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Ivanpah Solar Electric Generating System

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IVANPAH SOLAR ELECTRIC GENERATING SYSTEM AVIAN & BAT MONITORING PLAN

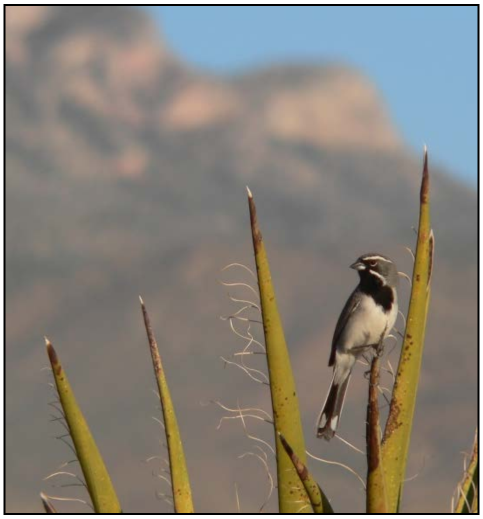
2014 SPRING REPORT
(23 MARCH 2014 – 22 MAY 2014)

Submitted
August 27, 2014

energyservices an NRG service
On behalf of Solar Partners I, II, and VIII LLC

Prepared by:

H. T. Harvey & Associates



IVANPAH SOLAR ELECTRIC GENERATING SYSTEM AVIAN & BAT MONITORING PLAN

2014 SPRING REPORT (23 MARCH 2014 – 22 MAY 2014)

Project # 2802-07

Prepared for:

Solar Partners I, II, and VIII

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August 2014

Executive Summary

Avian and bat monitoring surveys were conducted from 23 March to 23 May 2014 (the spring 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). Specifically, avian point count surveys, large raptor surveys, facility monitoring for avian detections, and scavenger and carcass removal trials were conducted. This report represents the second “quarterly” (i.e., seasonal) report summarizing monitoring methods and results for those surveys based on the procedures and requirements specified in the Plan.

Avian and bat monitoring surveys included avian point counts, raptor and large bird point counts and fatality searches. Avian point count surveys were conducted using variable-radius point counts at 80 survey points, including 40 points in heliostat arrays and 40 points in desert bajada habitats. A total of 38 bird species were recorded during these surveys. Species richness was highest on the lower desert bajada grid (24 species), slightly lower on the upper desert bajada grid (19 species), and lowest in the heliostat grids (ten species in Unit 1 and four in Unit 3). Avian abundance was similar on the two desert bajada grids, with 186 observations on the lower bajada and 182 on the upper bajada. Abundance was substantially lower in the two heliostat grids, with 49 observations in Unit 1 and 20 observations in Unit 3.

Surveys for raptors and other large birds were conducted at each of eight points (one on the east and west sides of each of the power units and two offsite points). Three to five surveys were conducted at each point (mean of 3.8 surveys/point). During these surveys, six raptor species and two other large bird species (common raven and turkey vulture) were identified. Common ravens comprised 33.8% of all large bird detections. Overall abundance of raptors and other large birds was higher on the eastern points than on the western points.

Avian and bat fatality searches were conducted in 1) the “tower area”, consisting of the power block and inner high-density (HD) heliostats surrounding each power block on approximately 154 acres, which was surveyed with 100% coverage; 2) the “heliostat area”, consisting of the inner and outer heliostat segments outside of the inner HD heliostats on approximately 720 acres, which was surveyed with 24.1% coverage in randomly selected arc-shaped plots; 3) the “fenceline”, consisting of the perimeter fences, which was 100% surveyed; 4) the “collector line”, consisting of the Unit 3 Collector Line, which was also 100% surveyed; and 5) offsite “control areas.” Overall, approximately 29.2% of the facility (not including the offsite control area, which is outside the facility) was searched. Searches were conducted within the spring season at intervals averaging 7.2 days (range 6-14 days, median = 7 days).

All bird and bat fatalities and injuries, including those found incidentally, are referred to as “detections” hereafter. According to the specifications of the Plan, avian detections were input into a fatality estimator equation (model) to provide an estimate of the fatalities for the facility. All fatalities were classified as either carcasses or as feather spots. Feather spots consisted of groups of feathers composed of at least two or more primary flight feathers, five or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1 m^2 or smaller, or feathers with any skin, flesh, or bone attached.

During the period 23 March – 22 May 2014, a total of two injured birds, 200 avian fatalities, and four bat fatalities were detected (202 total avian detections). Forty-two avian species and two bat species were positively identified among these detections. A total of 156 avian detections and three bat detections occurred during systematic fatality searches. Forty-four avian detections and one bat detection were made incidentally while performing other Project-related activities in accordance with the reporting protocol of the Ivanpah Wildlife Incident Reporting System. Avian species that are permanent residents in the Ivanpah Valley (i.e., residing there year-round) accounted for 31.2% of the total detections found on the site during the 2014 spring season. Nonbreeding-season residents (those species that breed outside the Ivanpah Valley but winter in the Project vicinity) accounted for 17.3% of total detections; breeding-season residents (species that breed in the Project vicinity but do not winter there) accounted for 11.4% of total detections, and transient species (species that migrate through the Project vicinity but do not regularly breed or winter there) accounted for 29.2% of detections. With respect to foraging guilds, aerial insectivores accounted for 22.3% of detections, followed by terrestrial insectivores (17.8%), granivores/insectivores (16.8%), nectarivore/insectivores (i.e. hummingbirds, 15.3%), and waterbirds (1.5%).

A total of 141 bird detections (69.8%) were recorded within the tower area (the area consisting of the power block and inner HD heliostats). This area, circumscribed by a 260-m radius from the tower and comprising approximately 5% of the facility, was searched with 100% coverage due to proximity to the towers. In addition, these towers were the focus of considerable activity by Ivanpah personnel, who detected and reported fatalities, resulting in high numbers of incidental fatality reports. As discussed below, ninety-seven of 100 avian detections showing evidence of flux effects (97.0%), as determined by microscopic examination, were located within the tower area, indicating that flux-related effects occurred overwhelmingly in the immediate vicinity of the towers. Given the intensive coverage of the power blocks and our microscopic examination of all detections, we are confident that we were able to detect a large proportion of the flux-related detections. In the other survey areas, fifty-four avian detections (26.7%) were recorded for the much larger area composed of the inner and outer heliostats. Three detections were discovered along the fenceline (1.5%), three were on Project lands outside the standardized search areas (1.5%), and one was found along the off-site control transects (0.5%). All bat fatalities were observed in the power block: two in the air cooled condenser (ACC) building, and two inside other Project buildings within the power block.

Of the 202 avian injuries and fatalities detected during 2014 spring season, microscopic examination indicated that 99 fatalities and one injured bird (49.5%) showed signs of singed feather damage from flux effects. Visible evidence of collision (primarily with heliostats) was found in the case of 15 detections (7.4%), including 14 fatalities and one injury. The cause of injury or mortality for the remaining 87 detections (43.1%) could not be confirmed (i.e., the carcass or feather spot displayed no signs of flux effects and no direct collision effects). Statistical analysis correlating the flux-related and unknown/non-singed detections with the production of flux suggests that microscopic examination by CEC and BLM-approved biologists correctly classifies the detections. Correlation of numbers of detections with the number of tower flux-days in a given week demonstrated a positive relationship ($R^2 = 0.64$) with more flux-related detections during weeks in which more tower flux-days occurred. Unlike the detections of singed birds, the number of unknown detections was not correlated with the number of tower flux-days in a given week ($R^2 = 0.03$). Therefore, spatial analysis of the distribution of detections where the cause is unknown shows no pattern that would suggest these detections are associated with flux effects.

Ninety-five (47.0%) of the 202 detections consisted only of feather spots. Because singed feathers are readily observable, fatalities for which the cause of death is unconfirmed are likely to have resulted from predation, collision, or illness. The ratio of feather spots to carcasses varied considerably across the site. It was highest in the inner HD heliostats (1:0.3), and lowest in the power block (1:6), with the inner and outer segments (1:0.5) nearer equal. The ratio of feather spots to carcasses was also high along the fencelines (0:3); however, only three fatalities were found along the fences. Ongoing carcass removal trials (detailed below) will elucidate both scavenging rates, and persistence rates of carcasses and feather spots, across the study area.

Spring-season carcass removal trials and searcher efficiency trials were conducted to model the fatality estimate. Carcass persistence during the spring season ranged from less than one day, in the case of three carcasses, to a full six-week trial period in the case of the seven carcasses whose remains persisted throughout the trial. Although all large carcasses were detected and at least partially eaten by scavengers, the scavengers left enough of the carcass in three of the four large-carcass trials that the remains would have been detectable and considered a fatality if detected during the standardized searches. In contrast, small carcasses tended to be more completely removed, with only five of 15 small carcasses (33.3%) leaving remains that persisted for the entire six-week trial. Conservatively assuming a 42-day persistence for the carcasses that lasted for the full trial period, mean carcass persistence was 18.8 days for small carcasses and 41.8 days for large carcasses. In comparison, the assumptions used in the power analysis in the Plan were 7.4 days for small birds and 21.8 days for large birds. The longer persistence of carcasses (averaging approximately twice that assumed for the Plan's power analysis) thus increases the statistical power of our sampling approach relative to the power analysis in the Plan.

Human searcher efficiency during the spring season averaged 63% for small birds, 75% for large birds, and 25% for feather spots/partial carcasses. Cumulative searcher efficiency values used in fatality estimates, which included searcher efficiency results from both the winter and spring seasons, were 46% for small birds, 57% for large birds, and 25% for feather spots/partial carcasses. Searcher efficiency rates for small and large bird carcasses were higher than the target rates assumed in the Plan. Detection dog trials occurred in spring in anticipation of integration of detection dogs during summer surveys.

In general, there were no obvious temporal patterns of detections during the spring survey period; however, there were five survey days in which more than 10 fatalities were detected. In each case, the majority of detections were found in the tower area of a single unit. Examination of these records showed that daily detection rates of more than 10 per day at Ivanpah coincided with increases related to pulses in migration. Indeed, the day (22 April) with the greatest number of fatalities (20) appeared to be associated with locally heavy migration activity throughout the desert southwest of California during the period of 18 – 25 April, according to the Cornell Lab of Ornithology's BirdCast website.[1] Smaller increases in fatalities coincided with weeks of moderate migration activity in the region.

The species composition of fatality detections throughout the solar plant was different than the composition of species observed using the heliostat areas during avian point counts (discussed below). This suggests that there was a bias in spring fatality detections towards particular avian guilds (transient insectivores and resident granivores), with the most common detections consisting of mourning doves, yellow-rumped warblers, Costa's hummingbirds, and migrating swallows and hummingbirds) and a bias in avian point counts away from ground foraging or smaller species (e.g., mourning dove or warblers), likely because such species are less detectable during distance point counts.

During the period 23 March – 22 May 2014, total estimated numbers of fatalities attributable to the Project were: 267 (90% confidence interval estimates 189-550) in the tower area and 186 (90% confidence interval estimates 101-437) in the heliostat area. Only three fatalities were found along the fenceline, so spring period sample sizes were insufficient to model fatalities for this area. In proportion to unit area, fatality estimates suggest the highest densities of fatalities occur in the tower area, which would be predicted because birds are at risk of collision in the tower area and heliostat area, but flux fatalities are concentrated around the towers.

According to Section 5.3 of the Plan, quarterly reports are required to categorize potential migratory bird mortality issues at Ivanpah 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.

The 2014 spring results indicate that the potential migratory bird mortality during this season would be categorized as low. Total detections of any one species or group represent a small proportion of local, regional, or national populations. The 202 avian detections included 43 different bird species spread among a variety of temporal occurrence groups and foraging guilds. Of these 43 species, 30 were represented by three

[1] http://birdcast.info/forecasts

or fewer detections. All of these 43 species have populations that are great enough locally (either as breeders, wintering birds, or migrants), regionally, and nationally that the loss of the individuals recorded in spring 2014 would have no substantive impact on populations at any of these geographic scales. The cause of injury or mortality for 87 of the 202 detections (43.1%) is not known with certainty, and thus these detections cannot be clearly ascribed to the facility.

Of the special-status species recorded, three bank swallows (a state-listed species) were detected with flux effects. Bank swallows are widespread breeders through the middle and northern latitudes of North America, an throughout the rest of the northern hemisphere. Given the location of the site (so close to the Nevada border) and the expected north-south orientation of migrants of these species in the vicinity, it is likely that some or all of these migrants are breeders from populations outside of California, populations that may not be of special status. Nonetheless, the three bank swallow detections in spring 2014 represented a very small proportion of the bank swallows expected to migrate north through the Ivanpah area in spring, heading to breeding sites as far north as Alaska and Canada. This species' populations are estimated at 13,800,000 birds in North America and 46,000,000 individuals worldwide. The most recent estimate available of the California breeding population numbered approximately 9,590 pairs in 2003, and burrow abundance along the Sacramento River estimated at 15,000 in 2012. Thus, at scales from local/regional (i.e., migrants moving through the Ivanpah area and the surrounding region) to national to global, the three bank swallow detections at Ivanpah during the 2014 spring season do not rise above the "low" category, as their loss would have a minimal effect on populations at any of these geographic scales.

Table of Contents

Figures

Tables

Appendices

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 units consisting of 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 tower. Ivanpah is located on approximately 1,457 hectares (3,600 acres) of Bureau of Land Management (BLM) land west of Interstate 15 near 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 (2013; "Plan") was prepared by the Project proponent in collaboration with 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 facility. Final agency acceptance of the Plan occurred in November 2013. The Plan is also intended to: 1) satisfy the BLM Right-of-Way (ROW) Permit requirement that the Ivanpah team develop an avian plan as well as a Migratory Bird Treaty Act (MBTA) Conservation Agreement; 2) satisfy the requirements for an 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).

The Plan 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 supports four main goals and associated objectives. As identified in the Plan, they are:

Goal 1. Identify Collision Risks: Risks will be identified by monitoring and identifying avian mortality and injury associated with facility structure collisions.

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

- Power towers
- Perimeter fences
- Heliostats
- Project Transmission Line (Unit 3 Collector Line)

Goal 2. Identify Solar Flux Risks: Risks from flux will be assessed by monitoring and identifying avian mortality and injury associated with solar flux generated by the facility.

- Objective 2. Estimate flux-related avian mortality and injury using empirical data to calculate facility-wide mortality and injury rates.

Goal 3. Identify Patterns of Avian Use at the Facility: Patterns of avian use will be assessed by conducting onsite and offsite surveys to document avian species composition onsite and offsite, compare abundance in representative habitats onsite and offsite, and document changes in avian use in these areas over time.

- Objective 3. Document patterns of collision- or flux-related mortality and injury associated with species, age/sex, season, weather, and visibility.
- Objective 4. Document spatial patterns associated with collision- or flux-related mortality and injury.
- Objective 7. Document use patterns of various avian species, including migratory birds, raptors, and golden eagles, particularly the seasonal variation of bird communities through breeding, migratory, and overwintering periods.

Goal 4. Provide a Framework for Management and Response to Risks: The designation and description of the functioning of the Technical Advisory Committee (TAC) provides a management and decision framework for the identification and implementation of potential adaptive management measures.

- Objective 5. Provide quantitative information for developing and implementing adaptive management responses commensurate with identified impacts.
- Objective 6. Provide a framework for the TAC to jointly review, characterize, and recommend responses, based on monitoring results, to the appropriate lead agency representatives.

1.3 Purpose of This Report

This report represents the second "quarterly" (i.e., seasonal) report summarizing monitoring methods and results for avian and bat injuries and fatalities 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 2014 spring season, which includes the period from 23 March through 22 May 2014.

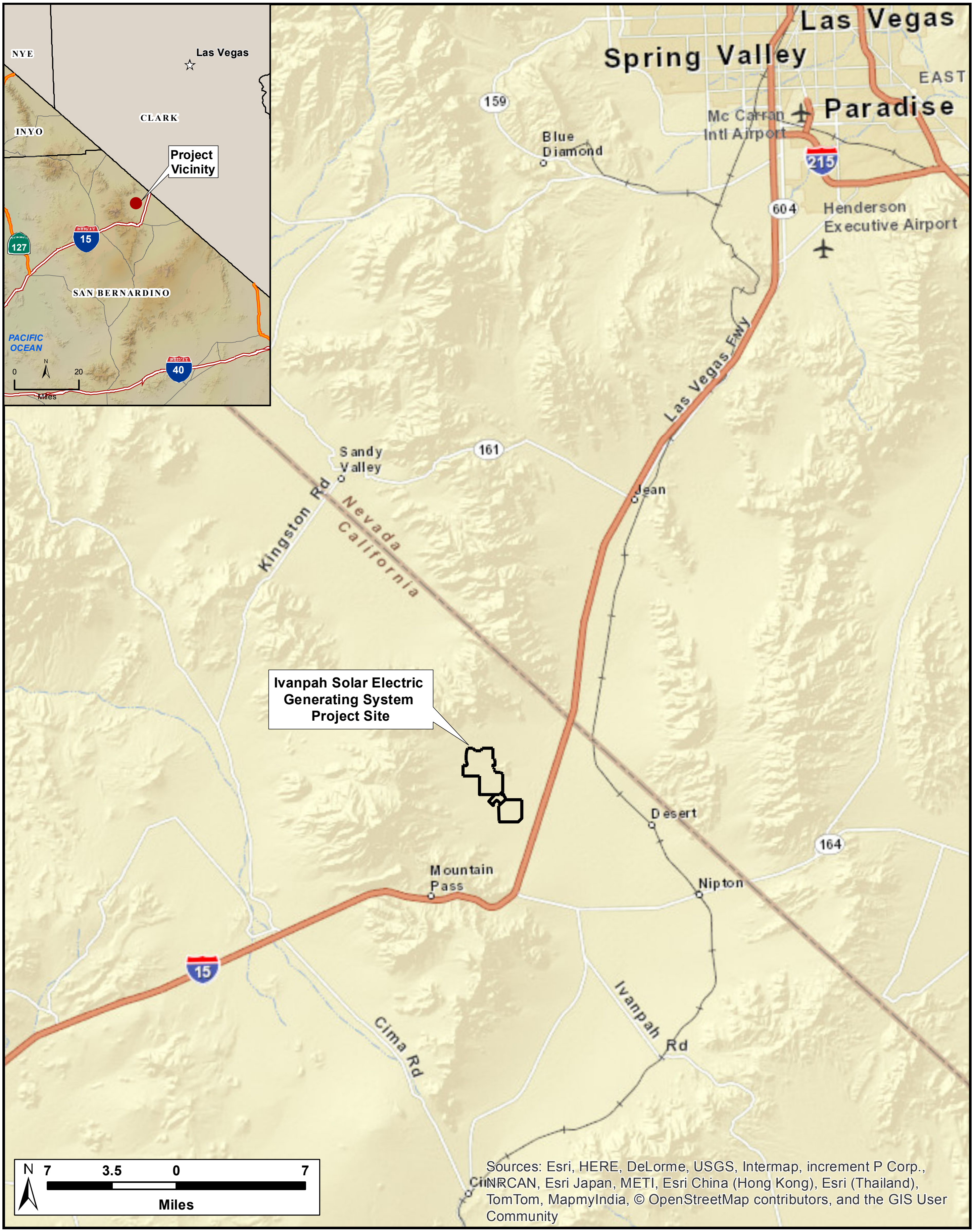

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Figure 1: Ivanpah Vicinity Map

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014

Section 2.0 Methods

The Plan describes the methods by which monitoring and certain analyses, such as compiling the overall fatality estimate, will occur. Below, these methods are described only briefly (because they are included in the Plan), with more detailed descriptions of any refinements that were necessary as the Plan was implemented in the field.

2.1 Avian Use Monitoring

This section describes the methods for monitoring avian use of the solar plant and nearby desert areas, as well as the methods for monitoring the occurrence of raptors and other large birds on and around the facility. More than 97 hours of field observation time for avian use surveys and 119 hours of field observation time for raptor/large bird monitoring were performed during the 2014 spring season.

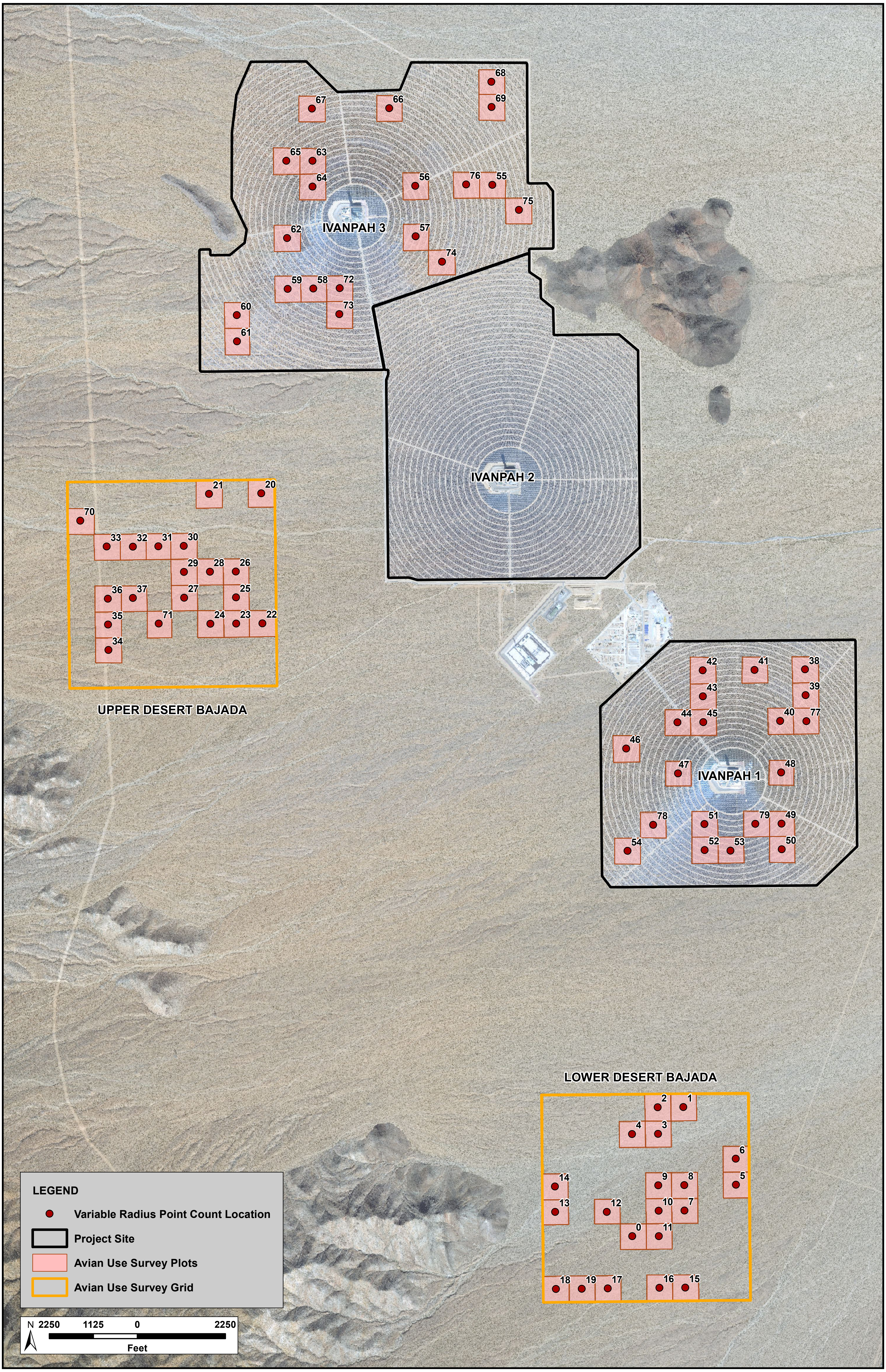
2.1.1 Avian Monitoring Surveys

Avian use surveys were conducted using standard, variable-radius point counts to assess bird use of the vegetated areas within the heliostat fields and nearby offsite areas within desert habitats. The 80 survey points identified in the Plan, and shown on Figure 2, were surveyed a total of four times each during the spring period by a CEC- and BLM-approved avian ecologist.

According to the text of the Plan, these 80 points were to be randomly selected from within the following five study areas:

1. 20 points within an approximately 2.59 square-kilometer (1-square-mile) study area located in Unit 1, within the lower bajada environment of the facility.
2. 20 points within an approximately 2.59 square-kilometer offsite study area located in comparable lower bajada environment as far as practicable from (and south of) the Unit 1 fence line.
3. 10 points within an approximately 1.29 square-kilometer (0.5-square-mile) study area located in Unit 2, within the upper bajada environment.
4. 10 points within an approximately 1.29 square-kilometer located in Unit 3, in the upper bajada portion of the facility.
5. 20 points within an approximately 2.59 square-kilometer offsite study area located in comparable upper bajada environment and as far as practicable from (and southwest of) the Unit 3 fence line.

Our 2014 spring season surveys were conducted consistent with the winter use survey approach and according to Figure 8 on Page 25 of the Plan, which is inconsistent with the text on Page 23 of the Plan because Figure 8 depicts 20 points in Unit 3 and zero in Unit 2. Habitat differences are minor between Units



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 2 Avian Use Monitoring Survey Locations.mxd

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Figure 2: Avian Use Monitoring Survey Locations
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014

2 and 3, and therefore we believe that the 20 points in Unit 3 are representative of habitat conditions in both Units 2 and 3. Nevertheless, as noted in the Winter Quarterly Report, we will adjust our approach for avian surveys starting in the summer of 2014 to reflect the text on Page 23 of the Plan by randomly selecting 10 of the 20 points in Unit 3 that we surveyed in the 2014 spring season, excluding those from future surveys, and randomly selecting 10 points to survey within a grid in Unit 2.

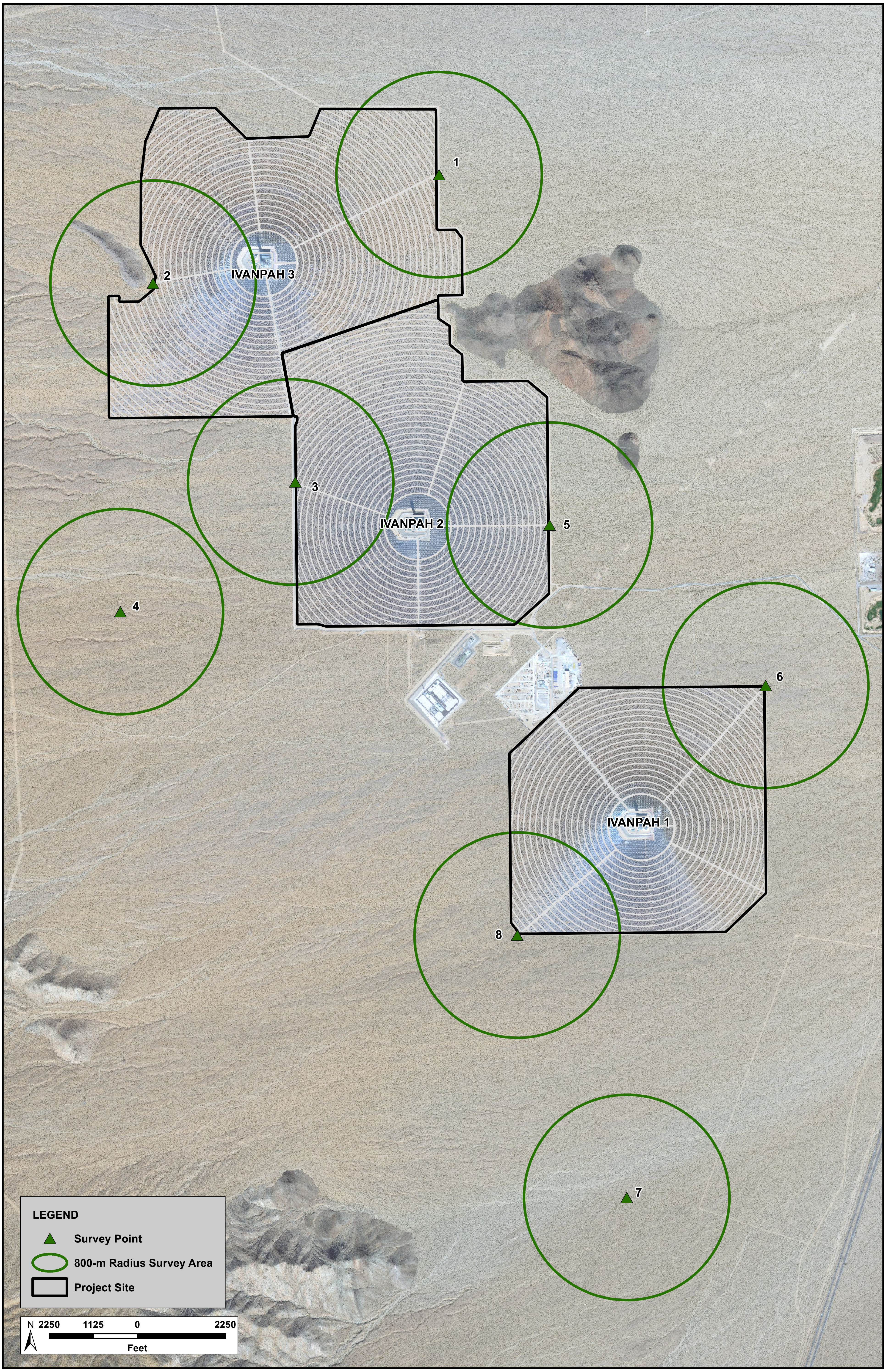
Each of the survey areas described above was divided into 200-m by 200-m square areas to define distinct sample plots. Within each study area, 20 avian use survey points were randomly selected from the sample plots, resulting in 20 point counts per 2.59 square kilometer for each habitat type in the facility and control areas, with each count location affording a minimum, non-overlapping survey radius of 100 m.

The Plan specifies that avian use surveys are to be conducted once per month during December-February and twice per month during the periods September-November and March-May. In accordance with this schedule, we conducted a total of four surveys (two in April and two in May) for the 2014 spring season.

Using distance-sampling techniques such as variable-radius point count methods, determination of bird densities is not as straightforward as simply calculating the mean number of individuals observed in each survey area (Buckland et al. 1993). Rather, the density distributions of the survey data (i.e., assessing density as a function of distance from each point) have to be considered in determining densities. Determining such density distributions typically requires a fairly large amount of data, especially when using programs such as Distance 6.0 (Thomas et al. 2010) to estimate bird densities. Due to the low number of individuals of any given species recorded during these surveys (owing to the naturally low abundance of spring birds in the habitats surveys), it was not possible to obtain reliable density estimates on a species-by-species basis for the 2014 spring season. Even when data were pooled within a 20-point grid, sample sizes were insufficient to allow for determination of reliable density estimates within a grid (e.g., to allow for comparisons between one 20-point heliostat grid and the other, or between one 20-point desert habitat control grid and the other). However, when data from the 40 heliostat points were pooled, and data from the 40 desert points were pooled, overall sample sizes for the heliostat arrays vs. the offsite desert habitats were large enough to provide reliable density estimates in each of these general habitat types using the program Distance 6.0. These comparisons are appropriate per the Plan, which states that avian use studies will concentrate on species composition and abundance, with a focus on comparison between the on- and offsite areas.

2.1.2 Raptor/Large Bird Monitoring Surveys

Surveys for raptors and other large birds were conducted from each of eight points as identified in the Plan and shown on Figure 3. These surveys were conducted using unlimited-distance point counts to assess use of the facility and offsite study areas. CEC and BLM-approved avian ecologists performed these surveys using binoculars and spotting scopes to identify raptors and other large birds, such as gulls (*Larus* spp.) and common ravens (*Corvus corax*) observed during a 4-hour survey period. The Plan specifies that surveys for raptors and other large birds be conducted twice per month during spring. An effort was made to conduct four surveys at each point; however, some surveys had to be cancelled due to poor weather conditions, or



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 3 Raptor and Large Bird Use Monitoring Survey Locations.mxd

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Figure 3: Raptor and Large Bird Use Monitoring Survey Locations

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014

because injured birds were found and needed to be transported to distant rehabilitation facilities. Therefore three points were surveyed three times, while the remaining five points were surveyed four or five times during the spring period.

2.2 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 and injured birds and bats at the facility. 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 facility. Not including any data management or analysis, approximately 3,665 person-hours were spent conducting standardized monitoring searches and performing carcass removal and searcher efficiency trials during the 2014 spring season.

2.2.1 Standardized Searches

2.2.1.1 Areas Surveyed

Per the Plan, monitoring searches were conducted in the "tower area", 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 (100% survey coverage); the "heliostat area", defined as the inner and outer heliostat segments outside of the inner HD heliostats (24.1% survey coverage in randomly selected arc-shaped plots); the "fenceline" defined as the perimeter fences (100% survey coverage); the "collector line", defined as the Unit 3 Collector Line (100% survey coverage); and offsite control areas. Table 1 provides the acreage searched within each of these areas, as well as the percent of the facility comprised by these search areas. Overall, approximately 29.2% of the facility (not including the offsite control area, which is outside the facility) was searched. All these areas are depicted on Figure 4.

To ensure a balanced distribution of heliostat field survey plots, we divided each unit into inner and outer heliostat fields, and randomly selected approximately 20% of each sub-area. This stratified random sampling design ensures that our survey plots will not be clustered or biased in any distance or direction from the towers.

Table 1. Monitoring Areas, 23 March – 22 May 2014.

Area	Acreage Searched (ac)	Percent of Facility
Tower Area	154	4.8%
Heliostat Area	720	22.4%
Fenceline	39	1.2%
Collector Line	26	0.8%
Offsite Control Area	7	NA*
Total Search Area	**939**	**29.2%**

* NA = Not applicable, because the offsite control areas are located outside the facility

2.2.1.2 Search Frequency and Timing

Spring fatality searches began the week of 23 March for all three units. According to the Plan, spring searches of each area were to be conducted at intervals of 7 days; this interval is shorter than the 25-day interval used for winter surveys to assess detections during spring migration. Because some surveys were delayed to address safety concerns related to high winds, the average 2014 spring search interval was 7.2 days (range 6 to 14, median 7 days) for the three solar units. This variation is expected to occur and as indicated in Section 3.1.1 of the Plan the fatality estimator (Huso 2010) is designed to accommodate slight variability in the search interval by incorporating the exact interval for each search to develop an average interval between standardized removal surveys, in days.

The Unit 3 power block, inner HD heliostats, outer segment arc plots, fence, and controls were surveyed seven times during the spring season. One survey of the Unit 3 inner segment arc plots was delayed due to safety concerns related to high winds, so this area was searched six times during the spring season. In order to smoothly transition to the 21-day summer search interval, an additional search was conducted for all areas in Units 1 and 2. These units were searched eight times in all areas except the inner segment arc plots. The inner segment arc plots were searched seven times during the spring period because high winds suspended one of the surveys in these areas.

2.2.1.3 Search Methods

Standardized searches for fatalities were performed by CEC and BLM-approved biologists conducting ambulatory surveys in accordance with the methods outlined in the Plan. We found that searcher efficiency was enhanced when a pair of searchers 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 5). Because searcher efficiency was enhanced in accordance with the goals of the Plan, this refinement was implemented throughout the Project site in lieu of the initially proposed pattern in the Plan. While walking each transect, searchers walked a narrow search section approximately 10 meters (m) wide.

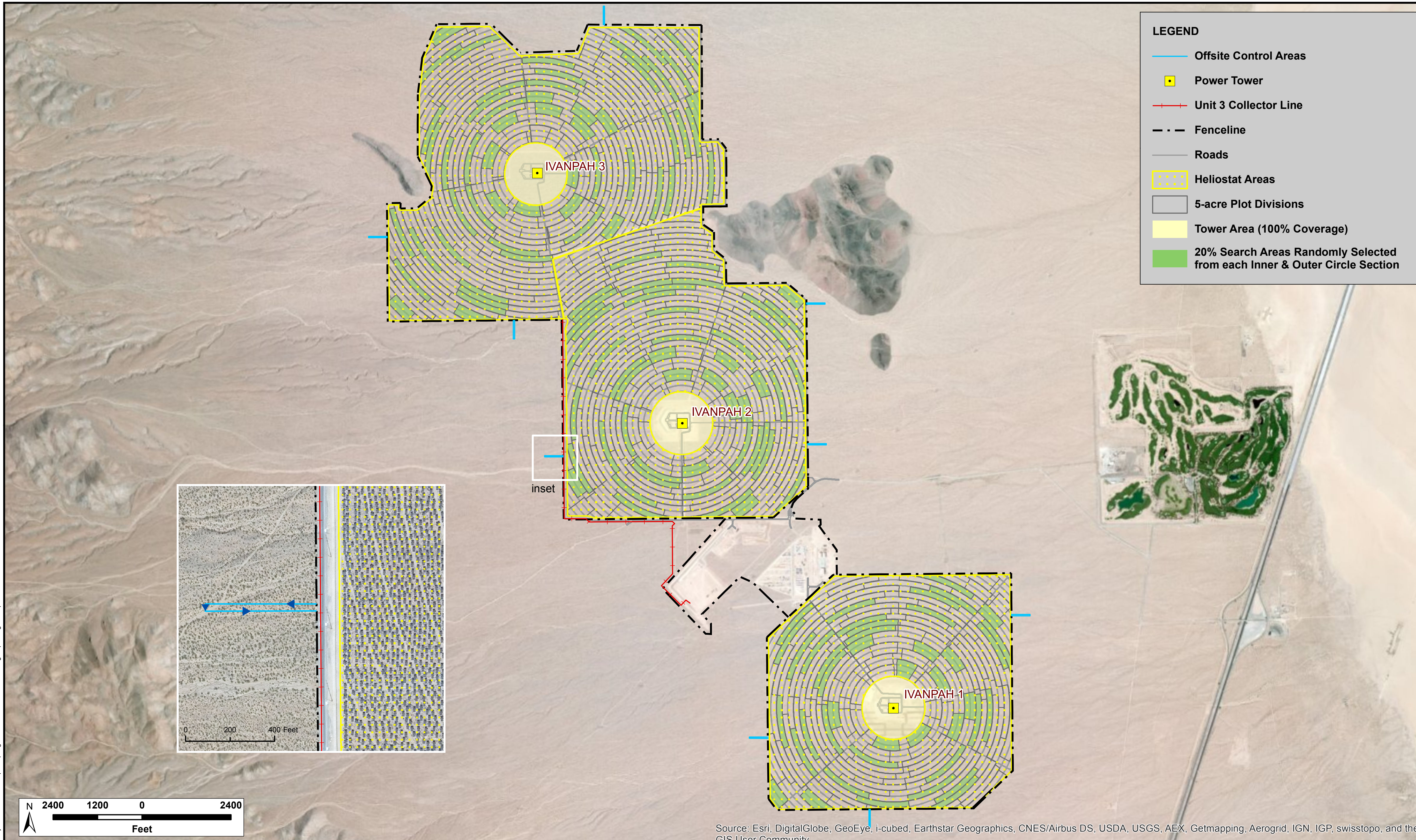

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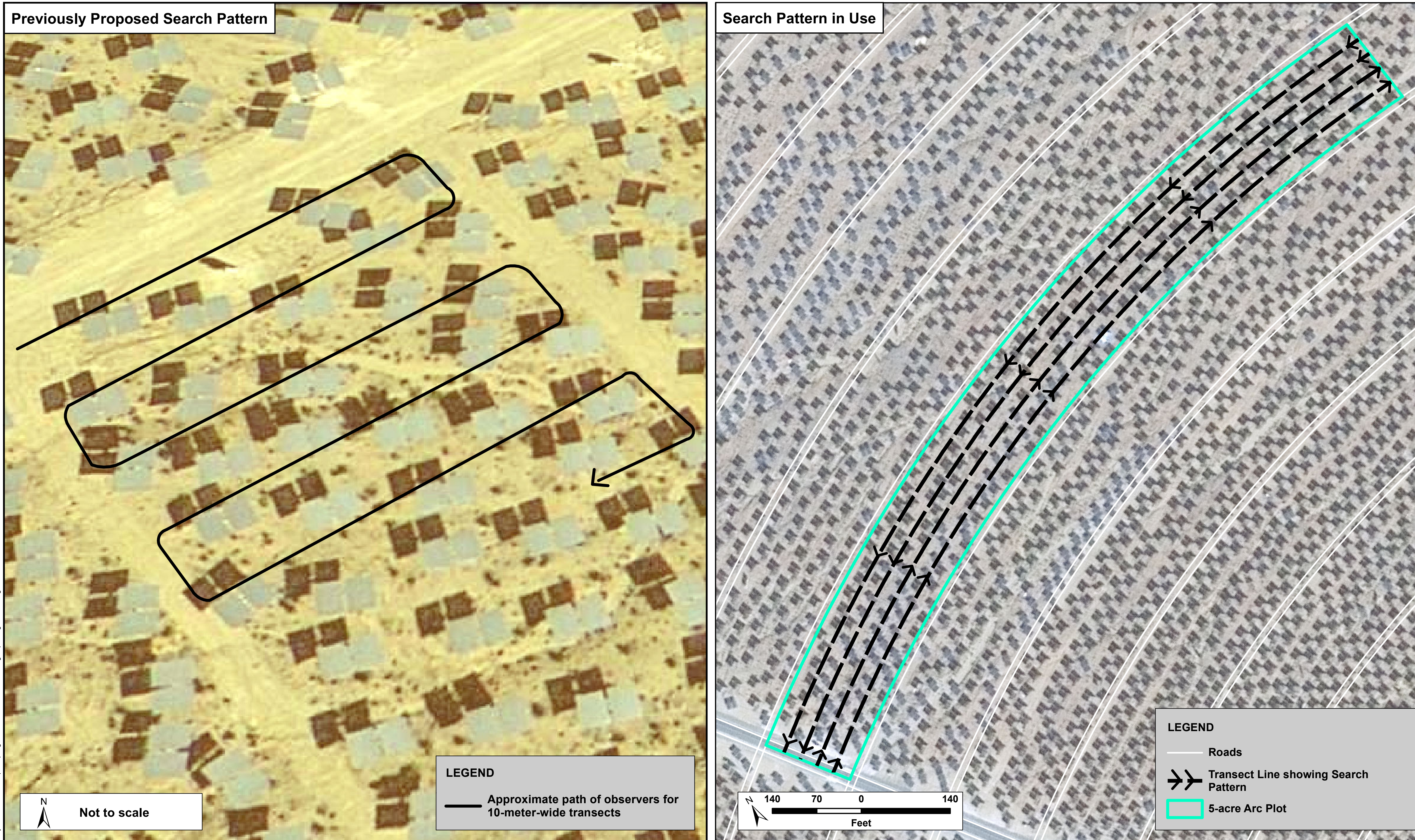
Figure 4: Ivanpah Search Areas
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014



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H.T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 5: Monitoring Search Pattern for Arc Plots
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Otherwise, searches were performed exactly as described in the Plan. Within the heliostat area, 24.1% of each heliostat field was surveyed using randomly distributed 2.02-hectare (5-acre) arc plots. Within the power block, biologists walked through and around the 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 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. Along the fenceline, a 6-m wide transect was surveyed, centered on the fence itself (i.e., 3 m on either side of the fence). The Unit 3 Collector Line was surveyed using a 30-m wide transect (i.e., 15 m on either side of the center line). Offsite surveys were conducted along two randomly selected 152-m long control areas, separated by approximately 10 m extending outward from the perimeter fence and back to the facility at nine locations, including the north, east, south, and west borders of facility.

Every carcass and feather spot was examined by a CEC and BLM-approved biologist using an AmScope SE306R-AZ-E2 20X-40X-80X Digital Binocular Stereo Microscope to detect any signs of flux or collision. When flux-related detections involving carcasses (as opposed to only feather spots) were found, the flux effects were assigned a grade according to 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

Surveyors also 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 singeing (e.g., charring, curling, or melting of feathers) or collision, 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 consisted of at least two or more primary flight feathers, five or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1 m² or smaller (Smallwood 2007), or if any skin, flesh, or bone was attached to the feathers.

2.2.2 Carcass Removal Trials

In accordance with the Plan, we set out carcasses approximately bi-weekly (i.e., every other week) for carcass removal trials. For both carcass removal trials and searcher efficiency trials (discussed below) and as per the terms of the USFWS Special Purpose Utility (SPUT) permit, during the spring quarter we were authorized to use only non-native species. Therefore, we used four species of non-native birds: European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), rock pigeons (*Columbia livia*), and ring-necked pheasants (*Phasianus colchicus*). We classified bird size as follows: $\leq$100 grams (g) were classified as small, and >100 g were classified as large. As a result, European starlings and house sparrows, which average <100 g, were used to represent small birds, while rock pigeons and ring-necked pheasants, which are >100 g, were used to represent large birds. We conducted 19 carcass removal trials during the 2014 spring season, using four large carcasses and 15 small carcasses. Because carcass removal rates on the power block likely differ from removal rates elsewhere on the Project facilities we initiated carcass removal trials on the power block during the spring survey period. Three carcasses, one large and two small, were placed on the power block. Thirteen carcasses (three large and ten small) were placed in surveyed areas of the facility. The remaining three small carcasses were placed along the off-site control transects.

We conducted carcass removal trials in accordance with the Plan and applicable permits; however, we also added monitoring for any feather spots resulting from those placed carcasses that were left behind after scavenging. Because feather spots often persist for searchers to find long after scavenging, monitoring both feather spots and carcasses provides a more accurate measure of persistence.

2.2.3 Searcher Efficiency Trials

In accordance with the searcher efficiency trials described in the Plan, we placed 19 carcasses during the spring season using 10 small carcasses and nine large carcasses in various vegetation heights and with various contrast to soil and vegetation to represent the range of conditions under which searches occur. Two of the small carcasses and one of the large carcasses disappeared (e.g., they may have been scavenged) before the searcher efficiency trial, leaving a sample size of eight small and eight large carcasses included in the trials. Because a number of the fatalities detected during searches were feather spots and partial carcasses, and these fatalities may differ from carcasses in detectability, we also placed 12 feather spots/partial carcasses in a range of field conditions. Each feather spot/partial carcass contained one wing and eight to 14 feathers.

2.2.4 Incidental Reporting

Some detections (defined as a dead or injured bat or bird) were outside standardized search areas, or were within search areas but not during standardized searches. Such detections were found by H. T. Harvey & Associates staff, the Project's designated biologists, or operational personnel. These detections, which were reported in accordance with the facility's Wildlife Incident Reporting System described in Section 3.4 of the Plan, were considered "incidental" detections. Thus, an "incidental detection" is a bird or bat found dead or injured in a time or place other than the standardized searches that are conducted according to the Plan. Data on such birds and bats were collected separately and reported in the SPUT permit database. As described in Section 2.2.6, incidental data were included in the fatality estimates when they were found in areas covered during standardized surveys (e.g., in the tower area and along the fenceline), during time periods in which those areas were being searched. Incidental detections from outside the survey areas are not included in the fatality estimates.

2.2.5 Relating Detections to Flux Activity

We assessed the relationship between the number of days towers are in flux and (a) the number of detections with signs of singeing and (b) the number of detections with no evidence of singeing (i.e., those from collisions and unknown causes). Data on flux activity at towers during the spring quarter were provided by NRG. We summed the number of days towers were in flux by week (Sunday to Saturday), for a total possible value of 21 flux-days per week (seven days for each of the three towers). We summed all singed detections found during standardized surveys, as well as incidental detections, by week. We also summed non-singed fatalities found per week (collision and unknown) during the spring. We excluded all fatalities that were estimated to be older than one week to reduce the influence of older fatalities confounding the relationships. We then fit a polynomial trendline and calculated the coefficient of determination (R^2) between the number of singed detections and the number of tower flux-days per week, and fitted a general linear model and calculated the coefficient of determination (R^2) between the number of non-singed detections and the number of tower flux-days per week.

2.2.6 Fatality Estimator

Animals die at an unknown rate which must be inferred from regular searches of a site. Carcasses also persist for varying amounts of time and are imperfectly detected by searchers. For these reasons, it is often inappropriate to draw conclusions based on the raw number of fatalities in an open system. The desire to estimate fatalities given these variables has driven the development of several statistical methods for estimating fatalities (e.g., see Johnson et al. 2003, Smallwood 2007, and Huso 2010). 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 the number of fatalities, F, is the quotient of the number of carcasses detected, C, over the product of carcasses left unscavenged, r, and the proportion that an observer sees, p (Huso 2010).

The inputs for r and p are estimated in subgroups of covariates that will influence the detectability and persistence of each carcass, such as carcass size, vegetation height, and stage of decay or scavenging (i.e., feather spot/partial carcass versus carcass). Given the tendency for many fatality models to underestimate site-wide fatalities, we chose to use a fatality estimator written by M. Huso (2010), which was shown to outperform previous fatality estimation models by more accurately accounting for imperfect detectability. This model, *The Fatality Estimator*, was developed to estimate fatalities primarily for wind energy projects; however, it can be applied to other sources of fatalities including power lines and solar projects (Huso 2010). The estimator uses this conceptual framework of fatalities, combined with bootstrapping from models of r and p to calculate variances and confidence intervals for the estimates of fatalities. Bootstrapping is a statistical method used to create a distribution to assign measures of variance to estimates for data where the underlying distribution is either unknown or cannot be represented algebraically (Efron and Tibshirani 1986). Bootstrapping resamples the data with replacement, several thousand times, to create a distribution that may be used to infer information about the sample mean.

Estimating Carcass Removal Times. Measurements of carcass removal rates typically include one or more censoring values. A censoring value is used in statistics when a value is only partially known. For example, if a carcass was checked on day 7 and was present, and was checked again on day 10, but was found to be missing, then the date of scavenging is unknown, and an interval censor would be used. Because we used camera traps, the majority of scavenging times were known precisely, and the data was not censored. However, when cameras failed to record the moment of scavenging, we applied interval censoring.

There are four commonly used distributions of survival models that can be used in the fatality estimator for a value of *r:* exponential, Weibull, loglogistic, and lognormal. These four distributions have different rates and shapes of decay curves that attempt to model the survival of carcasses over a given search interval. We used Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) to rank the fit of each survival model to our carcass removal trial data. Because the exact time of death for detected fatalities is usually unknown, the probability of persistence cannot be calculated exactly for each carcass, but it can be estimated from the selected survival model and bootstrapped to obtain a range of estimates of *r* for each carcass.

Estimating Searcher Efficiency. Searcher efficiency, or the proportion of fatalities that an observer sees, p, is represented most simply by the following equation:

$$p = \frac{NumberObserved}{NumberAvailable}$$

Because the 2014 spring season was the second season in which searcher efficiency trials were performed at Ivanpah, the sample size is not yet large enough to allow us to fully investigate the effects of variables such as bird size and vegetation cover, but these variables will be examined in future seasons as the sample size increases.

Fatality Estimates. Per Section 3.1 of the Plan, we report estimates for the tower area components (i.e., the power block and inner HD heliostats) together, because 100% of this area was searched; however, these estimates were calculated separately for the power block and inner HD heliostats due to the inclusion of incidental observations form the power block. We ran a separate estimate for the heliostat area, in which 24.1% of the total area was searched.

The ACC units are only marginally accessible to scavengers from the outside; therefore, they act primarily as a closed system with a scavenging rate that approaches zero. Because of this, we did not use the fatality estimator equation to determine the numbers of fatalities at the ACC units; rather, we included the raw numbers, which we believe are representative of the fatality population within the ACC units, in the overall fatality estimates for the tower area.

Within the power block, a large percentage of the detections were found incidentally. Incidentals are typically not included in fatality estimates due to the sporadic, unpredictable nature of such reports and unaccounted-for search effort. However, because these detections accounted for such a large proportion of the detections recorded during the 2014 spring season, we included them in our estimate for the power block and fenceline. We adjusted the search interval for incidental detections on the power block to one day to reflect the high human use in these areas and thus the high probability that monitoring or operational personnel would see and report any highly visible fatality in these areas. Because of the carcass removal policies within the power block, no carcass removal trials were conducted in that area during the winter or early spring period. A change in this policy allowed carcasses to be placed on the power block for carcass removal trials late in the spring season. Because the sampling period was short, only three carcasses were placed, which is insufficient to calculate removal rates. Thus, for the spring season, carcass removal values for all Project areas were pooled and averaged and the mean carcass removal rates were used.

Because the fatality estimator is not appropriate for estimating rare events, we only present estimates for Project elements or groupings of more than five detections. The fatality estimator accounts for imperfect searcher efficiency, so fatalities that are not detected during a given search are still represented statistically. However, because of this, if a previously missed fatality is detected on a subsequent search, it will essentially be double-counted, and cause the overall fatality estimate to be falsely inflated. Therefore, any detections determined to be significantly older than the search interval were removed from the estimator (Huso 2010).

Section 3.0 Avian Use and Raptor/Large Bird Monitoring Surveys

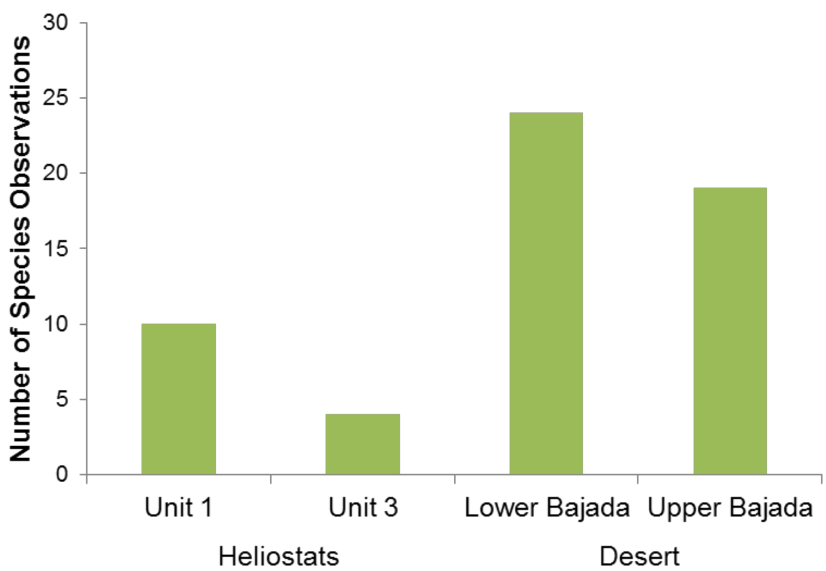
3.1 Avian Use Monitoring

This section provides the results of monitoring of avian use of the heliostat arrays and offsite desert bajada plots, including species composition and abundance. Species composition is compared between these avian use survey results and detections during standardized monitoring surveys. More than 97 hours of field observation time was spent conducting avian use surveys during the 2014 spring season.

3.1.1 Species Composition

A total of 38 bird species were recorded during avian use surveys during the 2014 spring season. Table 2 lists these species, their temporal occurrence status and foraging guild, and the frequency of occurrences (i.e., number of individuals detected) within the four survey grids. As indicated by Figure 6, species richness was highest in the lower bajada desert (24 species), followed closely by the upper bajada desert (19 species). Species richness was much lower in the heliostat grids, with 10 species observed in Unit 1, and only 4 species observed in Unit 3. Statistical tests were not attempted because of the high number of zero values in the samples.

Figure 6. Number of Bird Species Recorded at Avian Survey Points on Four Survey Areas.



Although all birds observed during surveys were recorded, only individual birds using the survey plots were included in these analyses. These included birds that were perched on a plot or aerial foragers (such as raptors) that appeared to be foraging on the plot. Birds that were only observed flying over or through the plot were not included in the analysis, both because these birds' occurrence did not signify use of a particular area and because inclusion of birds transiting over a plot would result in substantial problems associated with spatial autocorrelation of results (e.g., as birds are observed flying through multiple plots). Only four individuals were observed flying over plots during the spring period: two horned larks, one house finch, and one unknown swift.

3.1.2 Avian Abundance

Although species richness was higher on the lower desert bajada, avian abundance was similar on the two desert bajada grids (186 observations on the lower bajada, 182 observations on the upper bajada). The two heliostat arrays had substantially lower avian abundance, with only 49 observations in Unit 1 and 20 observations in Unit 3 during the spring period (Figure 7).

Figure 7. Number of Bird Observations Recorded at Avian Survey Points on Four Survey Areas.

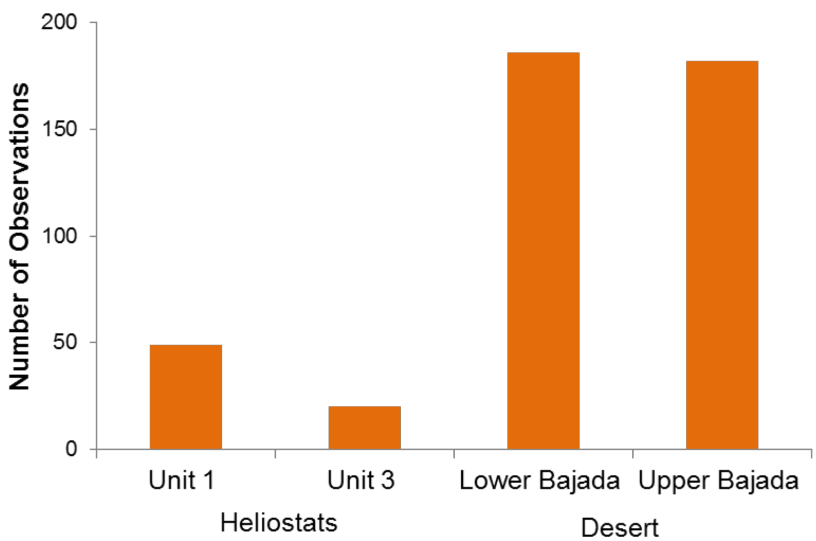


Table 2. Avian Use Survey Results - Frequency of Occurrence by Species and Survey Grid.

Common Name	Scientific Name	Foraging Guild*	Temporal Occurrence Group	Unit 1	Unit 3	Lower Bajada	Upper Bajada
American Kestrel	*Falco sparverius*	Carnivore/Insectivore	Permanent resident	1	0	0	0
American Pipit	*Anthus rubescens*	Granivore (winter)/ Insectivore (summer)	Non-breeding season resident	2	0	0	0
Ash-throated Flycatcher	*Myiarchus cinerascens*	Insectivore (terrestrial)	Breeding-season resident	0	0	6	12
Barn Swallow	*Hirundo rustica*	Insectivore (aerial)	Transient	0	0	1	3
Bewick's Wren	*Thryomanes bewickii*	Insectivore (terrestrial)	Permanent resident	0	0	6	0
Black Phoebe	*Sayornis nigricans*	Insectivore (terrestrial)	Permanent resident	0	0	1	0
Black-tailed Gnatcatcher	*Polioptila melanura*	Insectivore (terrestrial)	Permanent resident	0	0	1	0
Black-throated Sparrow	*Amphispiza bilineata*	Granivore (winter)/ Insectivore (summer)	Permanent resident	7	0	67	67
Blue-gray Gnatcatcher	*Polioptila caerulea*	Insectivore (terrestrial)	Permanent resident	0	0	1	0
Brewer's Blackbird	*Euphagus cyanocephalus*	Granivore	Permanent resident	0	0	2	0
Brewer's Sparrow	*Spizella breweri*	Granivore (winter)/ Insectivore (summer)	Permanent resident	0	0	49	17
Bullock's Oriole	*Icterus bullockii*	Insectivore (terrestrial)	Breeding-season resident	0	0	1	4
Cactus Wren	*Campylorhynchus brunneicapillus*	Insectivore (terrestrial)	Permanent resident	2	0	10	32
Chipping Sparrow	*Spizella passerina*	Granivore	Transient	0	0	0	1
Cliff Swallow	*Petrochelidon pyrrhonota*	Insectivore (aerial)	Breeding-season resident	0	0	2	0
Common Raven	*Corvus corax*	Omnivore	Permanent resident	5	0	1	0
Crissal Thrasher	*Toxostoma crissale*	Insectivore (terrestrial)	Permanent resident	0	0	1	0
Gambel's Quail	*Callipepla gambelii*	Granivore	Permanent resident	0	0	0	2
Horned Lark	*Eremophila alpestris*	Granivore (winter)/ Insectivore (summer)	Permanent resident	15	13	4	0
House Finch	*Carpodacus mexicanus*	Granivore	Permanent resident	8	0	1	1

Common Name	Scientific Name	Foraging Guild*	Temporal Occurrence Group	Unit 1	Unit 3	Lower Bajada	Upper Bajada
Ladder-backed Woodpecker	*Picoides scalaris*	Insectivore (terrestrial)	Permanent resident	0	0	0	1
Lark Sparrow	*Chondestes grammacus*	Granivore	Transient	0	1	0	0
Le Conte's Thrasher	*Toxostoma lecontei*	Insectivore (terrestrial)	Permanent resident	0	0	3	0
Lesser Goldfinch	*Spinus psaltria*	Granivore	Permanent resident	1	0	0	0
Lesser Nighthawk	*Chordeiles acutipennis*	Insectivore (aerial)	Breeding-season resident	1	1	0	1
Loggerhead Shrike	*Lanius ludovicianus*	Carnivore/Insectivore	Permanent resident	0	0	3	13
Northern Mockingbird	*Mimus polyglottos*	Omnivore	Permanent resident	0	0	0	2
Orange-crowned Warbler	*Oreothlypis celata*	Insectivore (terrestrial)	Non-breeding season resident	0	0	0	1
Say's Phoebe	*Sayornis saya*	Insectivore (terrestrial)	Permanent resident	0	0	0	2
Unknown		Unknown	Unknown	3	3	14	14
Unknown Flycatcher		Insectivore (terrestrial)	Unknown	0	0	1	0
Unknown Hummingbird		Nectivore/Insectivore	Unknown	1	0	2	0
Unknown Passerine		Unknown	Unknown	1	0	0	0
Unknown Sparrow		Unknown	Unknown	1	0	0	0
Unknown Swallow		Insectivore (aerial)	Unknown	0	0	1	0
Unknown Swift		Insectivore (aerial)	Unknown	0	0	0	1
Unknown Wren		Insectivore (terrestrial)	Unknown	0	0	1	0
Vaux's Swift	*Chaetura vauxi*	Insectivore (aerial)	Transient	0	0	0	4
Verdin	*Auriparus flaviceps*	Insectivore (terrestrial)	Permanent resident	0	0	0	1
Warbling Vireo	*Vireo gilvus*	Insectivore (terrestrial)	Transient	0	0	1	0
Western Kingbird	*Tyrannus verticalis*	Insectivore (aerial)	Breeding-season resident	0	0	1	0
Western Meadowlark	*Sturnella neglecta*	Granivore (winter)/ Insectivore (summer)	Permanent resident	1	2	0	0
White-crowned Sparrow	*Zonotrichia leucophrys*	Granivore	Non-breeding season resident	0	0	1	1

Common Name	Scientific Name	Foraging Guild*	Temporal Occurrence Group	Unit 1	Unit 3	Lower Bajada	Upper Bajada
Wilson's Warbler	*Cardellina pusilla*	Insectivore (terrestrial)	Transient	0	0	1	2
Yellow Warbler	*Setophaga petechia*	Insectivore (terrestrial)	Transient	0	0	2	0
Yellow-rumped Warbler	*Setophaga coronata*	Insectivore (terrestrial)	Non-breeding season resident	0	0	1	0
Totals				**49**	**20**	**186**	**182**

* Indicates primary diet in spring.

Avian abundance by temporal occurrence group is depicted in Figure 8. Permanent residents predominated in all areas. These birds were particularly conspicuous in spring since many sang or gave alarm calls from prominent perches as part of their breeding activities in the area. Breeding black-throated sparrows and cactus wrens were numerous in both desert bajada areas, while breeding horned larks were more common in the heliostat arrays.

Figure 8. Number of Bird Observations Recorded at Avian Survey Points on Four Survey Areas by Temporal Occurrence Group.

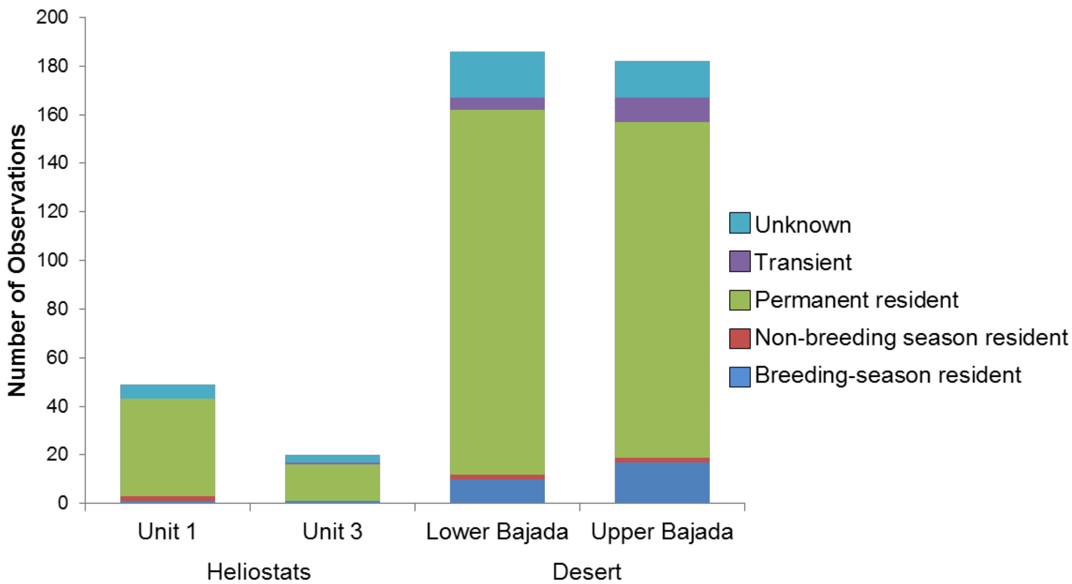
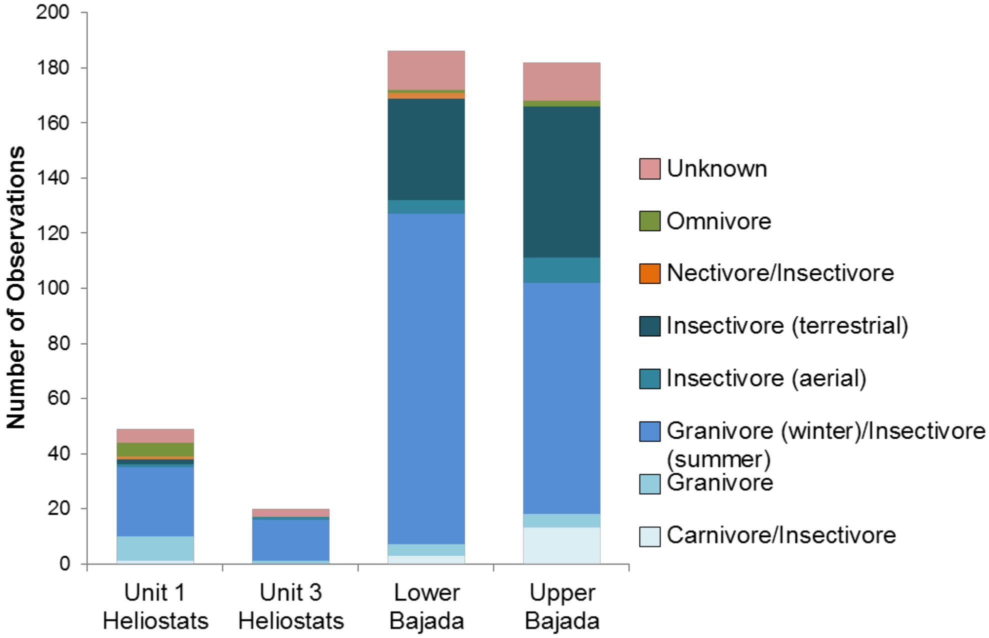


Figure 9 depicts bird abundance by foraging guild. Birds that are primarily granivores in winter and insectivores in spring and summer (when breeding and feeding young) dominated the foraging guilds in all areas. This is as expected given the predominantly insectivorous diet of the nestlings of many locally breeding species. Carnivores/insectivores were also more abundant on the upper desert bajada grid than on other grids; this pattern reflects the greater number of loggerhead shrikes observed in this area. The habitat in the upper desert bajada grid may be more suitable for nesting loggerhead shrikes. The upper desert bajada grid had larger numbers of all shrub and cavity nesting resident species than the lower bajada grid.

Figure 9. Number of Bird Observations Recorded at Avian Survey Points on Four Survey Areas by Foraging Guild.



Because the survey areas (e.g., 20 points in each grid) were identical for each of the four grids, comparison of general avian abundance metrics such as total observations, as was done above, is appropriate for elucidating relative abundance, both overall and by species and species group (e.g., temporal occurrence group and foraging guild). However, because the relative abundance of various species differed among grids, and bird detectability may vary among species, assessing relative abundance using raw numbers may result in inaccurate conclusions. As a result, we used the program Distance 6.0 (Thomas et al. 2010) to evaluate avian densities. As discussed in Section 2.1.1, distance sampling analysis requires a fairly large amount of data, and due to the low number of individuals of most species recorded during these surveys (owing to the naturally low abundance of spring birds in the habitat surveys), it was not possible to obtain reliable density estimates on a species-by-species basis. Even when data were pooled within a 20-point grid, sample sizes were insufficient to allow for determination of reliable density estimates within a grid (e.g., to allow for comparisons between the two 20-point heliostat grids or the two 20-point desert habitat control grids). However, under the assumption that the two heliostat grids were more similar to each other (in terms of habitat and winter bird communities) than to either of the desert bajada grids, and making the inverse assumption with respect to the two desert bajada grids, we pooled data from the 40 heliostat points and compared bird densities to data from the 40 pooled desert bajada points. The 95% confidence intervals around density estimates for each habitat type did not overlap, thus providing strong statistical evidence that bird density in the Desert Bajada was higher than bird density in the Heliostat Units (Table 3). However, this result should be interpreted with caution because the low number of avian observations resulted in high coefficients of variation within the heliostat arrays.

Table 3. Avian Density Estimates for Heliostat vs. Desert Bajada Grids (Derived Using DISTANCE).

		95% Confidence Interval		
Habitat Type	**Density Estimate (Birds/Hectare)**	**Low Estimate (Birds/Hectare)**	**High Estimate (Birds/Hectare)**	**Percent Coefficient Of Variation**
Heliostat Units	0.8	0.3	2.5	60.7
Desert Bajada	5.8	3.9	8.6	20.2

3.1.3 Comparison of Avian Use Survey Results to Fatality Detections

Whereas 38 bird species were recorded during avian use surveys, 42 species were recorded as detections during standardized fatality monitoring. Comparison of the most abundant bird species that were recorded on the avian use surveys to the species most frequently recorded as detections reveals no more similarity between detections and birds using the heliostat grids (as identified during avian use surveys) than between detections and birds using the desert bajada habitats (Table 4). Of the 10 species most frequently recorded as detections, two species (horned lark and cliff swallow) were among the most abundant species on the heliostat survey grids, while two species (horned lark and barn swallow) were among the most abundant species on the desert bajada survey grids. Horned larks were the most frequently observed species in the heliostat grids. These birds were also frequently recorded as detections, with three showing evidence of collision, and one showing evidence of singeing. Cause of death could not be determined for the remaining eight horned lark detections, but all were found in the heliostat arrays, so collision, predation, or illness is possible. Mourning doves, which were the most frequent fatality detection (74% as feather spots), were not recorded during use surveys; however, this species was observed incidentally as surveyors traveled among survey points. Yellow-rumped warblers were frequently recorded as detections, but rarely observed during avian surveys. Costa's hummingbirds were also rarely observed during point counts. The remaining commonly detected species were composed of departing winter residents and migrating species. Due to their transitory status, these birds are unlikely to be observed during point counts, which are designed to assess resident species utilizing the habitat.

Table 4. Comparison of the Most Abundant Bird Species Recorded as Detections and Recorded on Heliostat and Desert Bajada Survey Grids (in Descending Order of Abundance).

Detections[1]	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Horned Lark	Black-throated Sparrow
Yellow-rumped Warbler	House Finch	Brewer's Sparrow
Costa's Hummingbird	Black-throated Sparrow	Cactus Wren
Horned Lark	Common Raven	Ash-throated Flycatcher
Rufous Hummingbird	Western Meadowlark	Loggerhead Shrike
Tree Swallow	American Pipit	Bewick's Wren
White-crowned Sparrow	Brewer's Blackbird	Bullock's Oriole
Barn Swallow	Cactus Wren	Barn Swallow
Cliff Swallow	Cliff Swallow	Vaux's Swift
Violet-green Swallow	Lesser Nighthawk	Horned Lark

[1] Bird and bat fatalities and injuries found during the scheduled fatality searches are called detections

3.2 Raptor and Large Bird Use Monitoring

This section discusses the results of surveys for use of the site and surrounding areas by raptors and other large birds, including a summary of species composition, abundance, and habitat use, as observed from points around the edges of and outside the facility. In addition, this section provides information on the number of individuals of these species observed perched vs. those in flight, as well as the heights at which flying birds were recorded. A total of 119 hours of field observation time was spent conducting raptor/large bird surveys during the 2014 spring season.

3.2.1 General Species Composition, Abundance, and Habitat Use

Three to five 4-hour surveys for raptors and other large birds were conducted from each of eight points as shown on Figure 3. Four surveys were conducted at points 1, 2, 5, and 8. Five surveys were conducted at point 6. Weather delayed two surveys, and in one case a survey was cancelled in order to transport an injured American kestrel to a wildlife rehabilitation center. Thus, three surveys were conducted at points 3, 4, and 7. During these surveys, six raptor species and two other large bird species (common raven and turkey vulture) were observed and identifiable. Table 5 summarizes the total number of detections of each of these species during all surveys combined. Due to the long duration of each survey and the mobility of these birds, it was not always possible to track individuals throughout a survey to avoid counting the same individuals multiple times. Consequently, results of large bird use monitoring surveys are reported in terms of observation rather than individuals.

Table 5. Raptor/Large Bird Point Count Results Summary (Number of Observations).

Common Name	Scientific Name	Ivanpah Facilities	Desert	Mountains	Total
American Kestrel	*Falco sparverius*	3	1	0	4
Cooper's Hawk	*Accipiter cooperii*	0	2	0	2
Common Raven	*Corvus corax*	16	28	0	44
Golden Eagle	*Aquila chrysaetos*	0	4	1	5
Red-tailed Hawk	*Buteo jamaicensis*	5	15	0	20
Sharp-shinned Hawk	*Accipiter striatus*	0	1	0	1
Swainson's Hawk	*Buteo swainsoni*	0	2	0	2
Turkey Vulture	*Cathartes aura*	1	35	9	45
Unknown *Buteo*	*Buteo* species	0	2	0	2
Unknown Raptor		1	2	2	5
Total		**26**	**92**	**12**	**130**

Common ravens comprised 33.8% of all large bird observations. The preponderance of raven observations resulted less from the abundance of ravens on the site (with counts of up to six birds at a time, though more frequently singles or pairs) than from the persistent nature of the species (frequently present) and widespread occurrence. Ravens observations were most common in the desert adjacent to the Ivanpah facilities, with somewhat fewer observations at the Ivanpah facilities themselves and none observed toward the mountains. Nesting ravens were documented in Unit 1, and both individuals and pairs were observed in other units in the vicinity of the tower and flying within and close to the heliostat arrays. American kestrels were more commonly observed in the heliostat array than in the desert. None were observed in the mountains, although this falcon's small size makes very distant observations difficult. Most other raptors were most commonly observed over the desert, with few or no observations within the Ivanpah facilities. Most golden eagle observations were of birds in the desert. Few were observed in the mountains and none were observed at the Ivanpah facilities during formal surveys. Golden eagles were observed incidentally by biologists three times. A golden eagle was observed incidentally at the Ivanpah facilities by biologists on 22 March 2014, when an adult was observed perched on a transmission pole, then flying west away from the facility and over the desert. On 25 April, our biologist noted a transmitter or data-logger backpack on a golden eagle flying over the desert during the raptor survey. On 2 May 2014, H. T. Harvey biologist Stephen Peterson twice observed golden eagles flying over the Unit 3 heliostat array. He first noted a pair of adult golden eagles flying east across the northern end of Unit 3 at height category 1 (i.e. between 100 and 200 m agl). He later observed one golden eagle of unknown age flying west over the southwest corner of Unit 3 at height category 2 (i.e., greater than 200 m agl). In addition, two incidental observations of prairie falcons were made, one over the Unit 1 heliostats and one over the Unit 2 heliostats. There were relatively few incidental observations of other raptors at or over the Ivanpah facilities during the 2014 spring season. These involved occasional red-tailed hawk, common raven, American kestrel, and Swainson's hawk.

Because the survey effort was not the same at all points, the relative abundance of these species differs slightly from the raw observations presented in Table 5. Observations converted to number/survey hour are presented in Table 6. Because differences in survey effort were small, there is little difference between the two measures of raptor abundance.

Table 6. Raptor/Large Bird Point Count Results Summary (Number of Observations/Survey Hour).

Common Name	Ivanpah Facilities	Desert	Mountains	Total
American Kestrel	0.025	0.008	0	0.034
Cooper's Hawk	0	0.017	0	0.017
Common Raven	0.135	0.236	0	0.371
Golden Eagle	0	0.034	0.008	0.042
Red-tailed Hawk	0.042	0.127	0	0.169
Sharp-shinned Hawk	0	0.008	0	0.008
Swainson's Hawk	0	0.017	0	0.017
Turkey Vulture	0.008	0.295	0.076	0.380
Unknown *Buteo*	0	0.017	0	0.017
Unknown Raptor	0.008	0.017	0.017	0.042
Total	**0.219**	**0.776**	**0.101**	**1.097**

As shown by Table 6, the frequency of occurrence of large birds, in terms of the number/survey hour, was relatively low. An average of approximately 1.1 birds/hour was recorded during the 119 hours of raptor/large bird surveys.

Common ravens and red-tailed hawks were observed perched, primarily on offsite electrical transmission towers, moderately frequently. A raven was observed perched within Ivanpah facilities on one occasion (on a trailer) during these raptor surveys. One red-tailed hawk was observed perched on the perimeter fence of Unit 1. At no time during the 2014 spring season were raptors observed perched on the Ivanpah power towers.

The majority of observations of raptors and other large birds involved individuals seen in flight. Per Section 2.3 of the Plan, the height of flight above ground level (agl) was recorded in one of the following categories:

- 0 = < 10 m agl, (within the heliostat collision-risk zone)
- 1 = 10–100 m agl, (between the height of the heliostat collision-risk zone and the height of the elevated solar flux risk zone in areas closer to the power towers)
- 2 = 100–200 m agl (within the elevated solar flux risk zone (primary boiler area at 120–140 m agl)
- 3 = > 200 m agl (above the elevated solar flux risk zone)

Table 7 provides the number of observations of each species that were perched or that were flying in each height category; this information is provided separately for birds seen over Ivanpah facilities and over other habitats such as desert, mountains.

Within the Ivanpah facility, the majority of birds (most of which were ravens) were observed in the three lower height categories (i.e., below 200 m agl). In surrounding areas, the highest numbers were observed flying in the highest category, possibly as they approached the adjacent mountains.

Table 7. Flight Heights of Raptors and Other Large Birds Over Ivanpah Facilities and Other Habitats/Areas (Data are the Number of Observations at Each Flight Height).

	Above Ivanpah Facilities					Above Other Habitats/Areas				
Species	**Perched**	**0**	**1**	**2**	**3**	**Perched**	**0**	**1**	**2**	**3**
American Kestrel	0	0	0	3	0	0	1	0	0	0
Cooper's Hawk	0	0	0	0	0	0	0	2	0	0
Common Raven	3	0	5	4	1	1	2	7	9	1
Golden Eagle	0	0	0	0	0	0	0	0	0	4
Red-tailed Hawk	6	1	0	2	2	0	2	2	1	4
Sharp-shinned	0	0	0	0	0	0	0	1	0	0
Swainson's Hawk	0	0	0	0	0	0	0	1	0	1
Turkey Vulture	0	0	0	0	1	0	1	2	4	5
Unknown Buteo	0	0	0	0	0	0	0	0	0	2
Unknown Raptor	2	0	0	1	0	0	0	0	2	0
Total	**11**	**1**	**5**	**10**	**4**	**1**	**6**	**15**	**16**	**17**

3.2.2 Raptor and Large Bird Distribution

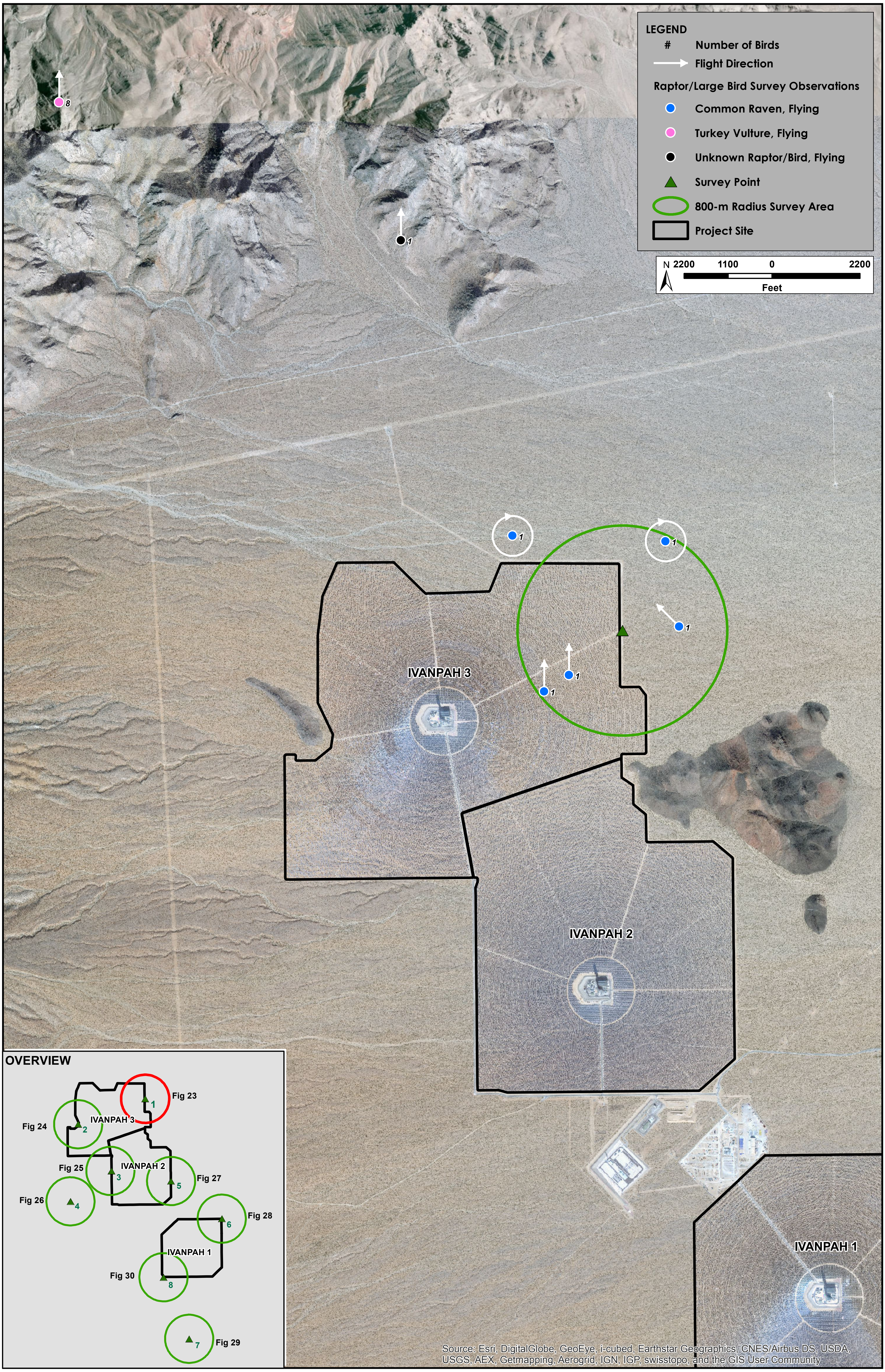
Table 8 provides the number of observations of each raptor and large bird species from each of the eight survey points (Figures 25-32).

Table 8. Raptor/Large Bird Point Count Results By Survey Point.

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
American Kestrel	0	0	1	0	0	0	1	2
Cooper's Hawk	0	1	0	0	0	0	1	0
Common Raven	5	4	3	1	4	7	7	2
Golden Eagle	0	1	1	2	0	0	0	0
Red-tailed Hawk	0	4	0	0	3	8	2	3
Sharp-shinned Hawk	0	0	0	0	1	0	0	0
Swainson's Hawk	0	0	0	0	0	1	1	0
Turkey Vulture	1	1	1	1	0	4	4	1
Unknown Buteo	0	1	0	0	0	1	0	0
Unknown Raptor	1	0	0	0	0	2	1	1
Total	7	12	6	4	8	23	17	9

Points 1 and 2, 5 and 3, and 6 and 8 represent paired points on the eastern and western sides of Units 3, 2, and 1, respectively. At all three units, overall abundance was higher on the eastern points than on the western. This difference appears to have resulted primarily from higher common raven abundance on the eastern points. Higher raven abundance on the eastern side of the site was expected because ravens move between the Ivanpah site and areas in Primm with anthropogenic food sources and the relatively low abundance of ravens in areas toward the mountains west of the Project site. Red-tailed hawks showed a similar pattern at Units 1 and 2, with much higher numbers of observations on the eastern side than the western side. Sharp-shinned hawks, Swainson's hawks, and turkey vultures were also more numerous on the eastern side of the facility. However, these migratory raptors were seen in such low numbers that their relative location may not be particularly meaningful. Other raptors were slightly more abundant on the west side than the east side of the three power units, but again, in low numbers.

Figures 10 through 17 depict the results of raptor surveys in terms of the locations of birds observed; number of individuals; whether the birds were flying or perched; and flight direction (for flying birds). All observations for the entire season are shown on a single figure for each of the eight survey points to document locations and concentrations, if any, of activity of raptors and other large birds.



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 10 Raptor Large Bird Survey Observations from Survey Point 1 Spring 2014.mxd

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Figure 10: Raptor/Large Bird Survey Observations from Survey Point 1, Spring 2014

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August 2014

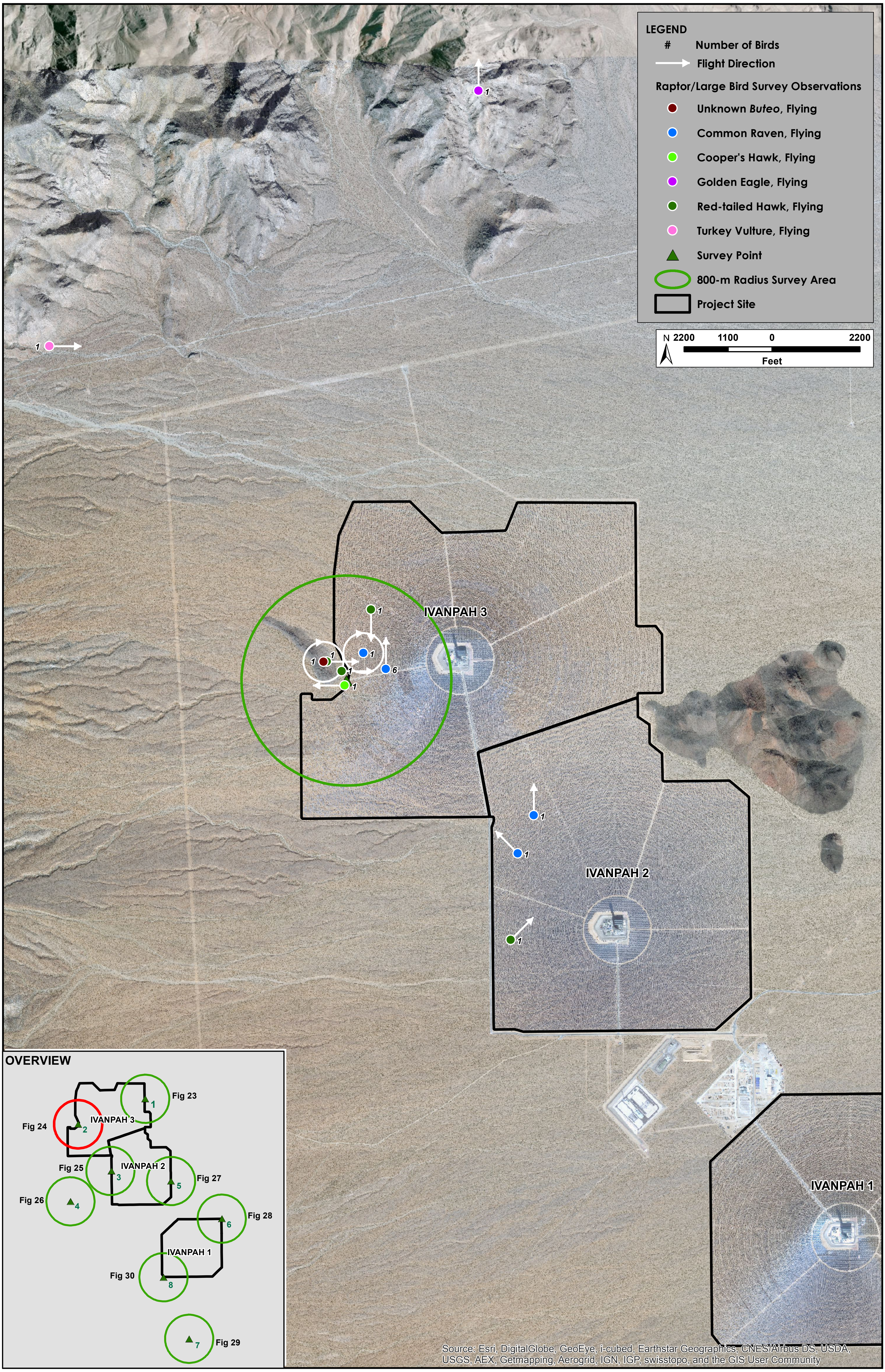

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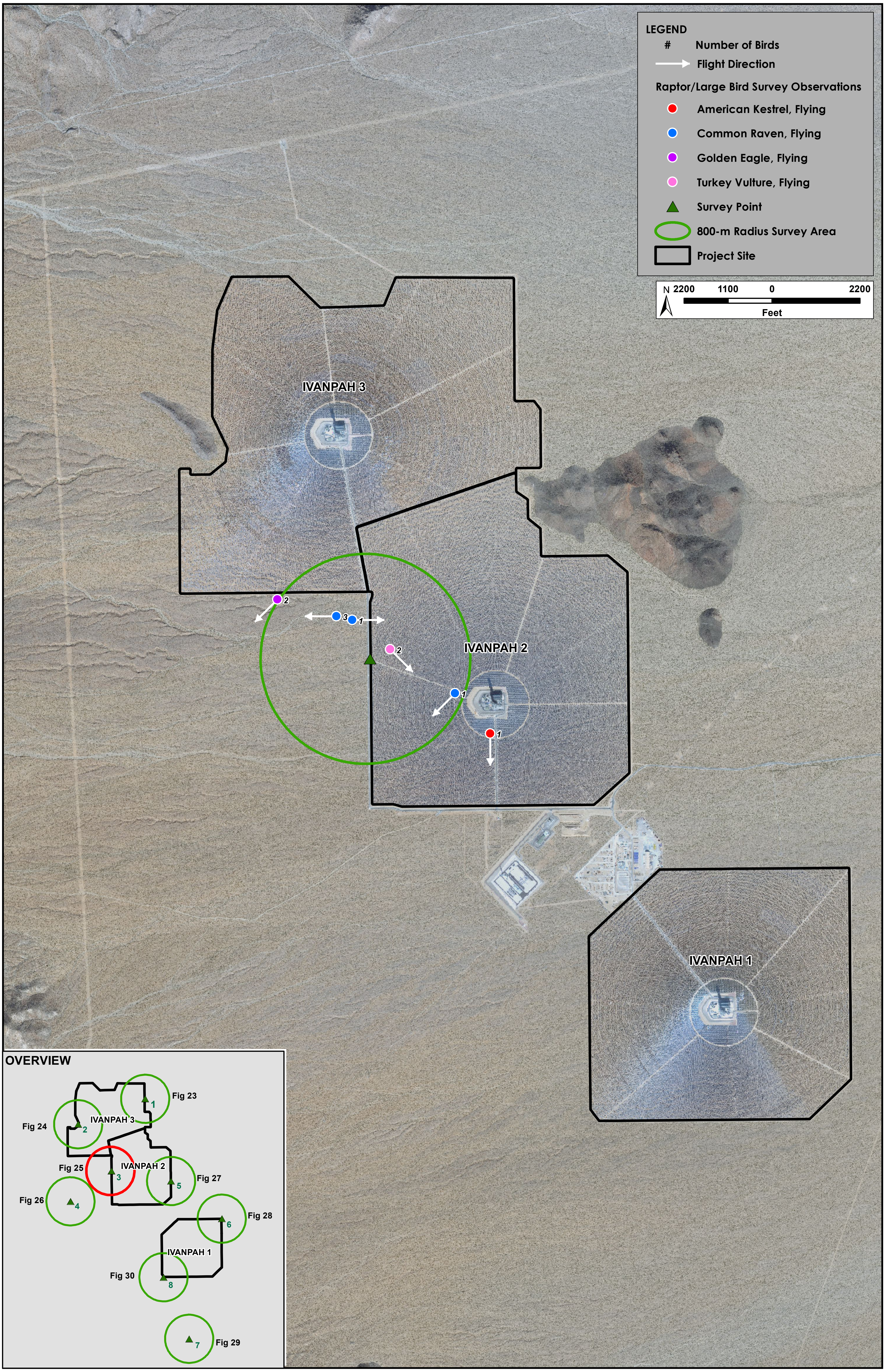
Figure 11: Raptor/Large Bird Survey Observations from Survey Point 2, Spring 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 12 Raptor Large Bird Survey Observations from Survey Point 3 Spring 2014.mxd

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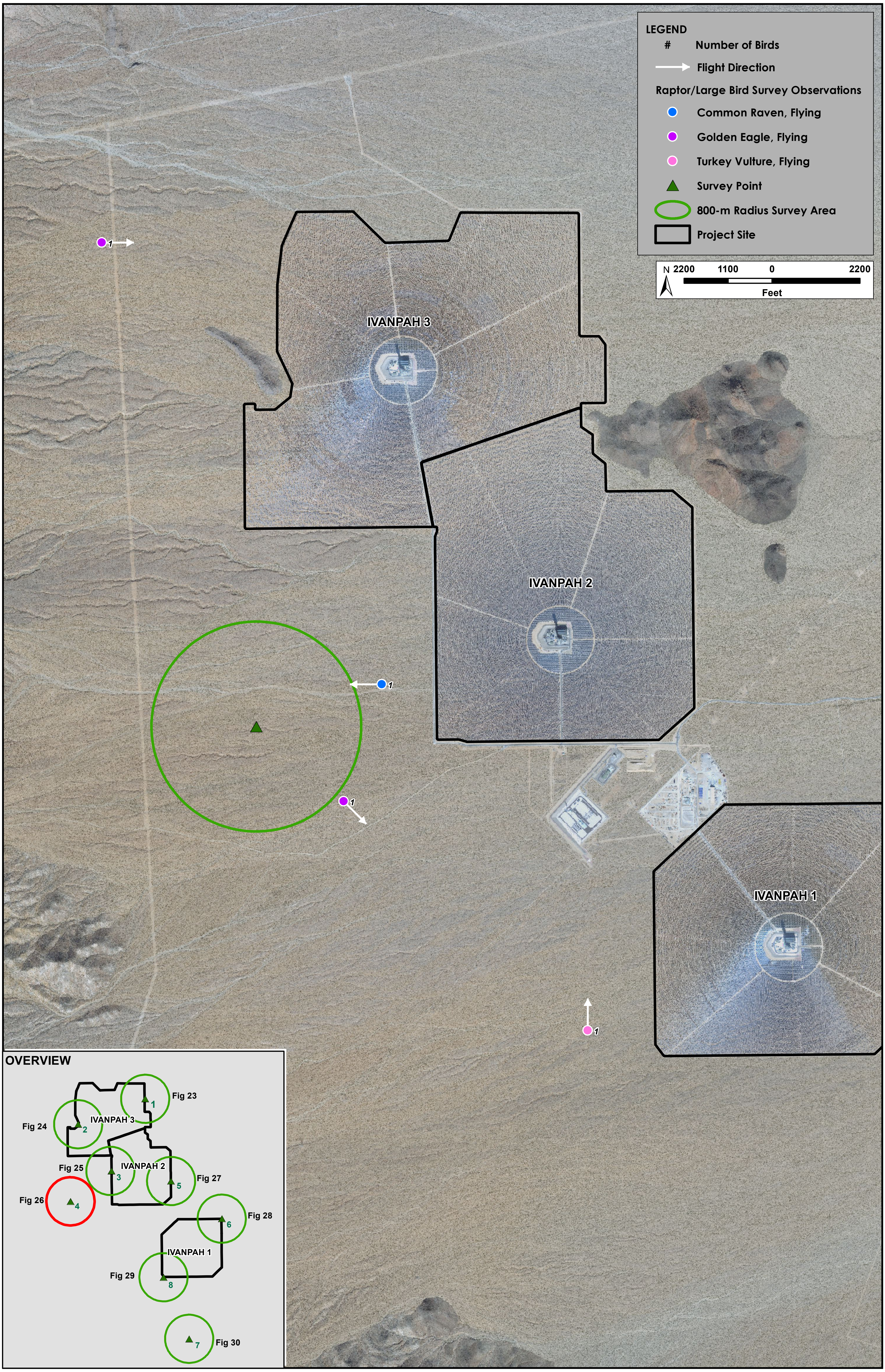
Figure 12: Raptor/Large Bird Survey Observations from Survey Point 3, Spring 2014
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 13 Raptor Large Bird Survey Observations from Survey Point 4 Spring 2014.mxd

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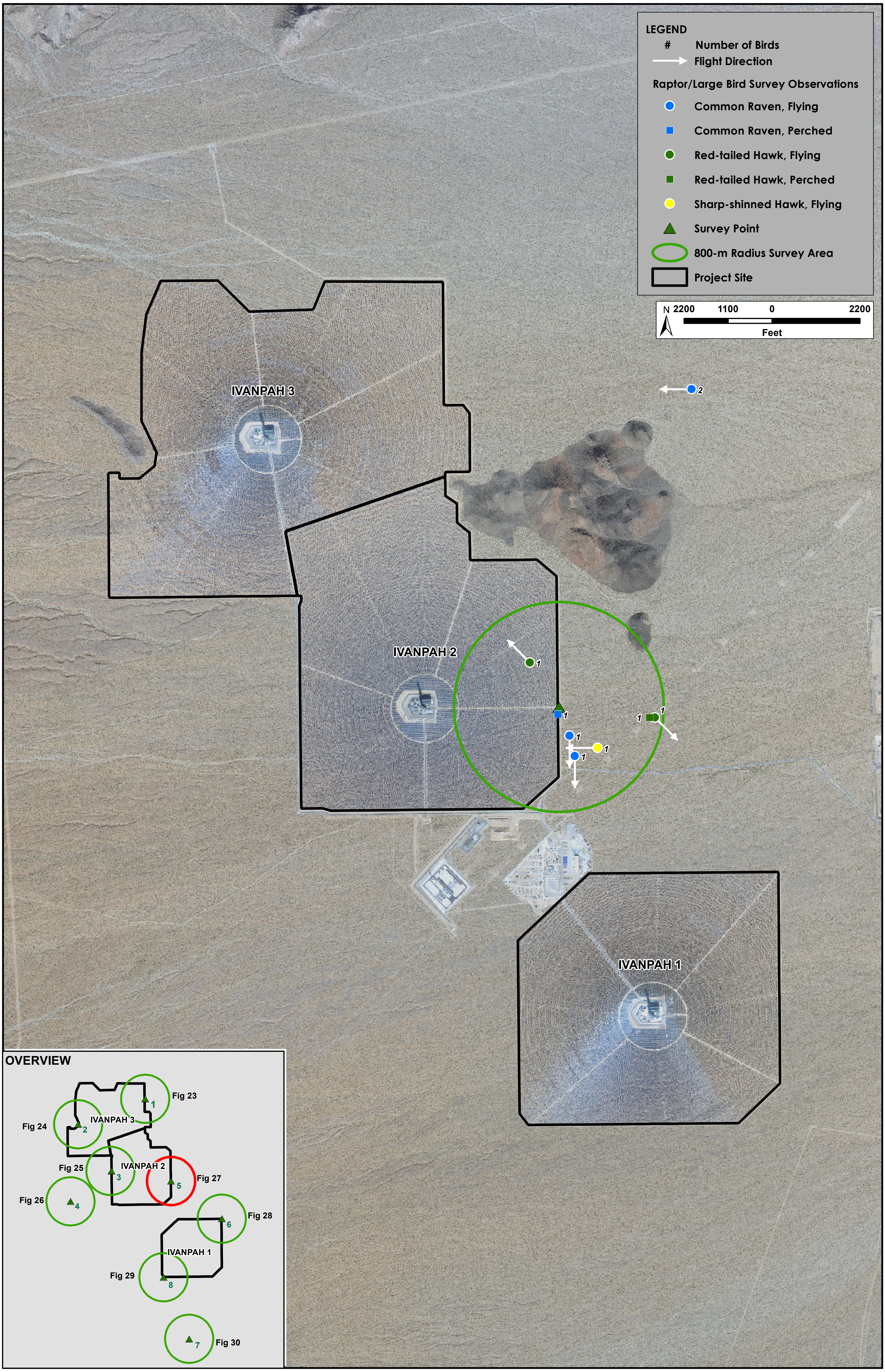
Figure 13: Raptor/Large Bird Survey Observations from Survey Point 4, Spring 2014

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 14 Raptor Large Bird Survey Observations from Survey Point 5 Spring 2014.mxd

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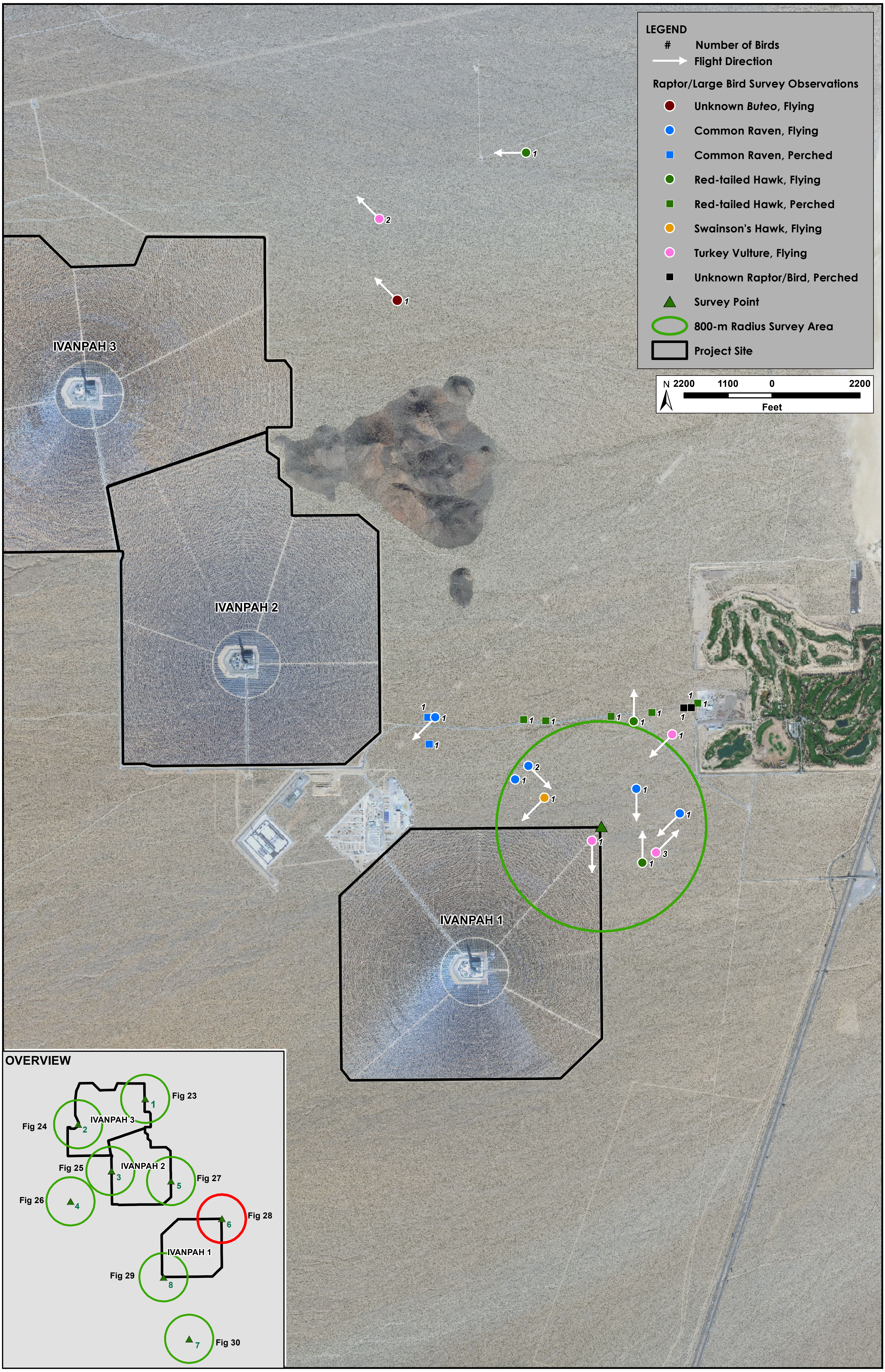
Figure 14: Raptor/Large Bird Survey Observations from Survey Point 5, Spring 2014
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 15 Raptor Large Bird Survey Observations from Survey Point 6 Spring 2014.mxd

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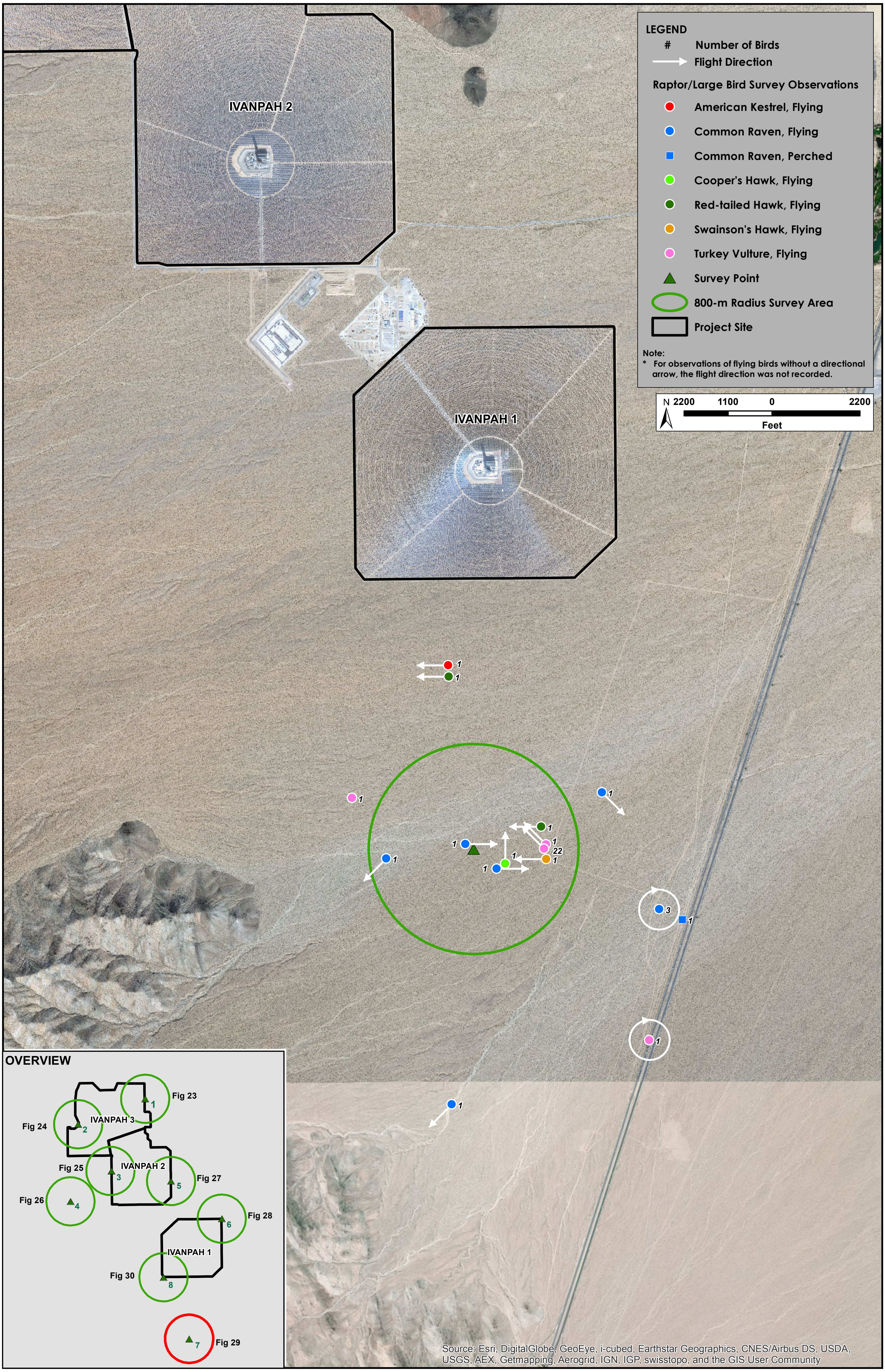
Figure 15: Raptor/Large Bird Survey Observations from Survey Point 6, Spring 2014
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 16 Raptor Large Bird Survey Observations from Survey Point 7 Spring 2014.mxd

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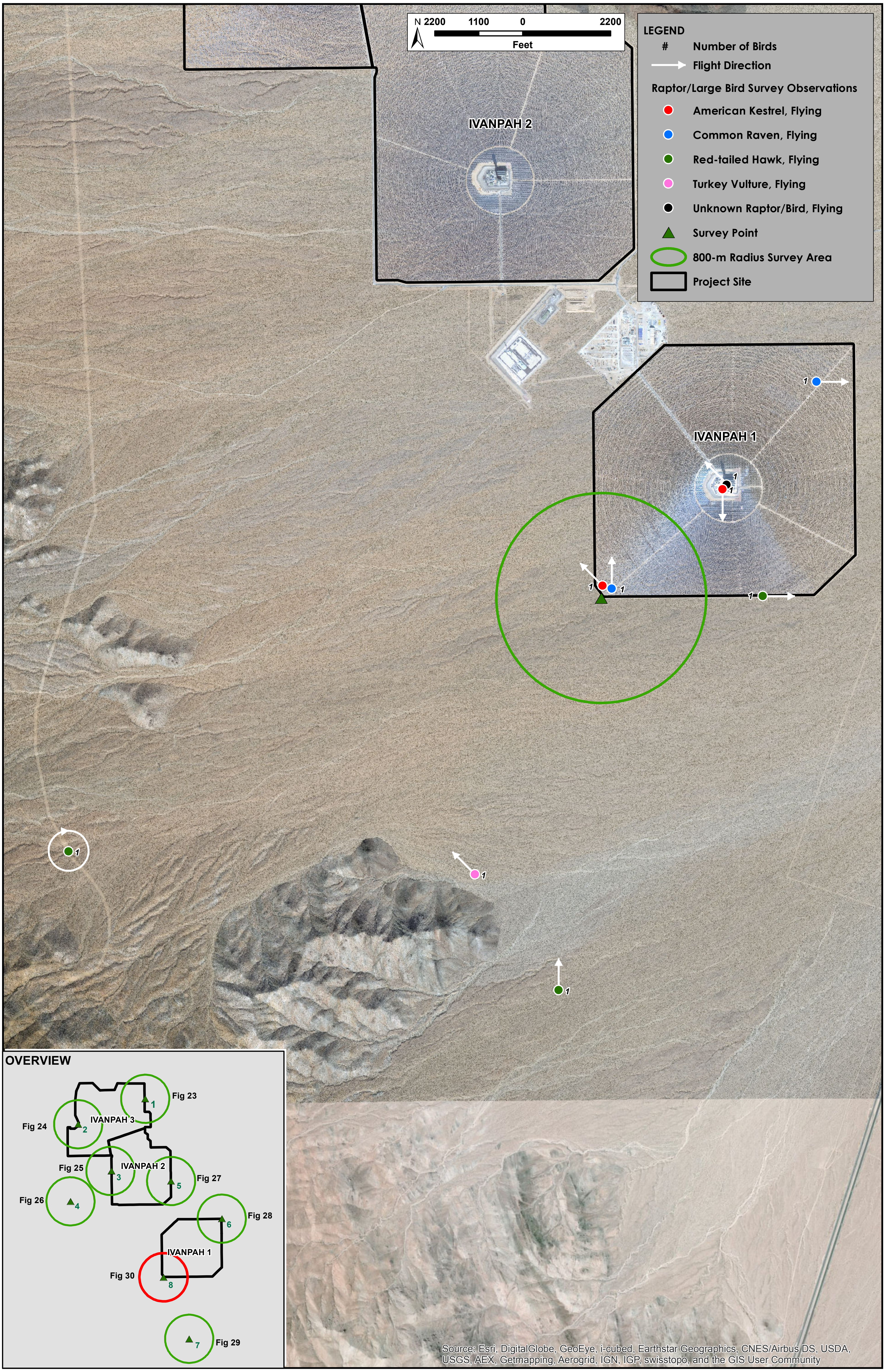
Figure 16: Raptor/Large Bird Survey Observations from Survey Point 7, Spring 2014

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 17 Raptor Large Bird Survey Observations from Survey Point 8 Spring 2014.mxd

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Figure 17: Raptor/Large Bird Survey Observations from Survey Point 8, Spring 2014

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014

Section 4.0 Monitoring Results

4.1 Avian and Bat Detections

The following section describes the basic descriptions and distributions of the detection data. The summary provides the numbers and species list of these detections. Bird and bat detections are also described by their temporal distribution, their migratory or residency status, and by foraging guild.

4.1.1 Summary of Avian and Bat Detections

During the period 23 March – 22 May 2014, a total of two injured birds, and four bat fatalities and 200 avian fatalities, were detected. Ten of the avian fatalities were initially found injured but succumbed to their injuries soon after capture. These birds are considered fatalities in this report. Of the two injured birds, a Brewer's sparrow (collision) found injured escaped during processing and flew away, while an American kestrel (flux) was taken to a rehabilitation facility, where it was still alive as of 1 July 2014. In total, spring detections included 43 avian species and two bat species. The total number of avian detections is listed by species in Table 9 below. Bat detections are listed by species in Table 3. Appendix A includes additional data on these birds and bats. Figures 18, 19, 20, and 21 depict the locations of the bird detections in Units 1, 2, and 3, and outside the units, respectively.

Table 9. Number of Individual Bird Detections, by Species, 23 March 23 – 22 May 2014.

Common Name	Scientific Name	Species Code*	Injuries	Fatalities
Mourning Dove	*Zenaida macroura*	MODO		23
Yellow-rumped Warbler	*Setophaga coronata*	YRWA		22
Unknown Passerine		UNPA		14
Costa's Hummingbird	*Calypte costae*	COHU		12
Horned Lark	*Eremophila alpestris*	HOLA		10
Rufous Hummingbird	*Selasphorus rufus*	RUHU		7
Tree Swallow	*Tachycineta bicolor*	TRES		7
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP		7
Barn Swallow	*Hirundo rustica*	BARS		6
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW		6
Violet-green Swallow	*Tachycineta thalassina*	VGSW		6
Unknown Swallow		UNSW		5
Unknown Hummingbird		UNHU		5
American Kestrel	*Falco sparverius*	AMKE	1	4
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL		4

Common Name	Scientific Name	Species Code*	Injuries	Fatalities
Western Meadowlark	*Sturnella neglecta*	WEME		4
Anna's Hummingbird	*Calypte anna*	ANHU		3
Bank Swallow	*Riparia riparia*	BANS		3
Black-throated Sparrow	*Amphispiza bilineata*	BTSP		3
Calliope Hummingbird	*Selasphorus calliope*	CAHU		3
Loggerhead Shrike	*Lanius ludovicianus*	LOSH		3
Nashville Warbler	*Vermivora ruficapilla*	NAWA		3
House Finch	*Carpodacus mexicanus*	HOFI		3
Wilson's Warbler	*Cardellina pusilla*	WIWA		3
Brewer's Sparrow	*Spizella breweri*	BRSP	1	2
Hermit Warbler	*Setophaga occidentalis*	HEWA		2
Lazuli Bunting	*Passerina amoena*	LAZB		2
Lesser Nighthawk	*Chordeiles acutipennis*	LENI		2
Lincoln's Sparrow	*Melospiza lincolnii*	LISP		2
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS		2
Townsend's Warbler	*Dendroica townsendi*	TOWA		2
White-throated Swift	*Aeronautes saxatalis*	WTSW		2
American Coot	*Fulica americana*	AMCO		1
Ash-throated Flycatcher	*Myiarchus cinerascens*	ASFL		1
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR		1
Broad-tailed Hummingbird	*Selasphorus platycercus*	BTAH		1
Eared Grebe	*Podiceps nigricollis*	EAGR		1
Eurasian Collared-Dove	*Streptopelia decaocto*	EUCD		1
Lesser Goldfinch	*Spinus psaltria*	LEGO		1
Olive-sided Flycatcher	*Contopus cooperi*	OSFL		1
Rock Pigeon	*Columba livia*	ROPI		1
Unknown Bird		UNKN		1
Unknown Heron		UNAR		1
Unknown Passerine or Swift		UNPS		1
Unknown Swift		UNKS		1
Unknown Warbler		UNWA		1
Vaux's Swift	*Chaetura vauxi*	VASW		1
Western Kingbird	*Tyrannus verticalis*	WEKI		1
Yellow Warbler	*Setophaga petechia*	YEWA		1
Yellow-breasted Chat	*Icteria virens*	YBCH		1

Common Name	Scientific Name	Species Code*	Injuries	Fatalities
Bats				
California Myotis	*Myotis californicus*	MYCA		2
Brazilian Free-tailed Bat	*Tadarida brasiliensis*	TABR		2

* Species code refers to the code (usually a four-letter designation) by which the species are referred on Figures 6-9.

4.1.2 Avian Detections by Temporal Occurrence Group and Foraging Guild

To provide information on how birds recorded as detections might use the Ivanpah site, both temporally (i.e., during which seasons and for what duration) and in terms of potential resource use on the site, we categorized all bird detections by temporal occurrence group and foraging guild.

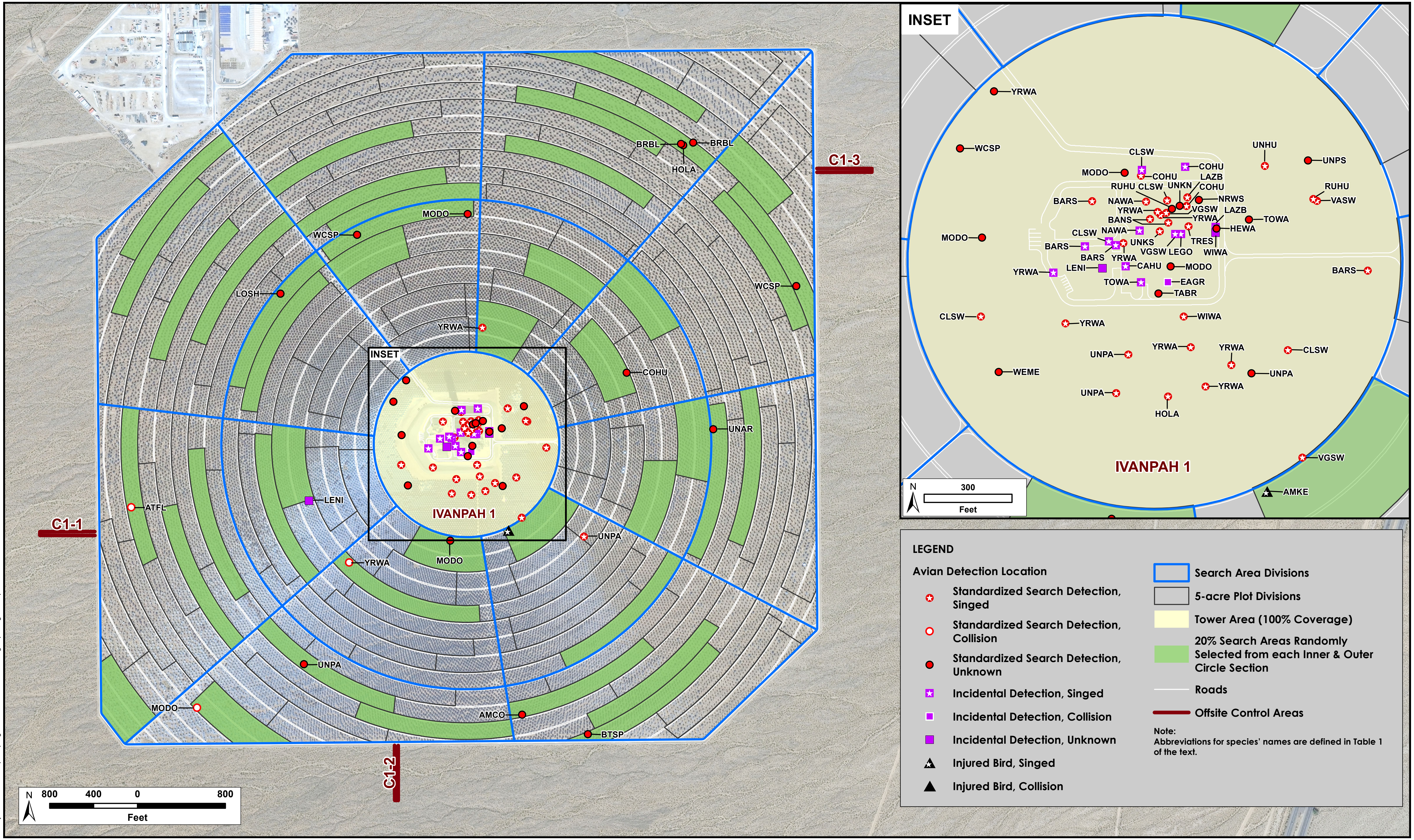
4.1.2.1 Avian Detections by Temporal Occurrence Group

Avian detections were categorized as representing one of four temporal occurrence groups, as follows:

- Permanent residents – species that are present in the Ivanpah Valley year-round
- Breeding-season residents – species that are present in the Ivanpah Valley only during the breeding season and during migration between breeding and wintering areas but which generally do not winter here (or are very rare in winter)
- Nonbreeding-season residents – species that are present in the Ivanpah Valley only during the nonbreeding season and during migration between breeding and wintering areas but which do not occur here during the breeding season
- Transients – species that are present in the Ivanpah Valley only during migration between breeding and wintering areas

Bird species were categorized according to these groups based on published and Internet information regarding their breeding and wintering ranges, and our knowledge of their breeding and wintering ranges.

Species that are permanent residents in the Ivanpah Valley accounted for 31.2% of the total detections on the site during the 2014 spring season (Figure 22), with nonbreeding-season residents accounting for 17.3% of total detections. The breeding-season resident species represented 11.4% of all detections. The remaining detections represented transient species (29.2%) and remains (often limited feather spots) that could not be identified to species (10.9%).



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 18 Ivanpah 1 Detections.mxd

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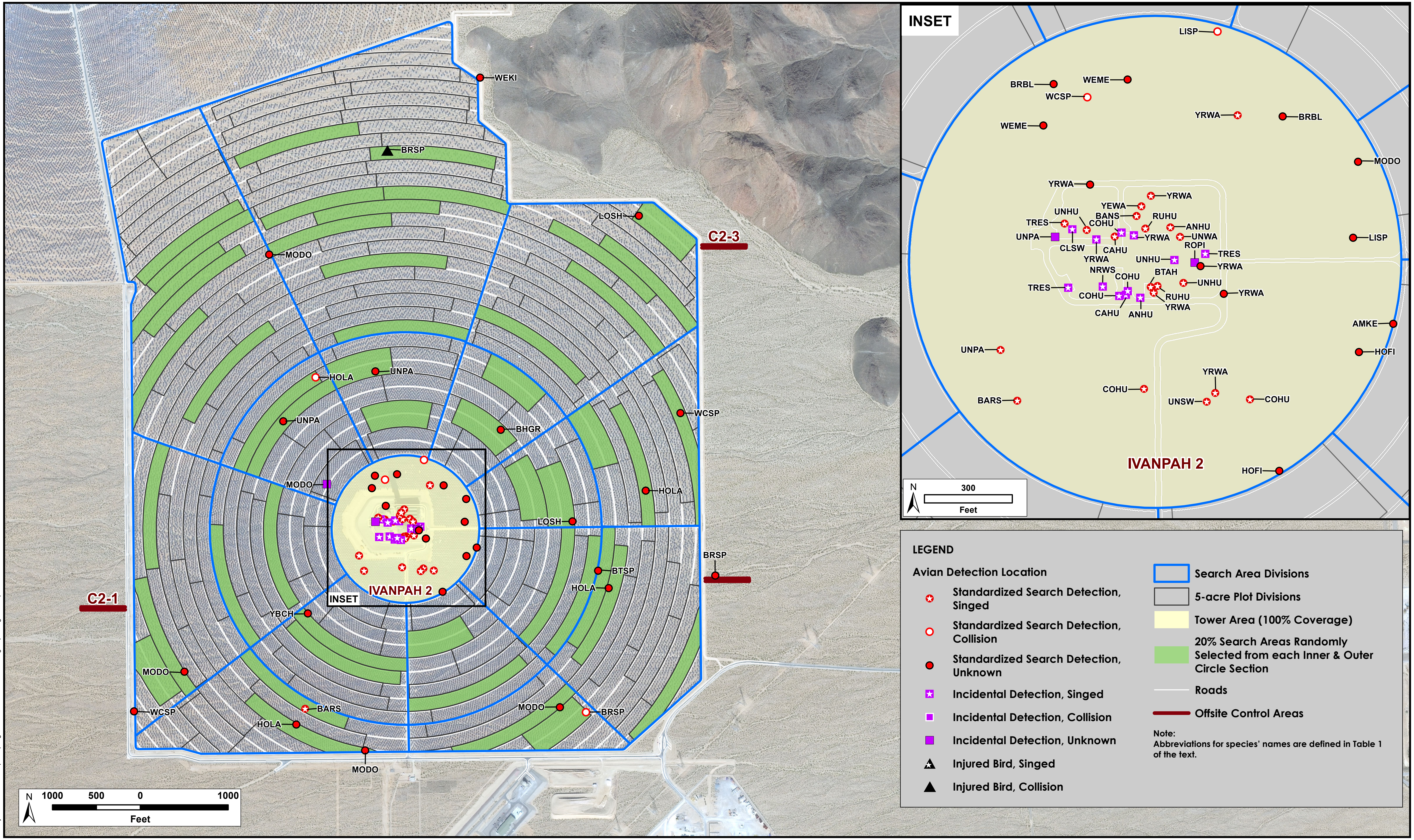
Figure 18: Ivanpah 1 Detections

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 19 Ivanpah 2 Detections.mxd

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Figure 19: Ivanpah 2 Detections
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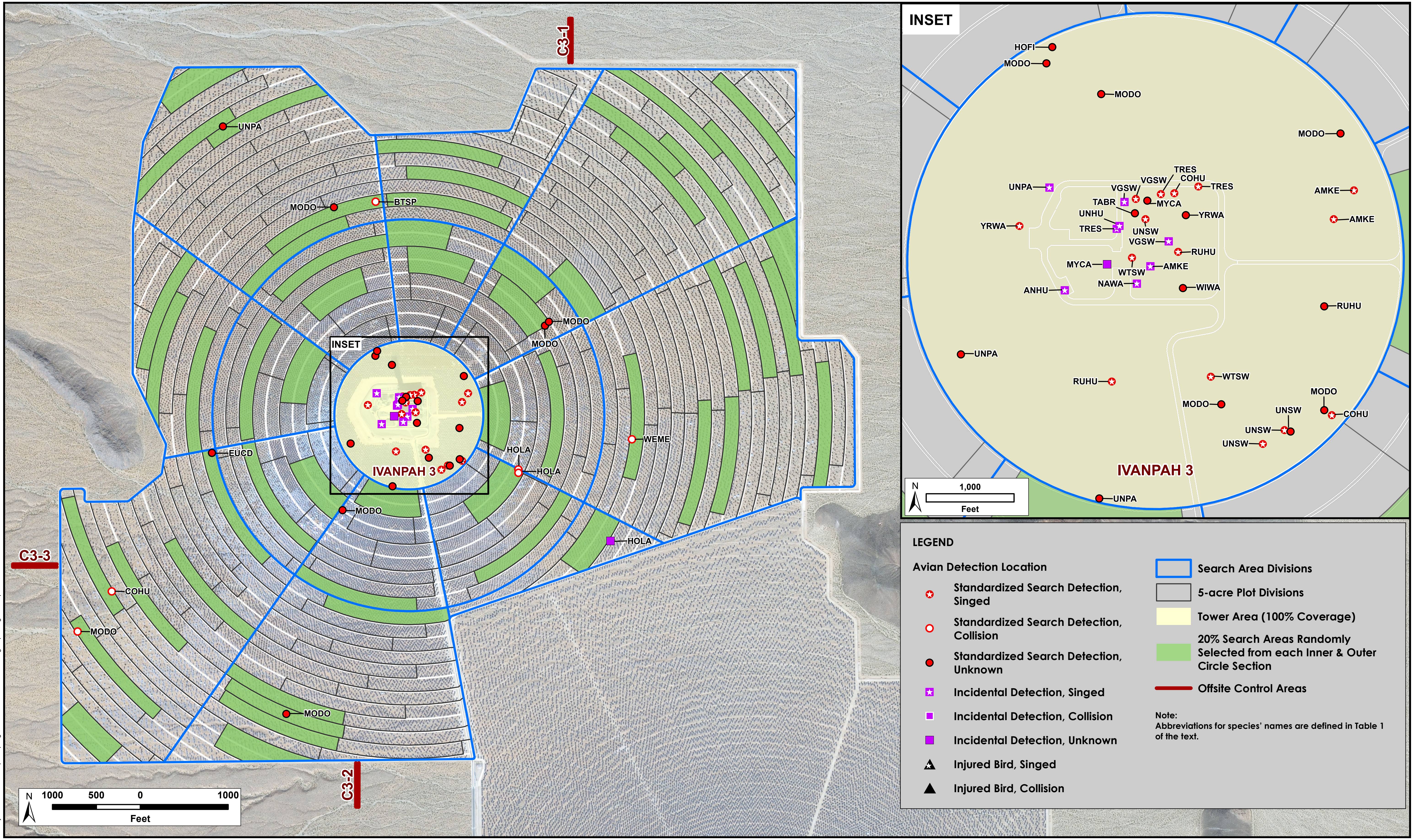
August 2014



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 20 Ivanpah 3 Detections.mxd

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Figure 20: Ivanpah 3 Detections
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014

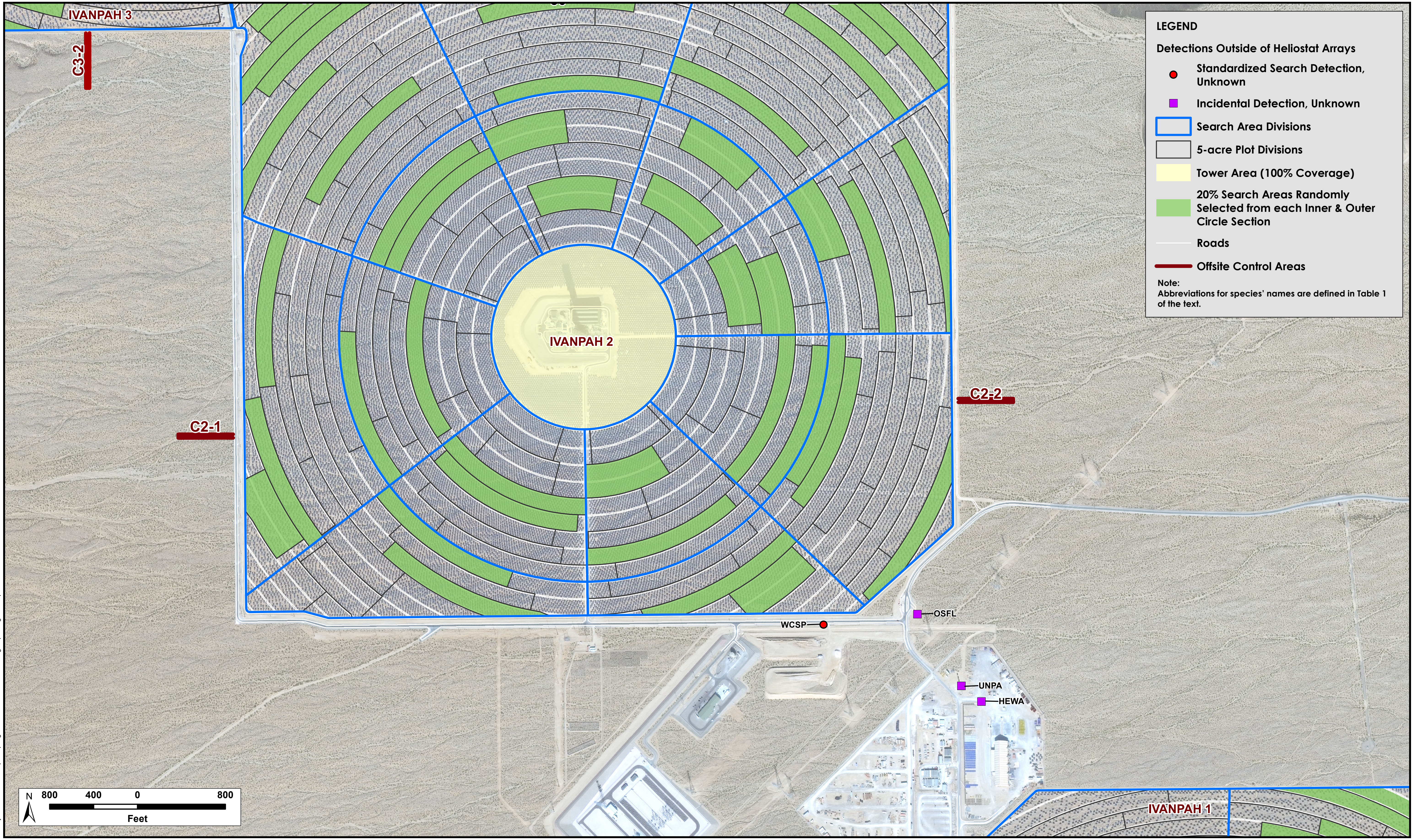

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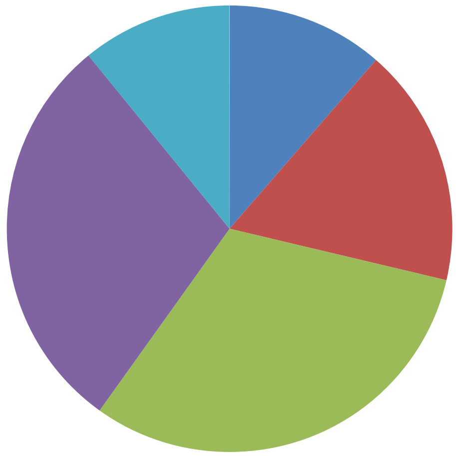
Figure 21: Ivanpah Detections Found Outside of Solar Units

Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)

August 2014

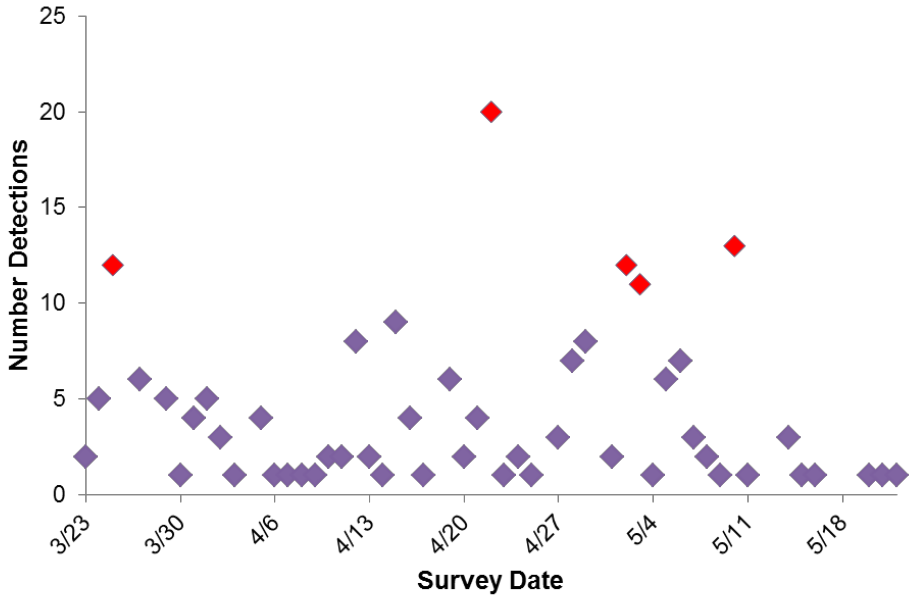
Figure 22. Percent of Detections in Each of Five Temporal Occurrence Groups.



There was no obvious temporal clumping of detections recorded during the spring season; however, five survey days resulted in more than 10 fatalities each (Figure 23). In each case, the majority of detections were in the tower area (power block and inner HD heliostats) of a single unit, and these detections were distributed among flux-related, collision, and unknown detections (rather than just one mortality cause). It is not yet clear why such increases in detections occurred, but they appear be related to increased migratory activity in the region. Some may have been associated with the passage of weak weather fronts, though no events meeting the criteria for "low-visibility weather events" per Section 2.2 of the Plan occurred during the 2014 spring monitoring period. The Cornell Lab of Ornithology, in cooperation with the National Oceanic and Atmospheric Association (NOAA), Oregon State University, and University of Massachusetts Amherst, releases a weekly analysis of migration activity across the United States on its "BirdCast" website.[2] Examination of these records showed that daily detection rates of more than 10 per day at Ivanpah coincided with increases in migration activity within the desert southwest. Two periods of heavy migration activity were documented by BirdCast: 18-25 April and 2-3 May. On 22 April, seventeen fatalities were found in the Unit 2 tower area. On 2 May, eight fatalities were collected incidentally on the Unit 1 power block, with an additional 13 found in the Unit 1 tower area during the standardized survey the following day. Moderate migration activity was documented by BirdCast around 21-25 March. On 25 March, 10 fatalities were found in the Unit 3 tower area. The 10 May survey of the Unit 1 tower area, which detected 12 fatalities, was preceded by moderate migration activity (as documented by BirdCast) from approximately 7-9 May. Fatalities detected during these surges were almost exclusively migratory species, with hummingbirds, swallows, and warblers representing the majority of species found.

[2] http://birdcast.info/forecasts

Figure 23. Number of Detections on Each Survey Date, 22 March – 23 May 2014.

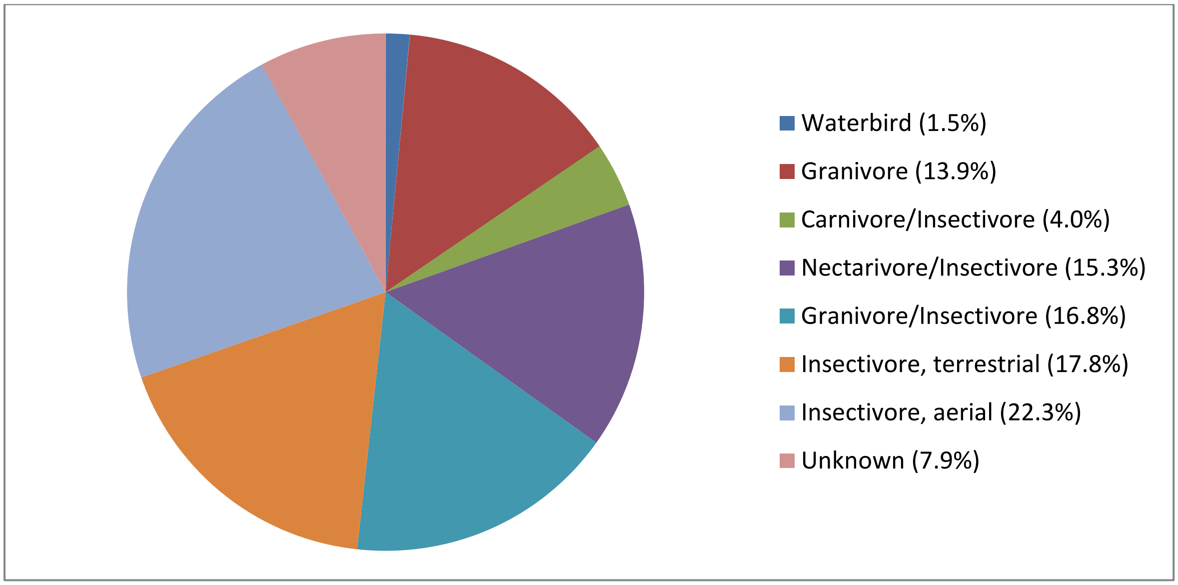


*Red points denote surveys where more than 10 fatalities were detected.

4.1.2.2 Avian Detections by Foraging Guild

We also categorized all detections within the search area by foraging guild, with all waterbirds included in one "waterbird" category. As indicated in Figure 24, aerial insectivores accounted for the largest percentage of detections (22.3%), followed by terrestrial insectivores (17.8%), granivores/insectivores (16.8%), and nectarivore/insectivores (i.e. hummingbirds, 15.3%). Waterbirds accounted for the smallest percentage of detections, with just three individuals detected during the 2014 spring season; of these, an eared grebe was found as a collision-related detection in the power block, while the cause of mortality of an American coot and an unknown heron/egret in the outer heliostat segments was unknown.

Figure 24. Percent of Total Detections in Each of Seven Foraging Guilds.



4.1.3 Injured Birds

Twelve injured birds were detected during this reporting period (Table 10). All but two of these injured birds (a Brewer's sparrow and an American kestrel) eventually succumbed to their injuries, and are included in this report as fatalities. Injured birds were transported to a wildlife rehabilitation center the same day they were detected. Two birds were not taken to a rehabilitator: a Costa's hummingbird died on site before it could be taken to a rehabilitator, and the aforementioned Brewer's sparrow escaped alive after colliding with a heliostat. With the exception of the American kestrel, all other injured birds died either en route to or at a wildlife rehabilitation center. As of July 1, the kestrel was still alive. It is not yet clear whether the kestrel will be releasable, as this will depend on whether it can recover from its flux related injuries and molt in normal feathers this autumn. All 10 birds with flux-related injuries were close to the towers; eight were found in a power block (within 100 m of a tower), and the other two were 274 m and 277 m, respectively, from the nearest tower.

Table 10. Avian Injuries Detected 23 March – 22 May 2014.

Date	Species	Cause of Injury	Burn Grade	Fate
3/24/2014	Tree Swallow	Singed	2	Died en route to rehab
4/5/2014	Yellow-rumped Warbler	Singed	2, 3	Died en route to rehab
4/5/2014	American Kestrel	Singed	2, 3	Alive, rehab center
4/12/2014	Violet Green Swallow	Singed	2, 3	Died 4/15 at rehab
4/24/2014	White-Throated Swift	Singed	2, 3	Died 5/2 at rehab
4/25/2014	Brewer's Sparrow	Collision, heliostat	N/A	Escaped alive
4/28/2014	Costa's Hummingbird	Singed	2, 3	Died on site
4/28/2014	Rufous Hummingbird	Singed	2, 3	Died at rehab 4/29
4/28/2014	Tree Swallow	Singed	2, 3	Died en route to rehab
5/3/2014	Lazuli Bunting	Singed	2, 3	Died en route to rehab
5/3/2014	Barn Swallow	Singed	2, 3	Died en route to rehab
5/6/2014	Western Kingbird	Unknown	N/A	Died at rehab 5/14

4.1.4 Foraging Guilds and Spatial and Temporal Distribution of Bats

Four bat detections representing two species (California myotis [*Myotis californicus*] and Brazilian free-tailed bat [*Tadarida brasiliensis*]) were detected during this reporting period (Table 11). All bat detections were within or immediately adjacent to the ACC buildings. The California myotis is a high-frequency emitting bat that typically forages aerially in close proximity to cluttered habitats (i.e., near shrubs, trees, and other objects). The California myotis is a year-round resident. Although the Brazilian free-tailed bat may occasional occur on site during winter and summer months, higher numbers are expected when this species is migrating through the area during spring and fall months.

Table 11. Summary of Bat Detections, 23 March – 22 May 2014.

Species	Date	Location
California Myotis	3/25/14	Unit 3 ACC
Brazilian Free-tailed Bat	3/31/14	Unit 3 ACC
Brazilian Free-tailed Bat	5/3/14	Unit 1 Power Block building
California Myotis	5/4/14	Unit 3 Common Area Standby Generator Room

4.1.5 Incidental Detections

A total of 44 incidental avian detections and one incidental bat detection were recorded during this quarter. Forty-one of these avian detections and the bat detection were within the solar units (Figures 18, 19, and 20). The other three detections were in areas of the Project site outside of the solar units, including the former location of the vehicle washing station, and within the Common Logistic Area (CLA) (Figure 9).

4.1.6 Fatalities Found During Standardized Searches

During the course of 2014 spring season standardized searches, searchers found 158 bird detections and three bat detections (Figures 18, 19, and 20).

4.2 Locations of Avian Detections

As indicated in Table 12, 141 detections (69.8%) were within 260-m of the tower; an area that was searched with 100% coverage. Fifty-four detections (26.7%) were detected over the much larger area composed of the inner and outer heliostats. Otherwise, three detections were along the fenceline (1.5%), three were on Project lands outside the standardized search areas (1.5%), and one (0.5%) was found along an off-site control transect east of Unit 2 (Figure 19). No detections were noted within the survey areas associated with the Unit 3 Collector Line. Of the 198 avian detections within the solar units, 77 (38.9%) were detected in Unit 1, 71 (35.9%) in Unit 2, and 50 (25.3%) in Unit 3. The three units operated with roughly the same number of days in flux during the spring period.

Table 12. Locations of Bird Detections, 23 March – 22 May 2014.

Location	Injuries	Fatalities
Power Block	0	84
Inner HD Heliostats	0	57
Inner Segment Heliostats	1	20
Outer Segment Heliostats	1	32
Unit Perimeter Fences	0	2
CLA Fence	0	1
Unit 3 Collector Line	0	0
Offsite Control Transects	0	1
Other Project Lands	0	3

4.3 Cause of Injury or Fatality

The following section describes the number of detections with evidence of flux or collision effects; the number for which cause of injury or fatality is unknown; the spatial distributions of detections with these causes relative to the towers; and the temporal distributions of detections with these causes relative to the number of days in which flux was occurring. Methods for identifying the cause of injury or fatality were provided in Section 2.2.1.3.

4.3.1 Solar Flux Effects

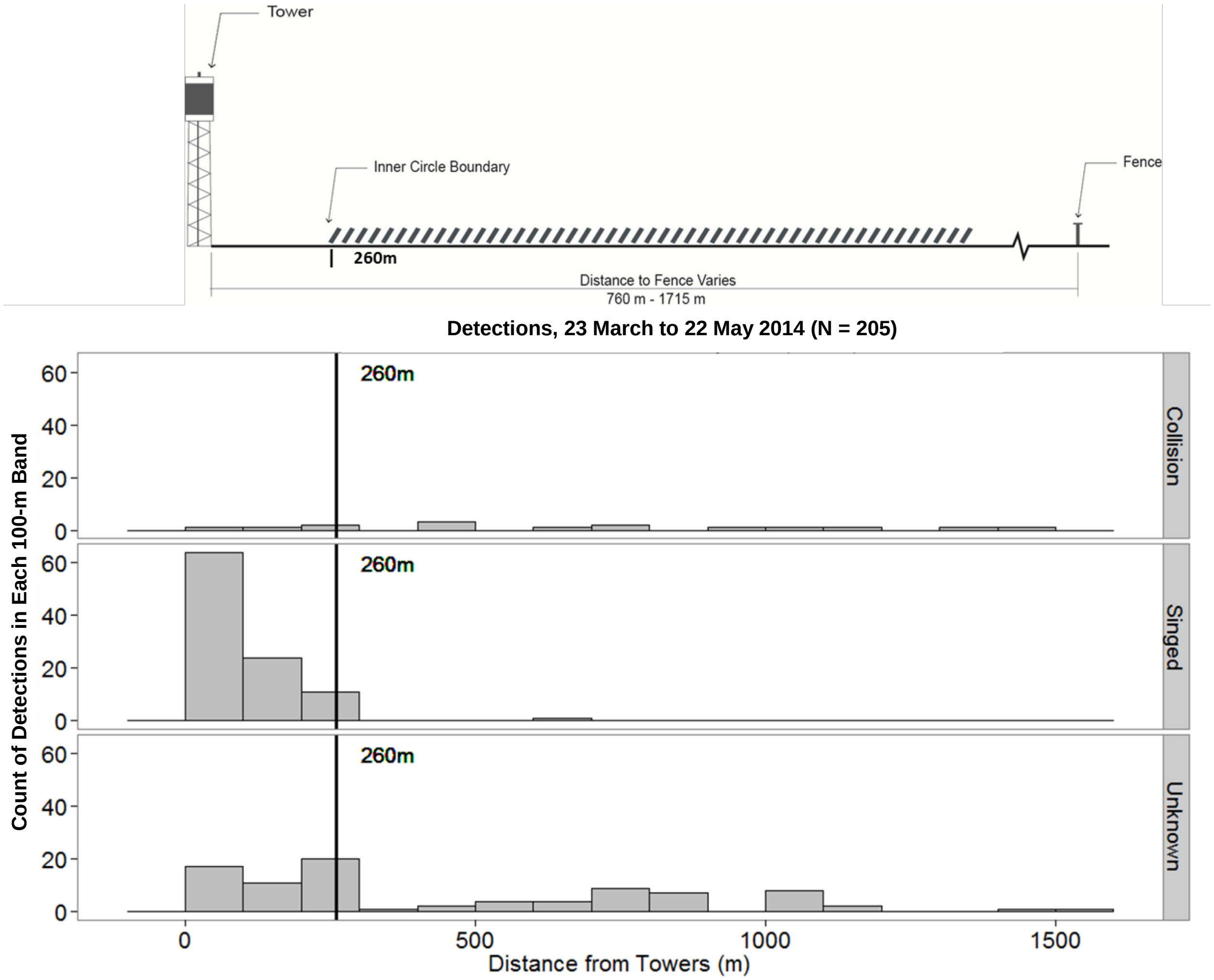
Of the 202 avian detections during the 2014 spring season, 99 fatalities and one injured bird (49.5%) showed signs of singed feather damage from flux effects. Four were raptors, 96 were small birds (≤ 100 g), and none were large birds. Table 13 indicates the number of detections in various parts of the Project site with and without evidence of flux effects as determined through microscopic examination.

Table 13. Locations of Flux and Non-Flux Related Bird Detections, 23 March – 22 May 2014.

Location	Flux	Non-Flux
Power Block	69	15
Inner HD Heliostats	28	29
Inner Segment Heliostats	2	19
Outer Segment Heliostats	1	32
Unit Perimeter Fences	0	2
CLA Fence	0	1
Unit 3 Collector Line	0	0
Offsite Control Transects	0	1
Other Project Lands	0	3

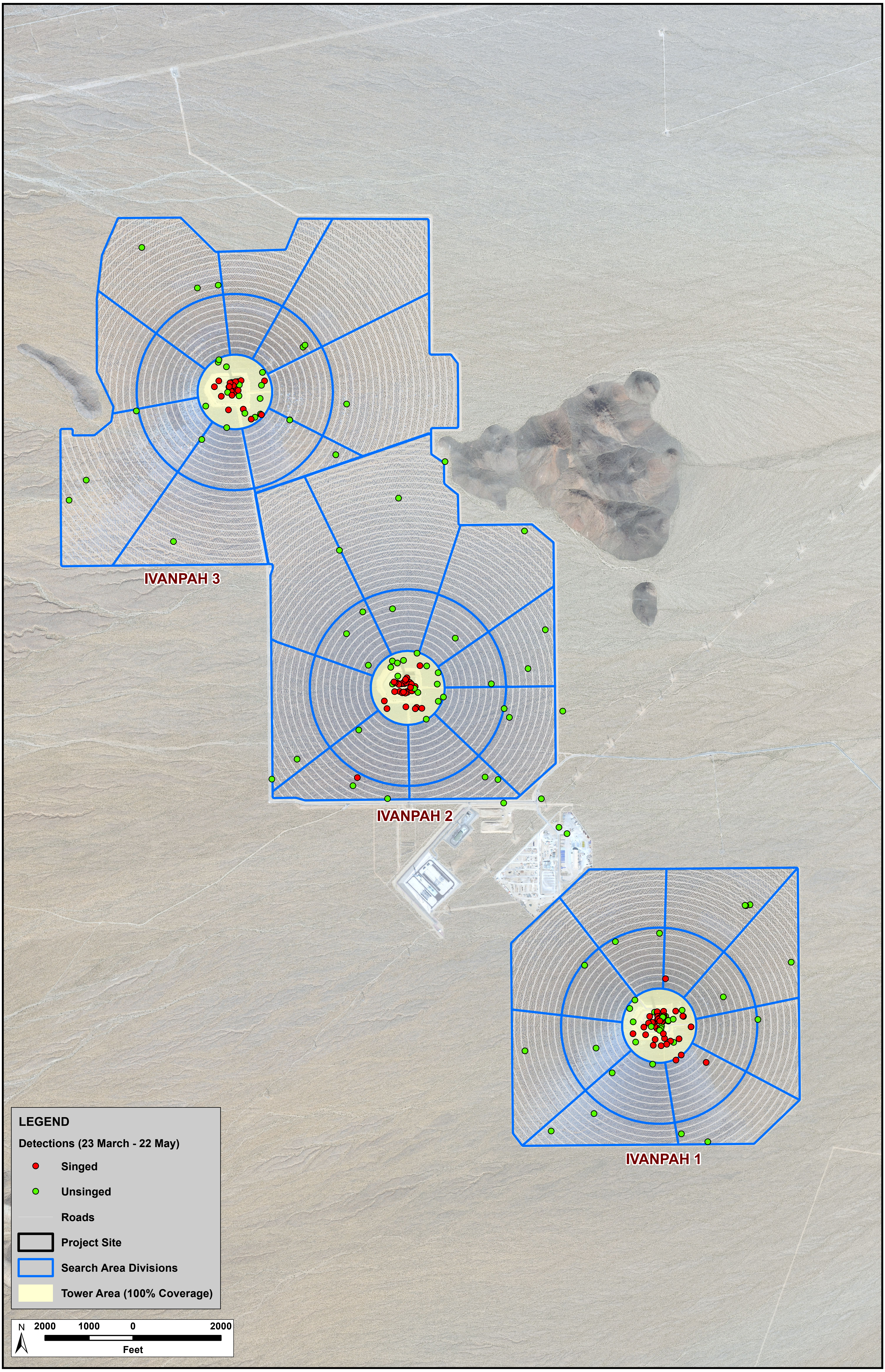
Figure 25 depicts the total number of detections involving evidence of singeing, evidence of confirmed collision, and unknown cause of injury or death by distance from the power towers. Detections with an "unknown" cause of injury or death refer to those for which there was no evidence of singeing (e.g., charring, curling, or melting of feathers) or collision (e.g., obvious physical trauma or detection adjacent to a heliostat with a bird-strike imprint and/or feathers on the heliostat), as confirmed through microscopic examination. The three incidental detections outside the solar units (none of which were singed) are not shown so that Figure 25 focuses on the solar units themselves. Figure 14 provides an overview of the spatial locations of each singed and non-singed detection within the solar units.

Figure 25. Number of Detections[1] Associated with Flux Effects or Collisions and Unknown Injury/Fatality Sources by Distance from Towers.



[1] Only raw data are presented, so this graph does not take into account the increase in survey area as distance away from the tower increases.

As indicated by these data, the vast majority of detections showing evidence of flux effects were discovered close to the towers. Ninety-seven (97%) of the 100 flux-related detections were within the tower area. The other three flux-related detections included two birds (an American kestrel found injured, and still alive at a rehabilitation facility as of 1 July 2014, and a yellow-rumped warbler that was found injured but that died en route to a rehabilitation facility) in the inner heliostat segments not far outside the inner HD heliostats and one partial carcass of a barn swallow detected in the outer segment (possibly relocated to this area by a scavenger; Figure 26). These results suggest that flux-related injury and mortality occurs in the immediate vicinity of the high-density flux fields around the towers, with relatively fewer flux-affected individuals capable of flying longer distances from the towers.



N:\Projects\2802-01\07\Report\Spring 2014 Avian and Bat Monitoring Report\Fig 26 Locations of Singed and Unsinged Detections within Solar Units.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 26: Locations of Singed and Unsinged Detections within Solar Units
Ivanpah Spring 2014 Avian and Bat Monitoring Report (2802-07)
August 2014

4.3.2 Spatial and Statistical Analysis of Unknown and Flux Mortality

Per the request of the TAC, analyses were conducted to determine the relationships between flux and both flux-related detections and detections where the cause was unknown, both spatially and in relation to a measure of flux activity. Two methods of analysis were used, a distance distribution method and a statistical analysis of the relationship of flux activity to singed and non-singed detections.

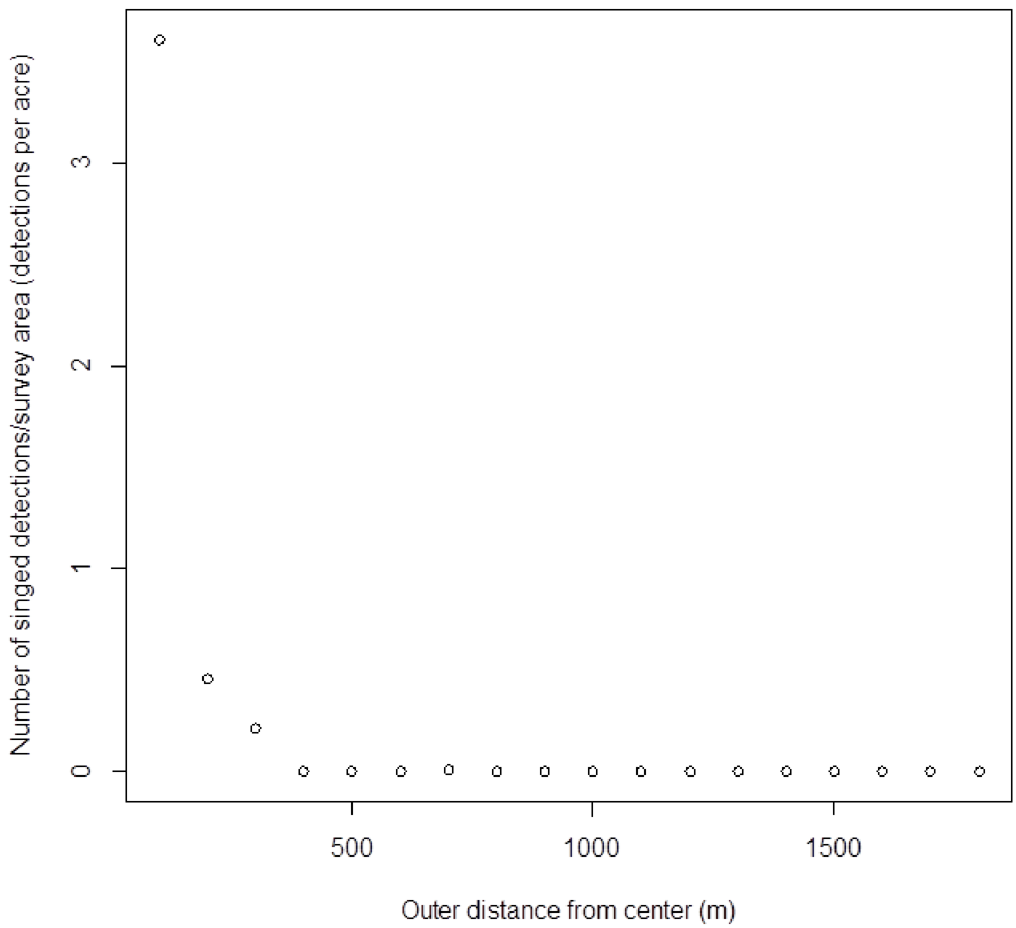
Beyond the 260-m radius area that is surveyed 100%, the amount of total area increases exponentially in relation to the radius, while plot size stays fixed at 5 acres. When considering relationships between fatality density and radius, it is important to take into account the amount of sampling effort at increasing radii; otherwise, one may make the mistake of inferring a distribution of fatalities that is actually driven primarily by the distribution of sampling effort.

To examine the relationship between radius from the power towers and the density of fatalities from unknown or collision causes beyond the 260-m tower area, we used ARCGIS to divide the Project area into concentric rings of 100 m around each of the power towers, clipping to the outer edge of the Project area. In each concentric ring we calculate the area in our fatality survey plots and the total area. Figure 2 depicts the three solar units and the standardized survey areas within the units.

4.3.2.1 Spatial Analysis of Singed Detections

To examine the relationship between radius from the tower and density of singed detections, we included all fatalities found with evidence of singeing from 30 October 2013 to 16 July 2014 (n=133). We divided the number of fatalities found in each concentric ring by the amount of area surveyed (acres) to calculate a density of fatalities for each ring. Figure 27 shows the density of singed fatalities for each concentric ring, grouped across units. We plotted a trendline using the LOESS function in R. This figure confirms that using both raw numbers of detections (as in Figure 25) and densities of detections (as in Figure 15), singed detections are clearly concentrated near the tower.

Figure 27. Density of Singed Detections (Detections Per Survey Acre in Each Distance Band), from 0 Meters out to a Distance 1600 Meters from the Tower, Adjusted by Search Area and Summed across the Three Tower Units.



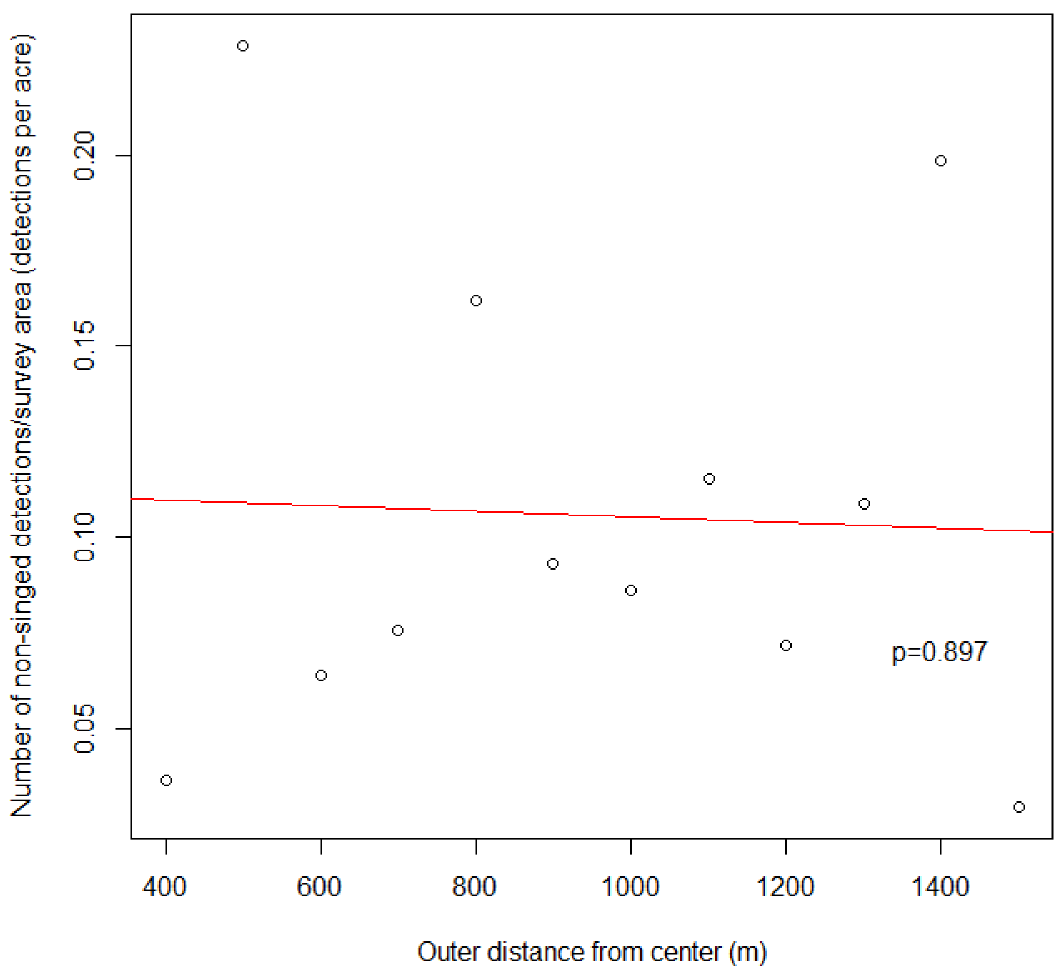
4.3.2.2 Spatial Analysis of Non-Singed Detections

To further examine the relationship of the fatalities to the project features like the towers, we next examined non-singed fatalities. Fatalities included in this analysis include all non-singed detections found during systematic surveys between 30 October 2013 and 16 July 2014 (n=313). We removed all fatalities with evidence of singeing, those found along the CLA fence surrounding the O&M and parking areas (outside the heliostat arrays), and those within 260 m of the center (the 100% survey area), which resulted in a sample size of 90 detections included in this analysis of the heliostat area beyond 260 m of the towers. In R, we used the cut function to count the number of detections found in each ring in each array area. We calculated the total survey area in acres for each distance band around the centers of the units and then calculated the density of unknown or collision caused detections by dividing the number found within each band by the amount of area surveyed in each band. We also eliminated data from the outermost bands, which contain so little area (and thus have such a low probability of detection) that they skew the data.

We ran a generalized linear model on the density of fatalities in each band, by band distance and unit, to examine the relationship between radius and fatality density on fatalities between 300 and 1600 m. Beyond 1600 m, the amount of survey area covered decreases dramatically and is restricted to the fence and corners of the units, resulting in low probability of any detections.

Figure 28 depicts the density of non-singed detections found between 300 m and 1600 m from the towers, expressed as the number of detections within a given band divided by the area surveyed within that band. Based upon the GLM analysis, there is no effect of band distance (p=0.9), Tower Unit [1, 2, or 3] (p=0.85), or the interaction of these two variables (p=0.9). Thus, the unknown detections are relatively evenly distributed and do not show a distribution that would indicate that the non-singed detections were associated with the effects of elevated levels of flux near the towers.

Figure 28. Density of Non-Singed Detections (Detections Per Survey Acre in Each Distance Band), from 300 Meters out to a Distance 1600 Meters from the Tower, Adjusted by Search Area and Summed across the Three Tower Units. The red trend line shows a slope no different from zero (p=0.9).



4.3.2.3 Statistical Analysis of Flux and Unknown Detections

At the request of the TAC, statistical analysis of the unknown detections and flux-related detections was conducted to determine the relationship between flux activity and number of detections at the facility. This analysis was conducted to complement the results of the spatial analysis (above) relating flux effects to distance from the tower and the microscopic inspections of detections conducted by the biologists to identify singed vs. non-singed detections.

Figure 29 shows the relationship between tower flux and singed bird detections during spring 2014, for the 8 weeks from 23 March to 15 May. There were a total of 81 detections with signs of flux during this period, collected both during standardized fatality surveys (n=57) and incidentally between surveys (n=24), which we summed by week (range of two to 25 singed birds per week). Tower flux data contained a binary value for each tower per day (i.e., either fluxing or not), and we summed the days of flux per week during this period, for a maximum of 21 tower flux-days per week (range of 11 to 21).

As expected, a positive correlation exists between tower flux-days and singed detections (coefficient of determination; R^2 =0.64). There was a temporal trend in the flux data, where early in the season there were fewer days of flux per week, with flux increasing as the season progressed. Bird activity also increased temporally with the onset of the migratory bird season. Because the x-axis is limited to 7 days of all three units in flux (= 21 tower flux-days) the slope of the curve increases with higher numbers of birds.

Figure 29. Relationship between Number of Days of Tower Flux per Week and Number of Singed Detections at Ivanpah During Spring 2014.

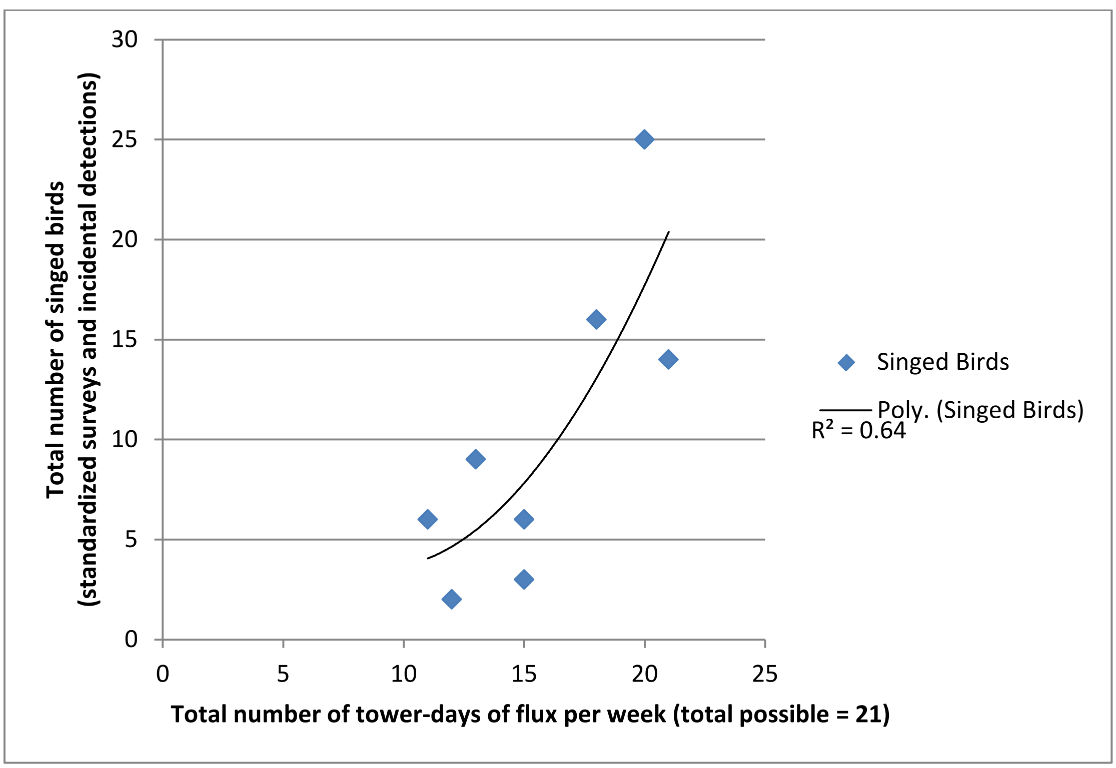
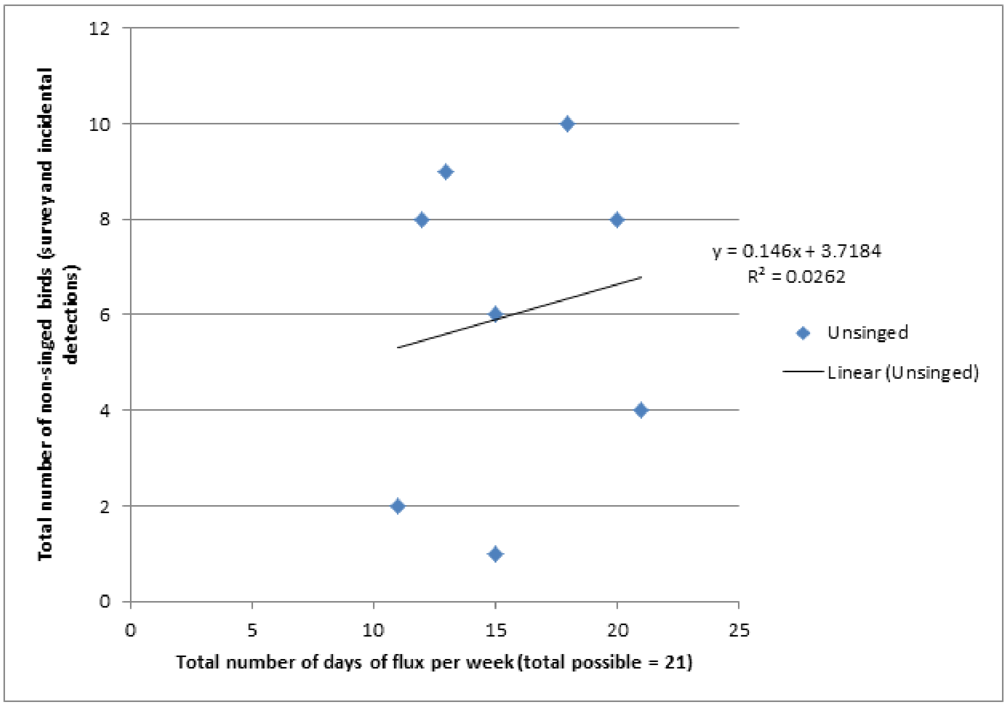


Figure 30 depicts the relationship between flux activity and number of non-singed fatalities found per week (collision and unknown, n=48) during the spring. The x axis has number of tower-days of flux per week, a possible total of 21. The y axis has the number of non-singed fatalities found per week. We only graphed the spring quarter because the search interval during the winter is too long to parse out this type of relationship. We also excluded all fatalities that were estimated to be older than one week to reduce the influence of older fatalities confounding the relationship. Basically there is no correlation (R squared = 0.03) between tower-days of flux and the number of non-singed fatalities. Thus, this statistical analysis is consistent with the necropsy microscopic analysis suggesting that unknown detections are not flux-affected.

Figure 30. Relationship Between Flux Activity and Number of Non-singed Fatalities Found Per Week (Collision and Unknown, N=48).



4.3.3 Collisions and Other Non-Flux Effects

Of the 202 detections, evidence of collisions was observed in the case of 15 (7.4%). As described in Section 2.2.1.3, the evidence that was used to classify these detections as collisions was proximity to heliostats that had smudge marks, body imprints, and/or feathers on or near the surface of the mirror. However, birds that collide with structures do not always leave visible evidence. Of the collisions, 14 were with heliostats, and one was apparently with a structure on the power block.

Aside from the 15 detections where evidence of collision was noted and the 100 detections with evidence of flux effects (discussed below), the cause of injury or mortality for the remaining 87 detections (43.1%) is not known with certainty, and no obvious evidence of mortality was observed for these detections; however, spatial, statistical, and microscopic analysis does not support that these mortalities were the result of flux.

No detections occurred along the Unit 3 Collector Line, and no evidence of collision or flux effects was found on the single fatality detected in the offsite control areas.

None of the bat detections showed evidence of flux effects; this result is expected because bats have a lower exposure rate to flux due to their foraging habits. All of the bat detections were in or near Project buildings on the power block, but the cause of death for these bats remains unknown.

4.4 Feather Spot Detections

The following section describes the number of detections that consisted only of feather spots and spatial patterns in the ratio of feather spots to carcass-based detections.

Ninety-five (47.0%) of the 202 detections consisted only of feather spots; 73 of these feather spots were identifiable to species, 21 were identifiable to order or family, and one was not identifiable. While evidence of flux effects through direct and microscopic examination was noted on 23 of these 95 feather spots, and evidence of collision was noted in the case of five other feather spots, the cause of the feather spot for the other 67 birds is unknown. The proportions of these 67 feather spots representing fatalities (e.g., collision) that had been scavenged and representing natural predation events associated with desert kit foxes, common ravens, or raptors are not known. Furthermore, in some cases, multiple feather spots may result from one fatality, over-representing the number of fatalities. Nevertheless, all feather spots meeting minimum criteria (i.e., ≥ 10 feathers of any type, ≥ two primary feathers, or five or more tail feathers within an area 1 m^2 or smaller [Smallwood 2007], or any skin, flesh, or bone attached to feathers) were recorded as detections.

As indicated in Table 14, the ratio of feather spots to carcasses varied considerably across the Project site. It was highest in the inner HD heliostats (1:0.3), and lowest in the power block (1:6), with the inner and outer segments (1:0.5) nearer equal. The ratio of feather spots to carcasses was also high along the fence lines (0:2); however, only three fatalities were found along the fences. The change in ratio between the power block and inner HD heliostats could result from the rapidity with which carcasses around the tower are detected by people, so that there is less time for scavenging that would result in feather spots. Feather spots around the relatively open power block may also be removed by the wind more easily than in the rest of the solar field and deposited in the inner HD heliostats.

Table 14. Ratios of Feather Spots to Carcasses Relative to Site Locations.

Location	Total	Feather Spots	Carcasses	Feather Spot: Carcass Ratio
Power Block	69	12	72	1:6
Inner HD Heliostats	15	43	14	1:0.3
Inner/Outer Heliostat Segments	60	33	21	1:0.5
Perimeter Fence	4	0	4	0:2

Section 5.0 Fatality Estimation

This section utilizes the detection data as described in Section 4 to develop an overall fatality estimate in accordance with the Plan. The estimates of carcass removal rates and searcher efficiencies are derived and subsequently utilized in the model with the detection data to provide estimates for the facility areas as required in the Plan. The areas for which estimates are provided include the tower area, heliostats, and fenceline. The total estimate for the entire facility is then presented.

5.1 Estimating Model Parameters

5.1.1 Carcass Removal Trials

We conducted 19 carcass removal trials during the 2014 spring season. These trials included four large carcasses and 15 small carcasses. Carcasses were placed in the inner HD heliostats and inner and outer heliostat segments, and along the fenceline, and a camera was placed at each carcass to record the scavenger species. Three carcasses were placed around the power block after approval was granted late in spring to conduct carcass removal trials around the power block. Scavenger species included common ravens (N=9), desert kit fox (N=1), white-tailed antelope squirrels (*Ammospermophilus leucurus*; N=2), and a turkey vulture (N=1). For the remaining carcasses, the scavenger species was not captured on camera. For two of these carcasses, high winds may have moved the carcass out of the field of view. Twelve feather spots or partial carcasses were created by scavengers consuming carcasses that we placed for carcass removal trials. Seven of these feather spots/partial carcasses were present through a full six-week trial period; these remains, which resulted from five small carcass and two large carcasses, were collected at the end of the period. In one case, a large carcass was scavenged, leaving a partial carcass; however, the carcass had to be removed after 30 days when scavengers moved it to a road. Although all large carcasses were detected and at least partially eaten by scavengers, the scavengers left enough of the carcass in two of four large-carcass trials that the remains would have been detectable and considered a fatality if detected during the standardized searches. In contrast, small carcasses tended to be more completely removed, with only five of 15 small carcasses leaving remains that persisted for the entire six-week trial.

Carcass persistence rates for the spring season ranged from less than one day, in the case of three carcasses, to a full six-week trial period in the case of the seven carcasses whose remains persisted throughout the trial. Figure 31 shows the persistence durations for individual small carcasses, and Figure 32 shows the persistence of large carcasses. Because seven of the carcasses persisted for the full six-week trial before being removed by the carcass removal trial team, it is unknown how long they might have persisted if not removed. Assuming conservatively 42-day persistence for those carcasses, mean carcass persistence was 18.8 days for small carcasses and 41.8 days for large carcasses. The latter estimate excludes persistence of the large carcass that had to be prematurely removed from the trial. In comparison, the assumptions used in the power analysis in the Plan were 7.4 days for small birds and 21.8 days for large birds. The longer persistence of carcasses (averaging approximately twice that assumed for the Plan's power analysis) thus increases the statistical power of our sampling approach relative to the power analysis in the Plan.

Figure 31. Persistence Durations for 15 Small Carcasses Placed for Carcass Removal Trials.

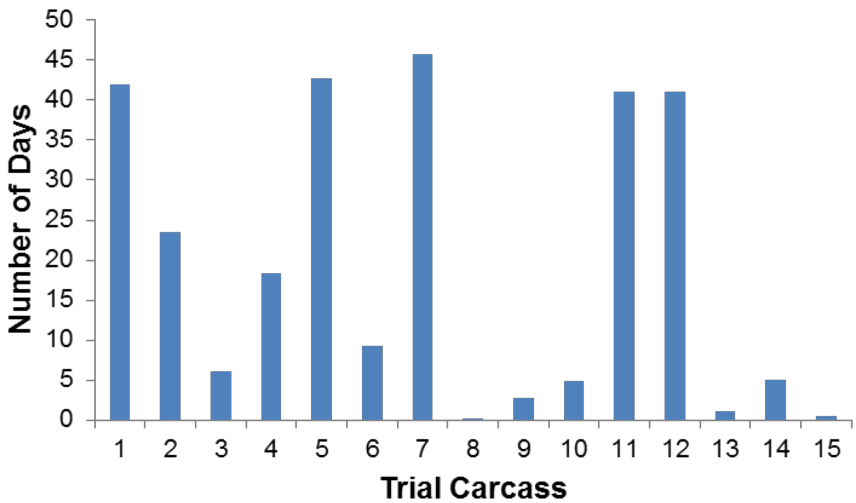
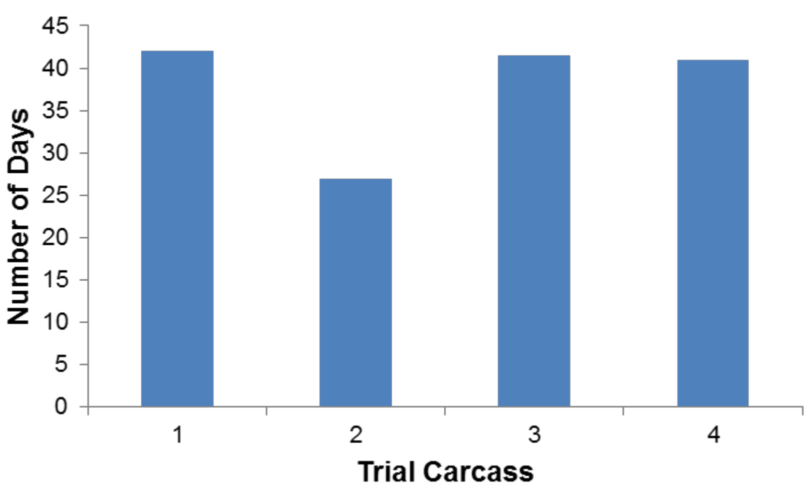


Figure 32. Persistence Durations for Four Large Carcasses Placed for Carcass Removal Trials.



The power block differs from the inner HD heliostats and the heliostat fields both in physical structure and human activity. It is therefore likely that scavenging rates and discovery rates of carcasses and feather spots in the power block are different from those within the heliostat area. Because trials on the power block began late in the spring period, data are available for only three carcasses: two small and one large (these three were included in the 19 mentioned above). All three carcasses were detected and partially scavenged by common ravens, two within a single day. All three left detectable feather spots, and as a result, carcass persistence on the power block averaged 41 days. Carcass removal results on the power block are preliminary, and should be interpreted with caution.

5.1.2 Model Selection for Carcass Removal Decay Curve

Based on the carcass removal data, four selected survival models were compared for relative quality using the Akaike information criterion (AIC) score (Table 15) as suggested in Huso (2010). As a part of the fatality estimator process, Huso (2010) recommends measuring the relative quality of the estimator model for each set of data to determine which model to use. Thus, AIC provides a means for model selection. In other words, although the absolute value of AICc may vary, the difference in AICc values among models provides information about which model is most statistically supported.

Table 15. AICc Values for Each of Four Distribution Models of Carcass Persistence.

Model	AICc	Shape	r
Weibull	98.78	2.05	0.78
Exponential	105.15	1	0.92
Loglog	98.74	1.7	0.77
Lognormal	99.02	3.06	0.76

Although the model with the lowest AICc value is typically held to be the most supported, any model with a change in AICc values of less than two from the "best model" is considered to have strong evidence supporting it (Burnham and Anderson 2004). The loglogistic, lognormal, and Weibull models for carcass persistence had ΔAICc values <2, and we chose to use the Weibull model (a continuous distribution model) because it was equivalent to or better than the other model options and was the same model selected for the 2013-2014 winter-quarter fatality estimates.

5.1.3 Searcher Efficiency Trials

During the 2014 spring season, 10 small carcasses, 9 large carcasses, and 12 feather spots/partial carcasses 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. Two of the small carcasses and one large carcass disappeared (e.g., they may have been scavenged) before the searcher efficiency trial, leaving a sample size of 8 small carcasses, 8 large carcasses, and 12 feather spots/partial carcasses included in the trials. In total, 62.5% of all small carcasses, 75.0% of all large carcasses, and 25.0% of all feather spots/partial carcasses that were planted were successfully discovered by searchers, for a mean searcher efficiency of 50%. Due to the low sample size (because this is the second seasonal report), we were not yet able to formally compare searcher efficiency rates among different levels of visual obstruction. Such analyses will be investigated in future seasons. Based on the success of detection dog trials in spring 2014, the TAC approved the use of detection dogs for searches beginning in summer 2014, which will increase searcher efficiency even further.

Model Selection for Searcher Efficiency Trials. We included trials from both the 2013-2014 winter quarter and the 2014 spring quarter to increase sample size for searcher efficiency values. The null model, with no explanatory variables, and the model with size of carcass plant included as a variable were equivalent in relative model strength. Therefore, we chose to include size in the final model because it had the potential to account for the most variation among samples.

5.2 Facility-Related Fatality Estimates

As per the Plan, facility-wide estimates of potential avian impacts are to be estimated based on the following:

1. Observed number of detections found during standardized searches in the monitoring season for which the cause of death can be determined and is facility-related
2. Non-removal rates, expressed as the estimated average probability that a potential detection is expected to remain in the study area and be available for detection by the observers, based on removal trials
3. Searcher efficiency, expressed as the proportion of placed trial carcasses found by observers during the searcher efficiency trials.

After determining the proper model structure for both searcher efficiency and carcass persistence trials, we ran a series of fatality estimates. We only report fatality estimates as per the requirements of the Plan and only for areas and categories with more than five detections because using the fatality estimator with five or fewer detections will produce highly biased values due to the small sample size.

Fatality estimates were calculated separately for specific areas; tower area (power block and inner HD heliostats), heliostat area, and fenceline. Estimates are initially provided for facility-related fatalities (where cause of death can be determined and is facility related). Following the estimates of facility-related fatalities, an estimate is provided of total unknown fatalities where the cause cannot be determined.

5.2.1 Total Facility-Related Fatality Estimates

Table 16 provides the total facility-related fatality estimates for the 2014 spring season. These total estimates were calculated by adding the mean estimates and 90% confidence intervals for each Project component, which are discussed in the subsequent sections. Although fatality estimates are not provided in Tables 17 to 19 below when the number of detections for any group (e.g., flux, collision, flux + collision, large bird, raptor, or small bird) was less than five, all flux and collision-related detections (there were no detections from "other project impacts", as noted in Section 3.1 of the Plan) were included in the overall facility-related fatality estimates in Table 16.

Overall, there were an estimated 267 fatalities (90% confidence interval estimates 189-550) in the tower area (for all three units combined) and 186 fatalities (90% confidence interval estimates 101-437) in the three heliostat areas combined, for detections with signs of flux or collision, during the period 22 March – 23 May

2014. There were no fatality estimates produced for the fenceline because there were fewer than five detections for this Project element and none of the detections could be attributed to the facility. Note that estimates from the power block (a sub-area of the tower area) which should be interpreted with caution due to unaccounted-for search effort from other Project personnel, and unknown carcass persistence rates. Incorporating the unaccounted-for search effort by Project personnel responsible for incidental detections may necessitate future revision of these estimates (e.g., in the annual report).

Table 16. Estimates of Total Project-Caused Detections Based on Fatality Searches in all Areas, 23 March – 22 May 2014

Project Element	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Tower Area	93	267 (189-550)[1]
Heliostat Area	12	186 (101-437)
Fences	0	NA[2]
Spring Total	**105**	**453 (290-987)**

[1] Note that the Tower Area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort. Also includes unadjusted detections from the ACC units.

[2] NA = not applicable because there were fewer than five detections within that group.

5.2.2 Fatality Estimate for Tower Area

Tables 17 and 18 provide facility-related fatality estimates for the power block and inner HD heliostats for the 2014 spring monitoring period 23 March – 22 May 2014. For the power blocks, 44.0% of the detections were incidental observations found between standardized surveys. We included incidental detections when they were found in areas covered during standardized surveys, during time periods in which they were being searched. Incidental detections from outside survey areas are not included in these estimates. Because of the high amount of unaccounted-for searching (i.e., resulting in incidental detections) in the power block, we are providing fatality estimates separately for the inner HD heliostats vs. power block in Tables 17 and 18 below. However, results from these two areas are pooled for total fatality estimates provided below. Estimates from the power block should be interpreted with caution. Because detections were observed more frequently in the power block (a sub-area of the tower area) than otherwise expected if detections were made only through the fatality monitoring (and not with the addition of incidental detections made by other personnel), the total fatality estimates for the power blocks currently may be overstated.

Table 17. Estimates by Cause (a.) and Size Class (b.) of Total Project-Caused Detections Based on Fatality Searches in Power Blocks, 23 March – 22 May 2014[1] Estimates should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted-for search effort.

17a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Flux	49	139 (101-242)
Collision	1	NA[1]
Total Flux + Collision	**50**	**141** (104-244)

[1] NA = not applicable because there were fewer than five detections within that group.

17b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	1	NA
Raptor	1	NA
Small Bird	48	137 (99-204)
Total Detections	**50**	**141** (104-244)

Table 18. Estimates by Cause (a.) and Size Class (b.) of Total Project-Caused Detections Based on Fatality Searches in Inner HD Heliostats, 23 March – 22 May 2014.[1]

18a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Flux	23	100
Collision	2	NA[1]
Total Flux + Collision	**25**	**108** (67-288)

[1] NA = not applicable because there were fewer than five detections within that group.

18b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	0	NA[1]
Raptor	1	NA
Small Bird	24	103 (61-263)
All Detections	**25**	**108** (67-288)

[1] NA = not applicable because there were fewer than five detections within that group.

5.2.3 Fatality Estimate for Heliostat Area

Table 19 provides facility-related fatality estimates for the heliostat area for the 2014 spring season, 23 March – 22 May 2014. Note that one mourning dove carcass was removed from the estimates because it was determined to be much older than the search interval.

Table 19. Estimates by Cause (a.) and Size Class (b.) of Project Caused Detections for the Heliostat Area, 23 March – 22 May 2014. Estimate based on 144 plots and extrapolated to 598 on site.[1]

19a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Flux	2	NA[1]
Collision	10	150 (77-353)
Total Flux + Collision	**12**	**186** (101-437)

[1] NA = not applicable because there were fewer than five detections within that group.

19b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor	1	NA
Small Bird	10	138 (71-305)
All Detections	**12**	**186** (101-437)

[1] NA = not applicable because there were fewer than five detections within that group.

5.2.4 Fatality Estimate for Fenceline

The perimeter fencelines for all units, as well as the Common Logistic Area (CLA) fence, were surveyed throughout the full spring period. Two fatalities were detected along the unit perimeter fences. One fatality was detected along the CLA fence during regular surveys. None of these fatalities could be directly attributed to the facility (i.e., cause of death was unknown), so we do not provide a fatality estimate for either fenceline here.

5.3 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 flux or collision effects was noted in the case of these unknown detections, they cannot be clearly attributed to the facility. The methods for determining fatality estimates for these unknown detections are the same as those described in Section 5.2 for facility-related detections.

5.3.1 Total Fatality Estimates from Unknown Causes

Total fatality estimates from unknown causes were calculated as described in Section 5.2.1 above. During the period of 23 March – 22 May, estimates of fatalities from unknown causes, which cannot be attributed to the facility, were 146 (90% confidence interval estimates 87-434) in the tower area; 461 fatalities (90% confidence interval estimates 287-1352) in the heliostat area; and 12 (90% confidence interval estimates 6-18) in the fenceline area (Table 20).

Table 20. Power Block Fatality Estimates for Unknown Causes, 23 March – 22 May 2014.[1] Estimate should be interpreted with caution due to large amount of unaccounted-for search effort.

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Tower Area	38	146 (87-434)[1]
Heliostat Area	25	461 (287-1352)
Fence Lines	3	12 (6-18)
Total Detections, Unknown Cause	**66**	**619** (380-1804)

[1] Note that Tower Area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort. Also includes unadjusted detections from the ACC units.

5.3.2 Fatality Estimate for Tower Area

Table 21 provides fatality estimates from unknown causes for the power block for the spring period. Table 22 provides fatality estimates from unknown causes for the inner HD.

Table 21. Power Block Fatality Estimates for Unknown Causes, 23 March – 22 May 2014.[1] Estimate should be interpreted with caution due to large amount of unaccounted-for search effort.

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	2	NA[1]
Raptor	0	NA
Small Bird	8	29 (15-72)
Total Detections, Unknown Cause[2]	**10**	**33** (17-76)

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

Table 22. Inner HD Heliostats Fatality Estimates for Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	5	26 (11-81)
Raptor	1	NA[1]
Small Bird	15	75 (44-231)
Total Detections, Unknown Cause[2]	**21**	**108** (67-288)

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

5.3.3 Fatality Estimate for Heliostat Area

Table 23 provides fatality estimates from unknown causes for the heliostat area for the spring period.

Table 23. Heliostat Area Fatality Estimates for Unknown Causes, 23 March – 22 May 2014.[1] Estimate based on 144 plots and extrapolated to 598 on site[2].

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	12	222 (107-658)
Raptor	0	NA[3]
Small Bird	13	240 (125-664)
Total Detections, Unknown Cause[4]	**25**	**461** (287-1352)

[1] Note that not all of the types of estimates are additive; examining the data in the Heliostat Area in two slightly different ways provides similar results (i.e. unknown cause is similar to small bird + large bird detections).
[2] 598 plots comprise the total area of the Heliostat Area.
[3] NA = not applicable because there were fewer than five detections within that group.
[4] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

5.3.4 Fatality Estimate for Fenceline

Table 24 provides fenceline detection data from unknown causes for the 2014 spring monitoring period Because of the low number of detections for this time period (i.e., fewer than the five detections necessary for a fatality estimate), we do not provide a fatality estimate for the fenceline.

Table 24. Fenceline Fatality Estimates for Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Large Bird	0	NA[1]
Raptor	0	NA
Small Bird	3	NA
Total Detections, Unknown Cause	**3**	**NA**

[1] NA = not applicable because there were fewer than five detections within that group.

5.4 Regional Awareness Monitoring

According to the Plan, a communication protocol was implemented to monitor local veterinarians, game wardens, and wildlife rehabilitation facilities during facility operations to determine if significant new incidences of avian injury or fatality are reported to occur in the facility vicinity and region.

The Animal Kingdom Veterinary Hospital is the closest veterinary clinic to the Ivanpah facility and is located in the Las Vegas area about 35 miles northeast of Ivanpah. The closest wildlife rehabilitation facility is the Wild Wing Project located in North Las Vegas 47 miles northeast of Ivanpah. Representatives from each of these facilities were contacted and interviewed as a part of the protocol. Likewise, the local district game warden for the BLM and a field supervisor for CDFW were contacted to determine if they had noticed an increase in avian fatalities in the area or if they had noticed any singed or scorched injured or dead birds. Further, a designated biologist and veterinarian, Dr. Craig Himmelwright, working in the Ivanpah Valley was also interviewed for the same purpose. The following is a summary of results of interviewing these contacts for the purpose of the Regional Awareness Monitoring effort.

A representative from the Animal Kingdom Veterinary Hospital; Lisa Ross representing the Wild Wing Project; Ryan Regnell representing the BLM; Craig Himmelwright, D.V.M. in Ivanpah Valley representing the Designated Biologists for the Project; and Magdalena Rodriquez from CDFW were contacted. Each reported that they were not aware of any increase in avian fatalities for the region or any birds, injured or dead, that had been found with singed or scorched feathers since monitoring according to the Plan began at Ivanpah in early winter 2013-2014.

Section 6.0 Discussion

The 2014 spring season represented the first implementation of migration-period monitoring at Ivanpah, which included weekly standardized monitoring of avian and bat detections and avian use of the Ivanpah site per the Avian & Bat Monitoring and Management Plan. Searcher efficiency trials and carcass removal trials were conducted concurrently. Searcher efficiency and carcass removal trails on the power block were started late in the spring season once approval was obtained to place trial carcasses in that location.

Caution is necessary when drawing conclusions from the 2014 spring season monitoring results because of the relatively small number of detections relative to the several Project elements of interest (e.g., heliostat fields, tower, fenceline, and powerlines) and the variable sampling effort within the power block. Estimates of fatalities from the power block may be inaccurate because of the high number of incidental detections, which resulted in more detections than would be expected if detections were made only through the fatality monitoring. More extensive and robust conclusions will be possible at the end of the first full year of sampling.

6.1 Fatality Estimates

Elevated numbers of detections appear to be associated with increases in migratory activity within the desert southwest region, as anticipated. Species composition of spring detections was biased towards obligate and facultative insectivores, many of which were migrating, and so was not similar to the species composition of either the heliostat arrays or the adjacent desert bajadas.

During the period 23 March – 22 May 2014 total estimated numbers of fatalities attributable to the Project were 267 (90% confidence interval estimates 189-550) in the tower area; and 186 (90% confidence interval estimates 101-437) in the heliostat area. Fewer than five detections were found along the fencelines, so fatalities could not be estimated for this area for the spring period.

As noted above, these estimates (and particularly the magnitude of the estimates) should be considered with caution given the limited dataset for the 2014 spring season. Additionally, the large amount of uncontrolled search effort in the power block complicates fatality estimation in this area. Nevertheless, the relative magnitude of the fatality estimates among the three search areas (tower area, heliostat area, and fenceline) matches the pattern of detections observed. In proportion to unit area, fatality estimates suggest the highest densities of detections in the tower area, where heliostat density is highest and the majority of flux detections occur.

6.2 Carcass Removal and Searcher Efficiency Trials

After conducting the standardized searches in the units during the spring quarter, we believe that future sampling may confirm that the underlying scavenging rates and discovery rates of carcasses and feather spots occurring in the power block differ from those within the rest of the site. As recommended in the winter report, searcher efficiency and carcass persistence trials were initiated on the power block. As the number of trials increases, we will better determine whether or how different scavenging and discovery rates are in the power block compared to other areas within the facility.

For the spring season, searcher efficiency rates averaged 62.5% for small birds, 75.0% for large birds, and 25.0% for feather spots/partial carcasses. Detection rates of carcasses are higher than target rates assumed in the Plan. In contrast, detection rates for feather spots/partial carcasses were somewhat lower than the target rates. However, all feather spots/partial carcasses placed contained very few feathers (a wing and 8-14 feathers). In contrast, detected feather spots averaged ~50 feathers, with a range of 2 to more than 150 feathers. Therefore, future feather spots used in searcher efficiency trials will be classified as either small or large, with small feather spots containing 20 or fewer feathers and large feather spots containing 50 or more feathers. No partial carcasses will be used in future feather spot searcher efficiency trials. We believe this change will better reflect natural conditions and provide more information on detection rates of feather spots. Based on the success of detection dog trials in spring 2014, the TAC approved the use of detection dogs for searches beginning in summer 2014, which will increase searcher efficiency even further

6.3 Cause and Distribution of Fatalities

The cause of death for 49.5% of the 202 avian detections during the 2014 spring season were attributed to flux, 7.4% to collision, and 43.1% could not be confirmed (i.e., the carcass or feather spot displayed no signs of flux effects and no direct collision effects as determined by microscopic examination by CEC and BLM approved biologists) mainly because they were limited feather spots (see further discussion of feather spots below). Because singed feathers are readily observable, detections for which the cause of death is unconfirmed are likely to have resulted from predation, collision, or illness.

More than two-thirds of all detections, and 97 of 100 detections showing evidence of flux effects, were detected in the relatively limited tower area. This 260-m radius area consisted of the area that was searched with 100% coverage due to proximity to the towers and is coincidental with the areas with the highest concentrations of solar flux. In addition, these towers were the focus of considerable activity by Ivanpah personnel, who found and reported detections, resulting in high numbers of incidental fatality reports.

Two separate analyses were conducted to examine the relationship of flux to singed and non-singed detections. In the first analysis, correlation of numbers of detections with the number of tower flux-days in a given week demonstrated a clear positive relationship, with more flux-related detections during weeks in which more tower flux-days occurred, as expected. Examining the number of flux days and the frequency of non-singed detections, there is no correlation (R squared = 0.03) between tower-days of flux and the number of non-singed detections. Relationship between flux activity and number of non-singed fatalities found per week (collision and unknown, n=48). The second analysis determined the density of non-singed detections (detections per survey acre in each distance band) as a function of distance from the tower. A plot of this density, from 300 m out to the Project edge as summed across the three units, suggests that the slope is not statistically different from zero (p=0.11) at an Alpha level of 0.05. In other words, the density of non-singed detections does not increase towards the tower. These two analyses suggest that the microscopic examination of detections is accurate in determining flux vs. non-flux-related mortality.

6.4 Feather Spots

Ninety-five (47.0%) of the 202 detections consisted only of feather spots. While evidence of flux effects was noted on 23 of these 95 feather spots, and evidence of collision was apparent in five feather spots, the cause of mortality for the other 67 birds is unknown. These feather spots may have represented detections (e.g., collision) that had been scavenged, in which case they would legitimately be considered Project-related detections. However, they may also have represented natural predation events, which would not represent Project-related detections. The large proportion of feather spots among the detections for the site as a whole may inflate the fatality estimate as a result of the potential for multiple feather spots resulting from one fatality, feather spots resulting from predation not associated with the facility, or other causes. The ratio of feather spots to carcasses varied widely across the site, with a high ratio in the inner HD heliostats and a low ratio on the power block.

6.5 Incidental Detections

A total of 44 incidental avian detections and one incidental bat detection were found during this quarter. Thus, incidental detections represented a large percentage (21.8% for birds and 25% for bats) of the detections. This demonstrates that the Ivanpah Wildlife Incident Reporting System, described in Section 3.4 of the Plan, is functioning well. However, a number of these incidental detections were retrieved from the power block, and the retrieval of incidental detections from the power block can confound accurate fatality estimates for this area because the search effort involved in the detection of incidental detections is not quantifiable and is subject to considerable spatial and temporal variability. Because incidental detections are retrieved at random intervals, we cannot properly assess the search interval of detected carcasses, or searcher efficiency of personnel finding detections in these areas, which are both critical model parameters when estimating fatalities. Nevertheless, incidental detections from the power block were included with an assumed one day search interval in the fatality estimates because such a large proportion of detections in this area were incidental.

Because a high proportion of detections on the site are found in and around the power block, it is important to strive for accurate and precise fatality estimations within this area. We acknowledge the importance of obtaining data on any detections as soon as possible, but a change in the policy of removing these carcasses when they are detected incidentally was approved by the TAC on July meeting and will be implemented for the migratory fall season.

Section 7.0 Framework for Management and Risk Response

According to the Plan, quarterly reports are expected to categorize potential migratory bird mortality issues at Ivanpah as high, medium, or low to provide an appropriate biological basis for TAC review and decision making, based on the following definitions in Section 5.3 of the Plan:

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.

As noted in Section 5.1, only limited conclusions can be drawn from the spring 2014 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 would be categorized as low. The 202 avian detections included 43 different bird species spread among a variety of temporal occurrence groups and foraging guilds. Of these 43 species, 30 were represented by three or fewer detections (injury or fatality; see Table 1). While special-status species are discussed further below, all of the species represented by three or fewer detections have populations that are great enough locally (either as breeders, wintering birds, or migrants), regionally, and nationally that the loss of three individuals would have no substantive impact on populations at any of these geographic scales.

None of the 13 species represented by more than three detections is particularly rare locally, regionally, or nationally. Ten of these 13 species, including the mourning dove, yellow-rumped warbler, horned lark, white-crowned sparrow, tree swallow, barn swallow, cliff swallow, violet-green swallow, Brewer's blackbird, and western meadowlark, are abundant and widespread species. Two others, the rufous hummingbird and Costa's hummingbird, have more limited breeding distributions but are still very numerous within their breeding ranges and occur in large numbers (as a migrant in the case of rufous hummingbird and as a breeder in the case of Costa's hummingbird) in southeastern California. Populations of the 13th species, American kestrel (of which there were four recorded detections), are somewhat more limited, consistent with the larger territory sizes of raptors (as compared to the other 12 species, which were non-raptors). However, the American kestrel is a common and widespread species on local, regional, and national scales, and the magnitude of kestrel detections at Ivanpah during the 2014 spring season does not rise above the "low" category.

The special-status species recorded as detections were three bank swallows (a state-listed species), three loggerhead shrikes (a California species of special concern), and single individuals of Vaux's swift, olive-sided flycatcher, yellow warbler, and yellow-breasted chat, which are also California species of special concern. Loggerhead shrikes breed in the vicinity of the site, but all the other special-status species recorded as detections were transients that breed elsewhere. Given the location of the site (so close to the Nevada border) and the expected north-south orientation of migrants of these species in the vicinity, it is likely that some or all of these migrants are breeders from populations outside of California, populations that may not be of special status.

The cause of injury or mortality for 87 of the 202 detections (43.1%) is not known with certainty, and thus these detections cannot be clearly ascribed to the facility. Of the special-status species recorded, three bank swallows, the Vaux's swift, and the yellow warbler showed signs of flux effects and thus could be attributed to the facility, but the cause of death of the three loggerhead shrikes, the olive-sided flycatcher, and the yellow-breasted chat were unknown.

Bank swallows are widespread breeders throughout the middle and northern latitudes of North America (Garrison 1999). These birds completely vacate North America in winter, and as a result, large numbers migrate through southern North America (including southeastern California) in spring and fall en route between breeding and wintering areas. The three bank swallow detections in spring 2014 represented a very small proportion of the bank swallows expected to migrate north through the Ivanpah area in spring, heading to breeding sites as far north as Alaska and Canada. The North American population of this species is estimated at 13,800,000 birds (http://birds.audubon.org/species/banswa), and the species is found throughout most of Europe and Asia as well, with a global population estimate of 46,000,000 individuals (http://birds.audubon.org/species/banswa). The most recent estimate available of the California breeding population numbered approximately 9,590 pairs in 2003 (bird species accounts at http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/); numbers of burrows, which can be used to identify trends in abundance when monitored over time but which over-represent the actual numbers of breeding pairs, were estimated at 15,000 along the Sacramento River in 2012 (Bank Swallow Technical Advisory Committee 2013). Thus, at scales from local/regional (i.e., migrants moving through the Ivanpah area and the surrounding region) to national to global, the three bank swallow detections at Ivanpah during the 2014 spring season do not rise above the "low" category, as their loss would have a minimal effect on populations at any of these geographic scales.

The loggerhead shrike is declining over much of its range (Sauer et al. 2014), primarily due to habitat loss, but it remains a common and widespread bird throughout much of the western and southeastern United States where habitat remains. In California, this species is common in desert habitats. The southeastern deserts represent one of the areas of highest abundance in the state (Humple 2008), and Breeding Bird Survey data indicate no significant population trends, or perhaps even a slight increase, in the Mojave Desert since the mid-1960s (Sauer et al. 2014). The North American population of this species is estimated at 2,900,000 birds (http://birds.audubon.org/species/logshr). Even if the three individual detections at Ivanpah in spring 2014 could be attributed to the Project, such a low number would not substantially affect local, regional, or national populations of the species. However, as noted above, the cause of death of these individuals was unknown, and their mortality thus could not be determined to be "facility-caused". For all these reasons, the three loggerhead shrike detections in spring 2014 do not rise above the "low" category.

Vaux's swift, olive-sided flycatcher, yellow warbler, and yellow-breasted chat are sufficiently abundant at all geographic scales that the loss of single individuals would have a minimal impact on local, regional, and national populations. Further, the cause of mortality of the olive-sided flycatcher and yellow-breasted chat could not be determined. For these reasons, the single detections of these four California species of special concern do not rise above the "low" category.

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Appendix A. Individual Avian and Bat Detections

Table A-1. Incidental Avian Fatalities Found in Systematic Fatality Search Areas (n = 39) and Non-Search Areas (n = 5), 23 March – 22 May 2014.

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Carcass Condition	Cause of Death	Burn Grade	Time Since Death	UTM Coordinates
2014-61–ISEGS*‡	3/23/2014	3	Outer Segment	HOLA	A	U	Feather Spot	Unknown		< 1 week	11S 638171 3937468
2014-62-ISEGS	3/24/2014	3	Power Block	VGSW	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 637489 3937932
2014-63-ISEGS	3/24/2014	3	Power Block	TRES	A	M	Injured, died	Flux Effects	2	< 24 hours	11S 637435 3937945
2014-90-ISEGS	3/30/2014	1	Power Block	EAGR	A	U	Carcass	Collision		< 24 hours	11S 640386 3933470
2014-91-ISEGS	3/31/2014	2	Power Block	NRWS	A	U	Carcass	Flux Effects	2	< 1 month	11S 638598 3935824
2014-112-ISEGS	4/10/2014	2	Power Block	TRES	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 638562 3935823
2014-113-ISEGS	4/10/2014	2	Power Block	YRWA	A	M	Carcass	Flux Effects	3	< 24 hours	11S 638631 3935877
2014-122-ISEGS	4/12/2014	2	Power Block	ROPI	A	U	Carcass	Unknown		< 24 hours	11S 638694 3935848
2014-123-ISEGS	4/12/2014	2	Power Block	CAHU	A	F	Carcass	Flux Effects	2, 3	< 24 hours	11S 638622 3935815
2014-136-ISEGS	4/16/2014	2	Power Block	UNPA	U	U	Feather Spot	Unknown		< 24 hours	11S 638549 3935876
2014-140-ISEGS	4/17/2014	3	Power Block	AMKE	A	F	Carcass	Flux Effects	2, 3	< 1 week	11S 637470 3937906
2014-152-ISEGS	4/21/2014	1	Power Block	NAWA	A	F	Carcass	Flux Effects	2, 3	< 24 hours	11S 640357 3933524
2014-171-ISEGS	4/22/2014	2	Power Block	ANHU	U	F	Carcass	Flux Effects	1, 3	< 1 week	11S 638637 3935812
2014-172-ISEGS	4/22/2014		CLA Fence	HEWA	A	F	Partial Carcass	Unknown		< 24 hours	11S 639747 3934827
2014-174-ISEGS	4/24/2014	2	Power Block	COHU	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 638615 3935814
2014-177-ISEGS	4/27/2014	2	Power Block	COHU	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 638624 3935819
2014-179-ISEGS	4/27/2014	1	Power Block	TOWA	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640358 3933470
2014-180-ISEGS	4/28/2014	2	Power Block	COHU	A	M	Injured, died	Flux Effects	2, 3	< 24 hours	11S 638618 3935880
2014-186-ISEGS	4/28/2014	2	Power Block	TRES	A	M	Injured, died	Flux Effects	2, 3	< 24 hours	11S 638705 3935857
2014-195-ISEGS*	5/1/2014	2	Inner Segment	MODO	A	U	Carcass	Unknown		< 1 week	11S 638382 3936008
2014-197-ISEGS	5/2/2014	2	Power Block	YRWA	A	M	Carcass	Flux Effects	1, 3	< 24 hours	11S 638592 3935873
2014-198-ISEGS	5/2/2014	2	Power Block	CLSW	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 638567 3935884
2014-200-ISEGS	5/2/2014	3	Power Block	VGSW	A	M	Carcass	Flux Effects	1	< 24 hours	11S 637443 3937973
2014-201-ISEGS	5/2/2014	1	Power Block	CLSW	A	U	Carcass	Flux Effects	2	< 24 hours	11S 640360 3933587
2014-202-ISEGS	5/2/2014	1	Power Block	CAHU	A	F	Carcass	Flux Effects	1	< 24 hours	11S 640342 3933487
2014-203-ISEGS	5/2/2014	1	Power Block	COHU	A	F	Carcass	Flux Effects	1	< 24 hours	11S 640405 3933590
2014-204-ISEGS	5/2/2014	1	Power Block	LEGO	A	M	Carcass	Flux Effects	2	< 24 hours	11S 640400 3933520
2014-205-ISEGS	5/2/2014	1	Power Block	VGSW	A	M	Carcass	Flux Effects	2	< 24 hours	11S 640394 3933520
2014-206-ISEGS	5/2/2014	1	Power Block	BARS	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640332 3933509
2014-207-ISEGS	5/2/2014	1	Power Block	CLSW	A	U	Carcass	Flux Effects	1	< 24 hours	11S 640325 3933513

2014-208-ISEGS	5/2/2014	1	Power Block	BARS	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640300 3933508
2014-225-ISEGS	5/5/2014	1	Power Block	LAZB	A	F	Carcass	Flux Effects	1, 3	< 24 hours	11S 640436 3933527
2014-226-ISEGS	5/5/2014	1	Power Block	WIWA	A	F	Carcass	Unknown		< 24 hours	11S 640436 3933521
2014-233-ISEGS	5/6/2014	2	Power Block	UNHU	U	U	Carcass	Flux Effects	2, 3	< 1 week	11S 638673 3935851
2014-234-ISEGS	5/7/2014	3	Power Block	ANHU	A	F	Carcass	Flux Effects	1, 3	< 24 hours	11S 637381 3937881
2014-236-ISEGS*	5/7/2014		Other	OSFL	A	U	Feather Spot	Unknown		< 1 week	11S 639572 3935071
2014-238-ISEGS	5/8/2014	1	Power Block	YRWA	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 640267 3933481
2014-240-ISEGS*	5/10/2014		Other	UNPA	U	U	Feather Spot	Unknown		< 1 week	11S 639692 3934871
2014-253-ISEGS	5/11/2014	1	Power Block	LENI	A	F	Carcass	Unknown		< 24 hours	11S 640318 3933485
2014-256-ISEGS	5/14/2014	3	Power Block	NAWA	A	F	Carcass	Flux Effects	2, 3	< 24 hours	11S 637456 3937888
2014-258-ISEGS	5/16/2014	3	Power Block	UNPA	A	U	Feather Spot	Flux Effects	2, 3	< 24 hours	11S 637365 3937988
2014-259-ISEGS	5/20/2014	1	Inner Segment	LENI	A	F	Partial Carcass	Unknown		< 1 month	11S 639934 3933339
2014-261-ISEGS	5/22/2014	3	Power Block	UNHU	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 637438 3937948

* Denotes incidental detections outside of regularly searched areas.
‡ This incident number represents two individuals found within a single large feather spot.
[1] Alpha codes are defined in Table 1.

[2] “Unknown” cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with Project facilities; “Flux Effects” = singeing observed; “Collision” = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

Flux-related carcass detections were 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

Grades were not applied to feather spots or partial carcasses with an insufficient number of feathers.

[3] UTM = Universal Transverse Mercator coordinate system

Table A-2. Avian Fatalities Found During Systematic Fatality Searches, 23 March – 22 May 2014 (n = 156).

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Carcass Condition	Cause of Death	Burn Grade	Time Since Death	UTM Coordinates
2014-64 -ISEGS	3/24/2014	3	Power Block	VGSW	A	F	Carcass	Flux Effects	2, 3	< 24 hours	11S 637443 3937976
2014-65 -ISEGS	3/24/2014	3	Outer Segment	UNPA	U	U	Feather Spot	Unknown		> 1 month	11S 636841 3938918
2014-66 -ISEGS	3/24/2014	3	Outer Segment	COHU	A	M	Carcass	Collision		< 1 week	11S 636440 3937309
2014-67 -ISEGS	3/25/2014	3	Power Block	COHU	A	M	Carcass	Flux Effects	1, 3	< 1 month	11S 637495 3938011
2014-68 -ISEGS	3/25/2014	3	Power Block	YRWA	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 637334 3937948
2014-69 -ISEGS	3/25/2014	2	Inner HD	COHU	A	M	Carcass	Flux Effects	1, 3	< 1 week	11S 638640 3935717
2014-70 -ISEGS	3/25/2014	3	Inner HD	MODO	A	U	Feather Spot	Unknown		< 1 week	11S 637419 3938085
2014-71 -ISEGS	3/25/2014	3	Inner HD	MODO	A	U	Feather Spot	Unknown		> 1 month	11S 637362 3938117
2014-72 -ISEGS	3/25/2014	3	Power Block	TRES	A	U	Feather Spot	Flux Effects	2, 3	< 24 hours	11S 637520 3937989
2014-73 -ISEGS	3/25/2014	2	Inner HD	BRBL	A	U	Feather Spot	Unknown		< 1 month	11S 638549 3936035
2014-74 -ISEGS	3/25/2014	3	Inner HD	HOFI	A	U	Partial Carcass	Unknown		< 1 month	11S 637368 3938134
2014-75 -ISEGS	3/25/2014	3	Inner HD	MODO	A	U	Partial Carcass	Unknown		< 1 month	11S 637668 3938044
2014-76 -ISEGS	3/25/2014	3	Power Block	YRWA	U	U	Feather Spot	Unknown		< 1 month	11S 637507 3937959
2014-77 -ISEGS	3/25/2014	3	Inner HD	UNSW	A	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 637614 3937734
2014-78 -ISEGS	3/25/2014	3	Inner HD	UNSW	U	U	Feather Spot	Unknown		> 1 month	11S 637614 3937734
2014-79 -ISEGS	3/27/2014	2	Outer Segment	MODO	A	U	Partial Carcass	Unknown		< 1 month	11S 638506 3935082
2014-80 -ISEGS	3/27/2014	2	Outer Segment	MODO	A	U	Partial Carcass	Unknown		< 1 month	11S 639183 3935225
2014-81 -ISEGS	3/27/2014	2	Outer Segment	WCSP	A	U	Carcass	Unknown		< 1 month	11S 639611 3936242
2014-82 -ISEGS	3/27/2014	2	Outer Segment	BTSP	A	U	Feather Spot	Unknown		< 1 month	11S 639320 3935698
2014-83 -ISEGS	3/27/2014	2	Outer Segment	HOLA	A	U	Partial Carcass	Unknown		< 1 month	11S 639356 3935637
2014-84 -ISEGS	3/27/2014	2	Outer Segment	HOLA	A	U	Feather Spot	Unknown		< 1 week	11S 639488 3935974
2014-85 -ISEGS	3/29/2014	1	Inner HD	YRWA	A	U	Feather Spot	Flux Effects	Unknown	< 1 month	11S 640451 3933383
2014-86 -ISEGS	3/29/2014	1	Inner HD	YRWA	A	U	Feather Spot	Flux Effects	3, Unknown	< 1 month	11S 640409 3933402
2014-87 -ISEGS	3/29/2014	1	Inner HD	UNPA	U	U	Feather Spot	Unknown		< 1 month	11S 640472 3933374
2014-88 -ISEGS	3/29/2014	1	Inner HD	WCSP	A	U	Partial Carcass	Unknown		< 1 week	11S 640171 3933611
2014-89 -ISEGS	3/29/2014	1	Power Block	MODO	A	U	Feather Spot	Unknown		< 1 month	11S 640389 3933486
2014-92 -ISEGS	3/31/2014	3	Inner HD	UNPA	U	U	Feather Spot	Unknown		< 1 week	11S 637273 3937814
2014-93 -ISEGS	3/31/2014	3	Inner HD	AMKE	A	F	Feather Spot	Flux Effects	Unknown	< 1 week	11S 637682 3937985
2014-94 -ISEGS	3/31/2014	3	Power Block	TRES	A	M	Carcass	Flux Effects	1, 3	< 24 hours	11S 637481 3937981
2014-95 -ISEGS	4/1/2014	2	Inner HD	HOFI	A	M	Feather Spot	Unknown		< 1 week	11S 638780 3935630
2014-96 -ISEGS	4/1/2014	2	Inner HD	WEME	A	U	Partial Carcass	Unknown		< 1 month	11S 638538 3935992
2014-97 -ISEGS	4/1/2014	2	Inner HD	HOFI	A	U	Partial Carcass	Unknown		< 1 month	11S 638864 3935753
2014-98 -ISEGS	4/1/2014	3	Inner Segment	MODO	A	U	Feather Spot	Unknown		< 1 month	11S 637243 3937583
2014-99 -ISEGS	4/1/2014	2	Power Block	ANHU	A	M	Carcass	Flux Effects	2, 3	Unknown	11S 638669 3935885
2014-100-ISEGS	4/2/2014	3	Outer Segment	MODO	A	U	Feather Spot	Unknown		< 1 month	11S 637223 3938634
2014-101-ISEGS	4/2/2014	3	Outer Segment	BTSP	A	U	Partial Carcass	Collision		< 1 month	11S 637368 3938652
2014-102-ISEGS	4/2/2014	3	Outer Segment	MODO	A	U	Carcass	Collision		> 1 month	11S 636320 3937171
2014-103-ISEGS	4/3/2014	3	Outer Segment	WEME	A	U	Carcass	Collision		< 1 month	11S 638249 3937819
2014-104-ISEGS	4/5/2014	1	Power Block	YRWA	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640340 3933511
2014-106-ISEGS	4/5/2014	1	Power Block	MODO	A	U	Feather Spot	Unknown		> 1 month	11S 640342 3933584
2014-107-ISEGS	4/5/2014	1	Inner HD	UNPS	U	U	Partial Carcass	Unknown		< 1 month	11S 640533 3933595
2014-108-ISEGS	4/6/2014	1	Inner Segment	MODO	U	U	Feather Spot	Unknown		> 1 month	11S 640382 3934130
2014-109-ISEGS	4/7/2014	3	Inner HD	AMKE	A	F	Feather Spot	Flux Effects	Unknown	< 1 week	11S 637661 3937955
2014-110-ISEGS	4/8/2014	3	Inner Segment	MODO	A	U	Feather Spot	Unknown		< 1 week	11S 637951 3938216
2014-111-ISEGS	4/9/2014	2	Inner Segment	LOSH	A	U	Feather Spot	Unknown		< 1 week	11S 639233 3935870
2014-114-ISEGS	4/11/2014		CLA Fence	WCSP	A	U	Carcass	Unknown		< 24 hours	11S 639311 3935044
2014-115-ISEGS	4/11/2014	2	Outer Segment	BRSP	A	U	Carcass	Collision		< 1 week	11S 639273 3935207
2014-116-ISEGS	4/12/2014	1	Power Block	YRWA	A	F	Carcass	Flux Effects	1, 3	< 1 week	11S 640279 3933428
2014-117-ISEGS	4/12/2014	1	Power Block	COHU	U	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640359 3933581
2014-118-ISEGS	4/12/2014	1	Inner HD	UNPA	U	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 640344 3933395

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Carcass Condition	Cause of Death	Burn Grade	Time Since Death	UTM Coordinates
2014-119-ISEGS	4/12/2014	1	Inner HD	WEME	A	U	Feather Spot	Unknown		< 1 week	11S 640209 3933378
2014-120-ISEGS	4/12/2014	1	Inner HD	YRWA	A	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 640424 3933361
2014-121-ISEGS	4/12/2014	1	Inner HD	VGSW	A	F	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 640524 3933286
2014-124-ISEGS	4/13/2014	1	Inner Segment	LOSH	A	U	Feather Spot	Unknown		< 1 week	11S 639861 3933914
2014-125-ISEGS	4/13/2014	1	Inner Segment	YRWA	A	M	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 640420 3933815
2014-126-ISEGS	4/14/2014	3	Inner HD	MODO	U	U	Feather Spot	Unknown		> 1 month	11S 637651 3937756
2014-127-ISEGS	4/15/2014	2	Inner HD	YRWA	A	U	Feather Spot	Flux Effects	3, Unknown	< 1 week	11S 638714 3935712
2014-128-ISEGS	4/15/2014	2	Control Transect	BRSP	A	U	Carcass	Unknown		< 1 week	11S 639726 3935677
2014-129-ISEGS	4/15/2014	2	Inner HD	YRWA	A	F	Carcass	Flux Effects	1, 3	< 1 week	11S 638740 3936001
2014-130-ISEGS	4/15/2014	1	Outer Segment	BRBL	A	F	Feather Spot	Unknown		< 1 month	11S 641010 3934322
2014-131-ISEGS	4/15/2014	2	Inner HD	LISP	A	U	Feather Spot	Collision		< 24 hours	11S 638720 3936088
2014-132-ISEGS	4/15/2014	1	Outer Segment	UNAR	A	U	Feather Spot	Unknown		< 1 week	11S 641058 3933526
2014-133-ISEGS	4/15/2014	1	Outer Segment	AMCO	A	U	Partial Carcass	Unknown		< 1 week	11S 640520 3932739
2014-134-ISEGS	4/15/2014	3	Inner Segment	MODO	A	U	Feather Spot	Unknown		< 1 week	11S 637965 3938230
2014-135-ISEGS	4/15/2014	2	Unit Fence	WCSP	J	U	Carcass	Unknown		< 1 week	11S 637706 3935225
2014-137-ISEGS	4/16/2014	3	Outer Segment	EUCD	A	U	Feather Spot	Unknown		< 1 week	11S 636792 3937786
2014-138-ISEGS	4/16/2014	2	Inner Segment	UNPA	U	U	Partial Carcass	Unknown		< 1 month	11S 638554 3936397
2014-139-ISEGS	4/16/2014	2	Inner Segment	UNPA	U	U	Carcass	Unknown		> 1 month	11S 638233 3936227
2014-141-ISEGS	4/19/2014	1	ACC Building	YRWA	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640363 3933510
2014-142-ISEGS	4/19/2014	1	ACC Building	VGSW	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640385 3933542
2014-143-ISEGS	4/19/2014	1	ACC Building	TRES	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 640408 3933528
2014-144-ISEGS	4/19/2014	1	Inner HD	CLSW	A	U	Feather Spot	Flux Effects	2, 3	< 1 week	11S 640510 3933398
2014-145-ISEGS	4/19/2014	1	Inner HD	UNPA	A	U	Feather Spot	Flux Effects	Unknown	> 1 month	11S 640696 3933232
2014-146-ISEGS	4/19/2014	1	Inner HD	UNPA	U	U	Feather Spot	Flux Effects	Unknown	< 1 month	11S 640331 3933355
2014-147-ISEGS	4/20/2014	1	Inner Segment	WCSP	A	U	Carcass	Unknown		< 1 week	11S 640075 3934075
2014-148-ISEGS	4/20/2014	1	Inner Segment	MODO	A	U	Carcass	Unknown		< 1 month	11S 640325 3933224
2014-149-ISEGS	4/21/2014	3	Inner HD	COHU	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 637659 3937751
2014-150-ISEGS	4/21/2014	3	Inner HD	WTSW	A	U	Feather Spot	Flux Effects	3, Unknown	< 24 hours	11S 637533 3937791
2014-151-ISEGS	4/21/2014	3	Inner HD	UNSW	U	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 637587 3937721
2014-153-ISEGS	4/22/2014	1	Outer Segment	HOLA	A	U	Feather Spot	Unknown		< 1 week	11S 640982 3934315
2014-154-ISEGS	4/22/2014	1	Outer Segment	BRBL	A	U	Feather Spot	Unknown		< 1 week	11S 640976 3934319
2014-155-ISEGS	4/22/2014	2	Inner HD	YRWA	A	U	Feather Spot	Unknown		< 1 week	11S 638724 3935815
2014-156-ISEGS	4/22/2014	2	Power Block	YRWA	A	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 638651 3935817
2014-157-ISEGS	4/22/2014	2	Inner HD	MODO	A	U	Feather Spot	Unknown		< 1 week	11S 638865 3935951
2014-158-ISEGS	4/22/2014	2	Inner HD	COHU	A	F	Carcass	Flux Effects	3	< 1 week	11S 638750 3935705
2014-159-ISEGS	4/22/2014	2	Power Block	UNHU	A	U	Partial Carcass	Flux Effects	2, 3	< 1 week	11S 638682 3935827
2014-160-ISEGS	4/22/2014	2	Power Block	UNHU	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 638582 3935883
2014-161-ISEGS	4/22/2014	2	Power Block	YRWA	A	U	Feather Spot	Unknown		< 1 week	11S 638586 3935930
2014-162-ISEGS	4/22/2014	2	Inner HD	BRBL	A	F	Feather Spot	Unknown		< 1 week	11S 638787 3935999
2014-163-ISEGS	4/22/2014	2	Power Block	RUHU	A	F	Carcass	Flux Effects	3	< 1 week	11S 638655 3935824
2014-164-ISEGS	4/22/2014	2	Power Block	BTAH	A	U	Carcass	Flux Effects	1, 3	< 1 week	11S 638648 3935823
2014-165-ISEGS	4/22/2014	2	Power Block	CAHU	A	F	Carcass	Flux Effects	3	< 1 week	11S 638611 3935876
2014-166-ISEGS	4/22/2014	2	Inner HD	AMKE	A	M	Feather Spot	Unknown		< 1 month	11S 638900 3935782
2014-167-ISEGS	4/22/2014	2	Inner HD	UNPA	A	U	Feather Spot	Flux Effects	Unknown	< 1 month	11S 638491 3935759
2014-168-ISEGS	4/22/2014	2	Inner HD	UNSW	A	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 638705 3935703
2014-169-ISEGS	4/22/2014	2	Inner HD	LISP	A	U	Feather Spot	Unknown		< 1 week	11S 638859 3935872
2014-170-ISEGS	4/22/2014	2	Inner HD	WEME	A	U	Feather Spot	Unknown		< 1 week	11S 638626 3936039
2014-173-ISEGS	4/23/2014	2	Inner Segment	HOLA	A	U	Partial Carcass	Collision		< 1 month	11S 638347 3936378
2014-175-ISEGS	4/24/2014	3	Power Block	WTSW	A	U	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 637451 3937915
2014-178-ISEGS	4/27/2014	1	Inner Segment	COHU	A	M	Carcass	Unknown		< 24 hours	11S 640819 3933685
2014-181-ISEGS	4/28/2014	3	Power Block	RUHU	A	M	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 637499 3937921

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Carcass Condition	Cause of Death	Burn Grade	Time Since Death	UTM Coordinates
2014-182-ISEGS	4/28/2014	3	Power Block	WIWA	A	M	Carcass	Unknown		< 24 hours	11S 637504 3937883
2014-183-ISEGS	4/28/2014	3	Power Block	UNSW	A	U	Feather Spot	Flux Effects	Unknown	< 1 month	11S 637465 3937955
2014-184-ISEGS	4/28/2014	3	Inner HD	UNPA	U	U	Feather Spot	Unknown		< 1 week	11S 637417 3937664
2014-185-ISEGS	4/28/2014	3	Inner HD	RUHU	A	F	Carcass	Flux Effects	1, 3	< 1 week	11S 637430 3939986
2014-187-ISEGS	4/29/2014	2	Power Block	UNWA	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 638679 3935875
2014-188-ISEGS	4/29/2014	2	Power Block	RUHU	A	M	Carcass	Flux Effects	2, 3	< 1 week	11S 638643 3935884
2014-189-ISEGS	4/29/2014	2	Power Block	YRWA	A	U	Feather Spot	Unknown		< 1 month	11S 638700 3935844
2014-190-ISEGS	4/29/2014	2	Inner HD	WCSP	A	U	Carcass	Collision		< 24 hours	11S 638584 3936021
2014-191-ISEGS	4/29/2014	1	Outer Segment	WCSP	A	U	Feather Spot	Other		< 1 week	11S 641292 3933921
2014-192-ISEGS	4/29/2014	2	Inner HD	BARS	A	U	Feather Spot	Flux Effects	Unknown	< 1 week	11S 638508 3935706
2014-193-ISEGS	4/29/2014	3	Inner Segment	HOLA	A	F	Carcass	Collision		< 24 hours	11S 637854 3937713
2014-194-ISEGS	4/29/2014	3	Inner Segment	HOLA	A	M	Carcass	Collision		< 24 hours	11S 637854 3937712
2014-196-ISEGS	5/1/2014	2	Outer Segment	MODO	A	U	Feather Spot	Unknown		< 1 month	11S 637882 3935361
2014-199-ISEGS	5/2/2014	2	Outer Segment	LOSH	A	U	Partial Carcass	Unknown		< 1 week	11S 639473 3936928
2014-209-ISEGS	5/3/2014	1	Inner HD	CLSW	A	U	Carcass	Flux Effects	1	< 24 hours	11S 640191 3933436
2014-210-ISEGS	5/3/2014	1	Inner HD	BARS	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640594 3933480
2014-211-ISEGS	5/3/2014	1	Power Block	YRWA	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 640376 3933543
2014-212-ISEGS	5/3/2014	1	Power Block	BANS	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640368 3933536
2014-213-ISEGS	5/3/2014	1	Power Block	RUHU	A	M	Carcass	Unknown		< 1 week	11S 640391 3933546
2014-214-ISEGS	5/3/2014	1	Power Block	CLSW	A	U	Carcass	Flux Effects	2, 3	< 24 hours	11S 640386 3933555
2014-215-ISEGS	5/3/2014	1	Power Block	NAWA	A	F	Carcass	Flux Effects	2, 3	< 1 week	11S 640364 3933554
2014-216-ISEGS	5/3/2014	1	Power Block	NRWS	A	U	Carcass	Unknown		< 1 week	11S 640419 3933555
2014-217-ISEGS	5/3/2014	1	Power Block	BANS	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640387 3933532
2014-218-ISEGS	5/3/2014	1	ACC Building	LAZB	A	F	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 640407 3933558
2014-219-ISEGS	5/3/2014	1	Power Block	BARS	A	U	Alive, injured	Flux Effects	2, 3	< 24 hours	11S 640308 3933555
2014-220-ISEGS	5/4/2014	1	Inner Segment	YRWA	A	U	Partial Carcass	Collision		< 1 week	11S 640044 3933166
2014-221-ISEGS	5/5/2014	1	Outer Segment	MODO	A	U	Feather Spot	Collision		< 1 week	11S 639618 3932767
2014-222-ISEGS	5/5/2014	1	Outer Segment	ATFL	A	U	Carcass	Collision		< 1 week	11S 639441 3933325
2014-223-ISEGS	5/5/2014	3	Inner HD	RUHU	U	U	Feather Spot	Unknown		< 1 week	11S 637651 3937864
2014-224-ISEGS	5/5/2014	3	Inner HD	MODO	A	U	Feather Spot	Unknown		< 24 hours	11S 637544 3933362
2014-227-ISEGS	5/6/2014	2	Power Block	YRWA	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 638649 3935918
2014-228-ISEGS	5/6/2014	2	Power Block	BANS	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 638634 3935897
2014-229-ISEGS	5/6/2014	2	Power Block	YEWA	A	M	Carcass	Flux Effects	1	< 1 week	11S 638639 3935907
2014-230-ISEGS	5/6/2014	2	Power Block	TRES	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 638559 3935890
2014-231-ISEGS	5/6/2014	1	Outer Segment	BTSP	A	U	Carcass	Unknown		< 1 week	11S 640702 3932683
2014-232-ISEGS	5/6/2014	2	Unit Fence	WEKI	A	U	Alive, injured	Unknown		< 24 hours	11S 638927 3937413
2014-235-ISEGS	5/7/2014	3	Outer Segment	MODO	A	U	Partial Carcass	Unknown		< 1 week	11S 637041 3936878
2014-237-ISEGS	5/8/2014	2	Outer Segment	HOLA	A	U	Partial Carcass	Unknown		< 1 month	11S 638268 3935174
2014-239-ISEGS	5/9/2014	2	Outer Segment	MODO	A	U	Feather Spot	Unknown		< 1 week	11S 638190 3936806
2014-241-ISEGS	5/10/2014	1	Power Block	COHU	A	M	Carcass	Flux Effects	1, 3	< 1 week	11S 640406 3933549
2014-242-ISEGS	5/10/2014	1	Power Block	UNKN	U	U	Feather Spot	Unknown		< 1 month	11S 640399 3933549
2014-243-ISEGS	5/10/2014	1	Power Block	WIWA	A	M	Carcass	Flux Effects	2, 3	< 24 hours	11S 640402 3933434
2014-244-ISEGS	5/10/2014	1	Inner HD	UNHU	A	U	Carcass	Flux Effects	2, 3	< 1 week	11S 640488 3933590
2014-245-ISEGS	5/10/2014	1	Inner HD	VASW	A	U	Carcass	Flux Effects	2	< 1 week	11S 640542 3933553
2014-246-ISEGS	5/10/2014	1	Inner HD	RUHU	A	F	Carcass	Flux Effects	2, 3	< 1 week	11S 640538 3933555
2014-247-ISEGS	5/10/2014	1	Inner HD	TOWA	A	F	Carcass	Unknown		< 24 hours	11S 640471 3933534
2014-248-ISEGS	5/10/2014	1	Power Block	UNKS	A	U	Carcass	Flux Effects	2, 3	< 1 month	11S 640378 3933523
2014-249-ISEGS	5/10/2014	1	Power Block	HEWA	A	F	Carcass	Unknown		< 24 hours	11S 640437 3933525
2014-250-ISEGS	5/10/2014	1	Inner HD	HOLA	A	U	Feather Spot	Flux Effects	Unknown	< 1 month	11S 640385 3933351
2014-251-ISEGS	5/10/2014	1	Inner HD	YRWA	A	U	Carcass	Unknown		< 24 hours	11S 640207 3933670
2014-252-ISEGS	5/10/2014	1	Inner HD	MODO	A	U	Feather Spot	Unknown		< 24 hours	11S 640193 3933518

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Carcass Condition	Cause of Death	Burn Grade	Time Since Death	UTM Coordinates
2014-254-ISEGS	5/14/2014	2	Inner Segment	BHGR	A	M	Feather Spot	Unknown		< 1 week	11S 638987 3936190
2014-255-ISEGS	5/14/2014	2	Inner Segment	YBCH	A	U	Partial Carcass	Unknown		> 1 month	11S 638312 3935559
2014-257-ISEGS	5/15/2014	2	Outer Segment	BARS	A	U	Partial Carcass	Flux Effects	1, 3	< 24 hours	11S 638299 3935229
2014-260-ISEGS	5/21/2014	1	Outer Segment	UNPA	U	U	Feather Spot	Unknown		> 1 month	11S 639916 3932885

[1] Alpha codes are defined in Table 1.

[2] "Unknown" cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with Project facilities; "Flux Effects" = singeing observed; "Collision" = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

Where sufficient information was available for earlier detections, flux-related carcass detections were 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

Grades were not applied in the case of feather spots or partial carcasses.

[3] UTM = Universal Transverse Mercator coordinate system

Table A-3. Injured Birds Found in Systematic Fatality Search Areas, 23 March – 22 May 2014 (n = 2)

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Cause of Injury	Injury	Outcome	UTM Coordinates
2014-176-ISEGS	4/25/2014	2	Outer Segment	BRSP	A	U	Collision	Bird observed to strike mirror and drop to the base of heliostat, face down. Eyes were closed initially and did not move. Bird came to and eyes opened when picked up. Bird flew from hand	Escaped alive	11S 638603 3937164
2014-105-ISEGS	4/5/2014	1	Inner Segment	AMKE	A	M	Singed	Burn Grade 2 and 3. Singeing and curling to entire dorsal surface and all flight feathers. Ventral feathers largely non-singed. Some singeing to face, but eyes did not appear injured.	Bird transferred to rehabilitator same day	11S 640487 3933251

[1] Alpha codes are defined in Table 1.

[2] "Unknown" cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with Project facilities; "Flux Effects" = singeing observed; "Collision" = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

The flux-related detection 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

Table A-4. Bat Fatalities Found During Systematic Fatality Searches, 23 March – 22 May 2014.

FWS #	Survey Date	Unit	Element	Species	Age	Sex	Cause of Death	Time Since Death	UTM Coordinates	How Found
2014-b05-ISEGS	3/25/2014	3	Power Block	MYCA	A	F	Unknown	< 1 month	11S 637467 3937974	Fatality Survey
2014-b06-ISEGS	3/31/2014	3	Power Block	TABR	U	U	Unknown	< 1 month	11S 637454 3937961	Fatality Survey
2014-b07-ISEGS	5/3/2014	1	Power Block	TABR	A	U	Unknown	< 1 week	11S 640376 3933458	Fatality Survey
2014-b08-ISEGS	5/4/2014	3	Power Block	MYCA	A	U	Unknown	< 24 hours	11S 637425 3937908	Incidental

[1] UTM = Universal Transverse Mercator coordinate system