	Fatality Search	6	Yes				X			
2016_190_ISGES	UNID	ACC	96	Small	Small Carcass	singed	Fatality Search	15	Yes	X	X					
2016_191_ISEGS	UNWA	Power Block	65	Small	Small Carcass	singed	Fatality Search	15	Yes	X	X					
2016_192_ISEGS	CLSW	ACC	46	Small	Small Carcass	singed	Fatality Search	14	Yes	X	X					
2016_193_ISEGS	OCWA	Power Block	58	Small	Small Carcass	singed	Fatality Search	14	Yes	X	X					
2016_194_ISEGS	MGWA	Inner HD	183	Small	Small Carcass	collision	Fatality Search	16	Yes	X		X				
2016_195_ISEGS	UNGR	Inner HD	232	Large	Feather Spot	unknown	Fatality Search	19	Yes	X		X				
2016_196_ISEGS	UNLB	ACC	51	Large	Feather Spot	other (entrapment)	Fatality Search	21	Yes	X	X					
2016_197_ISEGS	GRRO	Inner Segment	485	Large	Large Carcass	unknown	Fatality Search	25	Yes				X			
2016_198_ISEGS	CLSW	Power Block	10	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_199_ISEGS	UNHU	ACC	50	Small	Small Carcass	singed	Fatality Search	26	Yes	X	X					
2016_200_ISEGS	BTSP	ACC	47	Small	Small Carcass	singed	Fatality Search	26	Yes	X	X					
2016_201_ISEGS	UNID	Inner HD	200	Small	Feather Spot	collision	Fatality Search	21	Yes	X		X				
2016_202_ISEGS	BTGN	ACC	47	Small	Small Carcass	singed	Fatality Search	21	Yes	X	X					
2016_203_ISEGS	VERD	Power Block	20	Small	Small Carcass	singed	Fatality Search	21	Yes	X	X					
2016_204_ISEGS	UNSW	Power Block	25	Small	Feather Spot	singed	Fatality Search	21	Yes	X	X					
2016_205_ISEGS	TRES	Power Block	45	Small	Small Carcass	singed	Fatality Search	21	Yes	X	X					
2016_206_ISEGS	COHU	Power Block	35	Small	Small Carcass	singed	Fatality Search	21	Yes	X	X					
2016_207_ISEGS	COHU	Power Block	90	Small	Small Carcass	singed	Fatality Search	21	Yes	X	X					

2016_208_ISEGS	LBCU	Outer Segment	668	Large	Feather Spot	unknown	Fatality Search	34	Yes				X			
2016_209_ISEGS	BTSP	Power Block	30	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_210_ISEGS	BTGN	Power Block	10	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_211_ISEGS	UNHU	Power Block	27	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_212_ISEGS	RUHU	Power Block	28	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_213_ISEGS	UNHU	Power Block	28	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_214_ISEGS	LUWA	ACC	35	Small	Small Carcass	singed	Fatality Search	14	Yes	X	X					
2016_215_ISEGS	UNID	Power Block	37	Small	Feather Spot	singed	Fatality Search	14	No	X	X					Older than Search Interval
2016_216_ISEGS	WTSW	Power Block	0	Small	Feather Spot	singed	Fatality Search	14	Yes	X	X					
2016_217_ISEGS	LENI	Inner HD	221	Small	Feather Spot	unknown	Fatality Search	14	No	X		X				Older than Search Interval
2016_218_ISEGS	RUHU	Power Block	71	Small	Small Carcass	singed	Fatality Search	14	Yes	X	X					
2016_219_ISEGS	TRES	Power Block	62	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_220_ISEGS	CLSW	Power Block	114	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_221_ISEGS	TRES	Power Block	79	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_222_ISEGS	CLSW	Power Block	69	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_223_ISEGS	NRWS	Power Block	43	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_224_ISEGS	UNHU	Power Block	68	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_225_ISEGS	CLSW	ACC	39	Small	Small Carcass	other (entrapment)	Fatality Search	22	Yes	X	X					
2016_226_ISEGS	BANS	ACC	39	Small	Small Carcass	singed	Fatality Search	22	Yes	X	X					
2016_227_ISEGS	CLSW	ACC	50	Small	Small Carcass	other (entrapment)	Fatality Search	22	Yes	X	X					
2016_228_ISEGS	NRWS	ACC	60	Small	Small Carcass	singed	Fatality Search	22	Yes	X	X					
2016_229_ISEGS	NRWS	ACC	68	Small	Small Carcass	other (entrapment)	Fatality Search	22	Yes	X	X					

2016_230_ISEGS	UNHU	Power Block	29	Small	Small Carcass	singed	Fatality Search	22	Yes	X	X					
2016_231_ISEGS	TRES	Power Block	50	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_232_ISEGS	COHU	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_233_ISEGS	TRES	Power Block	40	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_234_ISEGS	LOSH	Inner HD	245	Small	Feather Spot	unknown	Fatality Search	22	Yes	X		X				
2016_235_ISEGS	UNSW	Inner HD	148	Small	Feather Spot	unknown	Fatality Search	22	Yes	X		X				
2016_236_ISEGS	BTSP	Outside Search - Power Block/Level 6	0	Small	Small Carcass	singed	Incidental	NA	No							Outside Standard Search Area
2016_237_ISEGS	NRWS	Power Block	59	Small	Feather Spot	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_238_ISEGS	COHU	Power Block	60	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_239_ISEGS	TRES	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_240_ISEGS	BUOR	Power Block	32	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_241_ISEGS	NRWS	Power Block	51	Small	Small Carcass	unknown	Incidental	1(1)	No	X	X					Older than Search Interval
2016_242_ISEGS	CLSW	Power Block	76	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_243_ISEGS	TRES	Power Block	51	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_244_ISEGS	VERD	Power Block	55	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_245_ISEGS	TRES	Power Block	24	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_246_ISEGS	NRWS	Power Block	10	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_247_ISEGS	NRWS	Outside Search - Tower	0	Small	Small Carcass	singed	Incidental	NA	No							Outside Standard Search Area
2016_248_ISEGS	UNHU	Power Block	44	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_249_ISEGS	UNSW	Power Block	38	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval

2016_250_ISEGS	TRES	Power Block	84	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_251_ISEGS	VGSW	Power Block	46	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_252_ISEGS	CLSW	Power Block	86	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_253_ISEGS	YWAR	Power Block	94	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_254_ISEGS	UNOR	Power Block	43	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_255_ISEGS	UNSW	ACC	57	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_256_ISEGS	CLSW	ACC	68	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_257_ISEGS	HOFI	Power Block	94	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_258_ISEGS	NRWS	Power Block	128	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2016_259_ISEGS	UNSW	Inner HD	227	Small	Feather Spot	unknown	Fatality Search	25	Yes	X		X				
2016_260_ISEGS	NRWS	Inner HD	194	Small	Feather Spot	unknown	Fatality Search	25	Yes	X		X				
2016_261_ISEGS	CLSW	Power Block	79	Small	Small Carcass	unknown	Incidental	1(1)	No	X	X					Older than Search Interval
2016_262_ISEGS	CLSW	Power Block	20	Small	Small Carcass	singed	Fatality Search	26	Yes	X	X					
2016_263_ISEGS	LUWA	ACC	64	Small	Small Carcass	singed	Fatality Search	26	Yes	X	X					
2016_264_ISEGS	TRES	Power Block	88	Small	Small Carcass	singed	Fatality Search	26	Yes	X	X					
2016_265_ISEGS	UNBD	Inner HD	195	Large	Feather Spot	unknown	Fatality Search	27	Yes	X		X				
2016_266_ISEGS	YWAR	Power Block	40	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_267_ISEGS	YWAR	Power Block	50	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_268_ISEGS	BTSP	Power Block	35	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_269_ISEGS	YWAR	Power Block	48	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_270_ISEGS	YWAR	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_271_ISEGS	TRES	Power Block	88	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval

2016_272_ISEGS	UNSP	Outer Segment	1150	Small	Small Carcass	unknown	Fatality Search	20	Yes				X			
2016_273_ISEGS	TRES	Power Block	51	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_274_ISEGS	MODO	Power Block	5	Large	Large Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_275_ISEGS	TRES	Power Block	11	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2016_276_ISEGS	UNFL	Power Block	4	Small	Feather Spot	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_277_ISEGS	UNID	Power Block	6	Small	Feather Spot	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_278_ISEGS	NOMO	Power Block	6	Small	Feather Spot	unknown	Incidental	1(1)	No	X	X					Older than Search Interval
2016_279_ISEGS	UNID	Power Block	16	Small	Feather Spot	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_280_ISEGS	UNSW	Power Block	4	Small	Feather Spot	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_281_ISEGS	MGWA	ACC	38	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_282_ISEGS	YWAR	ACC	38	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_283_ISEGS	BHCO	ACC	42	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_284_ISEGS	YWAR	ACC	62	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_285_ISEGS	TRES	ACC	63	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_286_ISEGS	UNHU	Power Block	109	Small	Small Carcass	singed	Fatality Search	29	Yes	X	X					
2016_287_ISEGS	WEKI	Inner HD	195	Small	Feather Spot	unknown	Fatality Search	29	Yes	X		X				
2016_288_ISEGS	UNSW	Inner HD	132	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				
2016_289_ISEGS	KILL	Inner HD	NA	Large	Feather Spot	unknown	Fatality Search	29	Yes	X		X				
2016_290_ISEGS	TRES	Power Block	77	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2016_291_ISEGS	LENI	Power Block	36	Small	Small Carcass	unknown	Incidental	1(1)	No	X	X					Older than Search Interval
2016_292_ISEGS	UNID	Inner HD	231	Small	Small Carcass	unknown	Fatality Search	29	Yes	X		X				
2016_293_ISEGS	LAZB	Inner HD	184	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				

2016_294_ISEGS	NOMO	Inner HD	179	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				
2016_295_ISEGS	YWAR	Inner HD	180	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				
2016_296_ISEGS	UNID	Inner HD	212	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				
2016_297_ISEGS	KILL	Inner HD	227	Large	Feather Spot	unknown	Fatality Search	29	Yes	X		X				
2016_298_ISEGS	LENI	Inner HD	221	Small	Feather Spot	unknown	Fatality Search	29	Yes	X		X				
2016_299_ISEGS	YWAR	Inner HD	248	Small	Small Carcass	unknown	Fatality Search	29	Yes	X		X				
2016_300_ISEGS	UNID	Inner HD	184	Small	Feather Spot	singed	Fatality Search	29	Yes	X		X				