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Avian & Bat Monitoring and Management Plan

Ivanpah Solar Electric Generating System

Prepared for

Solar Partners I, LLC; Solar Partners II, LLC; and Solar Partners VIII, LLC

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REV 14

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Avian & Bat Monitoring and Management Plan

1.0 Introduction

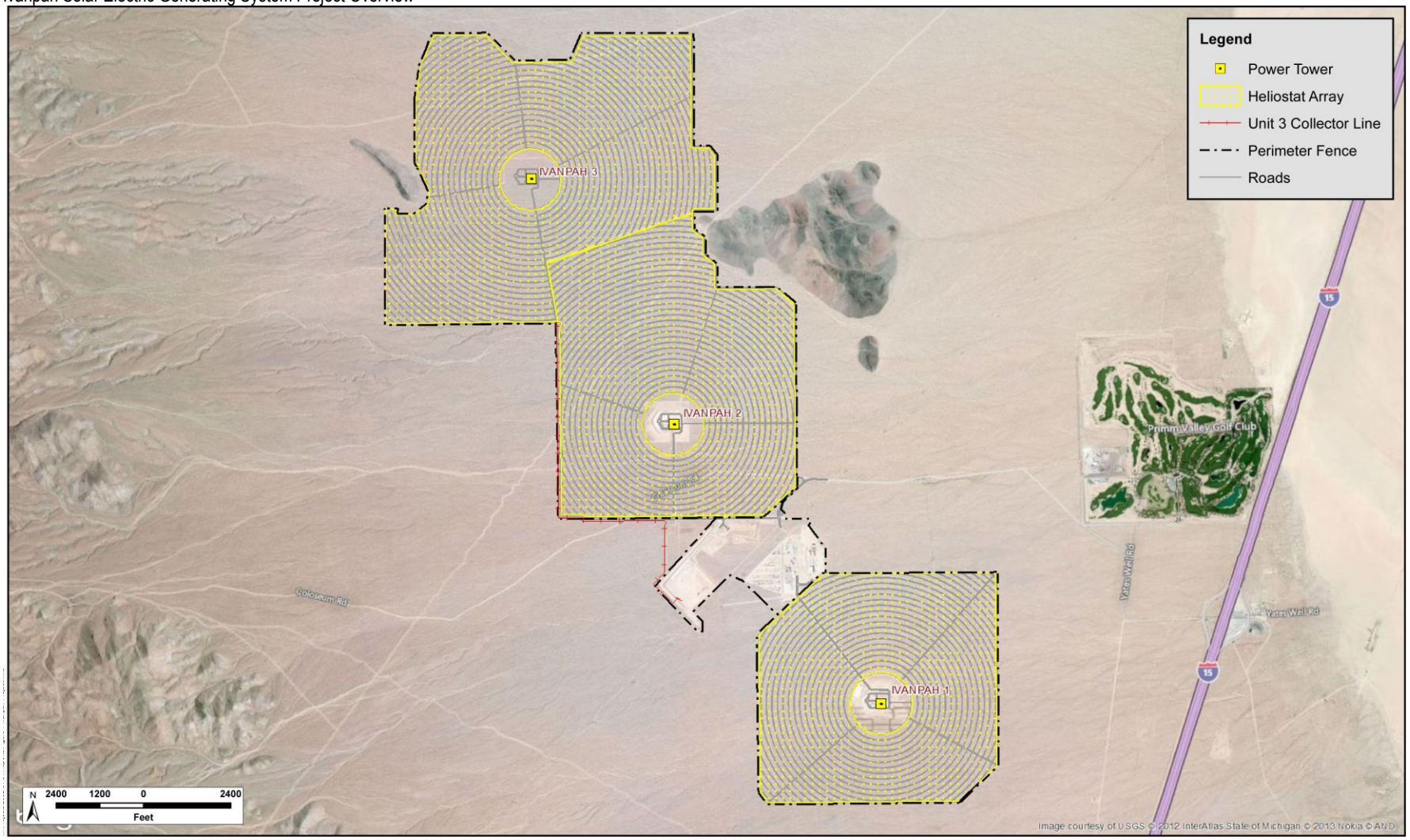
The Ivanpah Solar Electric Generating System (ISEGS) consists of three solar power electrical generating facilities with a combined net capacity of 377 megawatts. Each facility includes a central power tower, with associated electrical generating equipment, surrounded by a heliostat array that reflects sunlight to a receiver at the top of the tower (Figure 1). ISEGS is located on approximately 3,600 acres of federal land and was approved by the Bureau of Land Management (BLM) and the California Energy Commission (CEC) in 2010. Construction was initiated in 2010, and the first unit of the solar generating facility became operational in December 2013.

The purpose of this Avian & Bat Monitoring and Management Plan (hereafter Plan) is to comprehensively monitor and identify potential avian impacts that may be associated with the facility, in collaboration with the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), CEC, and BLM. This Plan is also intended to: 1) satisfy the BLM Right-of-Way (ROW) Permit requirement that the ISEGS team develop a Migratory Bird Treaty Act (MBTA) Conservation Agreement; 2) satisfy the requirements of the Avian and Bat Protection Plan approved by the CEC for ISEGS; 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 Endangered Species Act (ESA), 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 USFWS and other relevant state and federal agencies, project proponents can effectively minimize the potential for prosecutable offenses under the federal MBTA, Eagle Act, ESA, and relevant state regulations (USFWS, 2010, 2012).

Revision 14 documents the modifications to Revision 13, as approved by the TAC on 21 December 2017. Thus, Revision 14 details the procedures to be conducted, and the data analyses, reporting and management processes that will be implemented by ISEGS in collaboration with the USFWS, CDFW, CEC, and BLM (collectively, the Technical Advisory Committee or "TAC"; see Section 5.0) for the fifth year of avian and bat monitoring and management at the facility and for the life of the project. The monitoring has been adapted based upon the results of the first four years of monitoring as conducted under the prior approved versions of the Plan (Revisions 12 and 13). Specifically, the results from the first four years of monitoring indicated that based on the estimated fatalities, the consistent pattern of detections and consistently low impacts of avian fatalities allow for the discontinuation of Plan elements from Revision 13 that do not provide additional information to characterize avian mortality at the site. However, the monitoring described in Revision 14 is adaptive and the TAC may recommend modifications to the BLM Authorized Officer (AO) and CEC Compliance Project Manager (CPM) for the survey protocols and for adaptive management responses, if necessary, based on analysis of the survey data for avian and bat species detected at the site.

ISEGS incorporates practical design, construction, and operational measures to avoid or minimize potential avian impacts, including the mitigation measures identified by the CEC in the *Ivanpah Solar Electric Generating System Commission Decision* (CEC, 2010) and by BLM in the final environmental impact statement (BLM, 2010) and Right-of-Way grants for the facility. Substantial resources have been committed toward the development and implementation of avoidance, minimization, and mitigation actions to benefit the conservation of avian resources, including the development of this Plan, and implementation by the facility of voluntary best management practices discussed in Appendix F.

Figure 1.
Ivanpah Solar Electric Generating System Project Overview



1.1 Plan Goals

During the first two years of monitoring, the patterns of avian use at and surrounding the facility were documented, and throughout the first four years collision and flux risk were documented and reported in the quarterly and annual reports, meeting the goals of the Plan set forth in Revision 12 and Revision 13. For the fifth year of monitoring and for the life of the project under Revision 14, the goals are as follows:

1. **Assess levels of mortality:** Detections (i.e., fatalities or injuries) documented and an annual assessment of the level of mortality will be determined and provided consistent with the "high, medium and low" framework as described in Section 5.3.
2. **Provide a Framework for Management and Response to Risks:** The designation and description of the functioning of the TAC provides a management and decision framework for the identification and implementation of potential adaptive management measures.

1.2 Plan Objectives

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

1. Document patterns of avian and bat mortality and injury at the facility.
2. Provide quantitative and qualitative information for developing and implementing adaptive management responses commensurate with identified impacts.
3. Provide a framework for the TAC to jointly review, characterize, and recommend responses, based on monitoring results, to the appropriate lead agency representatives.

2.0 Adaptive Monitoring Plan

This monitoring Plan (Revision 14) is designed to determine the level of avian mortality and injury at the ISEGS project. The mortality and injury investigation will focus on the potential for collision and flux effects to occur during normal facility operation. Survey protocols are detailed in Sections 2.1 and 2.2. This monitoring Plan is adaptive, and modifications may be recommended by the TAC in response to the results obtained from the initial yearly surveys.

2.1 Collision- and Flux-related Monitoring

This section describes the monitoring studies that will be implemented to assess avian mortality and injury risks associated with avian collisions with the facility power tower and heliostats (Figure 1) and sunlight reflected from the heliostat field toward the solar tower receiver (solar flux). All avian casualties detected within the facility will be recorded and, based on a field inspection of each casualty, a cause of death or injury will be determined, if possible.

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

1. **Collision effects:** Birds with broken bones, chipped beaks, or other evidence of collision trauma, or birds found at the base of heliostats with bird-strike imprints in the dust on the heliostat.
2. **Flux effects:** Birds with any signs of singed feathers or tissues or visible ocular damage (per field evaluation with handheld magnifying glasses, binocular microscope or if detected during subsequent necropsy analysis).
3. **Flux and collision:** Birds with evidence of both collision and flux effects (evidence that flux impacts could have affected a bird's ability to avoid facility structures).

4. **Other:** Known cause, but not 1, 2, or 3 above (e.g.,, lightning strike, avian disease, entrapment in buildings, etc.).

5. **Unknown:** No known or presumed cause.

2.1.1 Study Components and Field Methodology

This section describes an operational field-survey approach based on the requirements of the CEC's Final Decision and the BLM's ROW stipulation 21. The approach primarily involves visual 14-day (i.e., twice monthly) surveys within the tower areas (power block and inner high density heliostat area) to detect avian casualties (fatalities and injuries). Surveyors and limits of responsibilities are described below.

- Onsite personnel – Onsite personnel that have been trained through the Worker Environmental Awareness Program (WEAP), the Wildlife Incidence Reporting Systems (WIRS – see Section 3.2) and the training specified within this Plan will conduct fatality searches and collect data. Onsite personnel will not handle carcasses (unless they obtain the necessary qualifications and are listed on the California Scientific Collection Permit and the facility Special Purpose Utility permit (SPUT Permit)). Onsite personnel conducting searches will report to the Designated Biologists and avian biologists for these activities.

- Avian biologist – Avian biologists are approved to work at the facility by the CEC and BLM based on their education and experience. Avian biologists are specialized in bird identification, and are qualified to identify carcasses to species. Avian biologists are qualified to conduct fatality searches, collect data, and report findings. Avian biologists report to the Designated Biologist and are authorized to handle carcasses if they are listed on a California Scientific Collection Permit and the facility SPUT Permit.

- Designated Biologist – The Designated Biologist is approved to work at the facility by the CEC and BLM based on his/her education and experience, and performs a suite of environmental services at the project, including managing the biological staff and oversight of the onsite personnel conducting searches. The Designated Biologist is qualified to conduct fatality searches, collect data, and report findings and may handle carcasses if they are listed on a California Scientific Collection Permit and the facility SPUT Permit. The Designated Biologist could perform the duties of an avian biologist if qualified to identify carcasses to species.

Surveys may be conducted by any surveyor described above; however, final determination of all species collected onsite will be made by an avian biologist or the Designated Biologist if qualified prior to the data being entered and reported on the monthly SPUT report. Nevertheless, accurate identification of rare, special status species will be emphasized during training for all surveyors to facilitate any required notifications for these species. All surveyors will have photo cards or appropriate guidebooks to classify specimens and will take photographs of all finds. All data collection will be standardized as per previous surveys with onsite personnel providing the data sheets to the Designated Biologist. The Designated Biologists will coordinate with the avian biologists as needed and assemble all data collected. All observations and detections of avian mortality will be reported via the SPUT Permit monthly, with an annual summary provided to the TAC. In addition, any detection of six or more fatalities within a 24-hour period will be reported within 48 hours, as per the SPUT Permit requirements.

Onsite personnel that will conduct monitoring will receive specialized training from an avian biologist. The curriculum and training materials will initially be provided by WEST, Inc., which has overseen and conducted the surveys at the facility since 2015. Training materials provided to the onsite personnel are provided in Appendix A. The training will be conducted in coordination and with the support of the Designated Biologist. Should new onsite personnel at the facility require training for surveys; the Designated Biologist will conduct training as necessary. This will ensure continuity in the methods to perform the surveys at the site. Components of the training program will include:

- A classroom-based portion with lecture and handout materials, and photographic or specimen-based (if available) species identification methods;
- A field-based portion that allows trainees the opportunity to practice and receive feedback on conducting carcass searches, identification of species, completing data forms, and following protocols for assessing and assisting injured birds and bats;
- Qualitative assessment of learning outcomes for each participant; with avian biologists following and observing onsite personnel during the transition.
- The avian biologists will document any concerns noted during the training of onsite personnel.
- A training log to be updated with each trainee's name and contact information upon successful completion of the course. A copy of the training log form is provided in Appendix B.

All reference material will be maintained and provided to the agencies if requested.

2.1.2 Onsite Monitoring

Avian mortality within the ISEGS facility will be evaluated by visual surveys in each of the three ISEGS units (Ivanpah 1, 2, and 3), as described below. The ISEGS units are shown in Figure 2.

Search Areas/ Methodology/Timing

This section describes the survey methods by which avian fatalities and injuries will be evaluated through surveys conducted in the tower area of each unit. The specific areas and the nature of the tower areas are described below. Specifics of the methods for the surveys to conducting the avian surveys are summarized in Table 1.

Tower area: The tower area consists of (a) the area that exists from the tower powerblock to the first heliostats (distance varies from the tower to the heliostats of approximately 350 - 650 feet) and (b) the inner high density heliostats (inner HD area) that extends from the powerblock boundary to the first ring road (concentric road surrounding the tower) containing the inner high density heliostats. These areas are cleared of vegetation for operational purposes. The tower area in each unit is located beneath the portions of the solar field that would have the highest flux intensity and surrounds the tallest structure within the facility. An aerial image of the Tower area for Unit 2 is shown on Figure 3. The area of the powerblock is shown shaded yellow and the inner HD area is shown as shaded in red.

Figure 2
Avian and Bat Fatality and Injury Sampling Scheme at Units 1, 2, and 3.

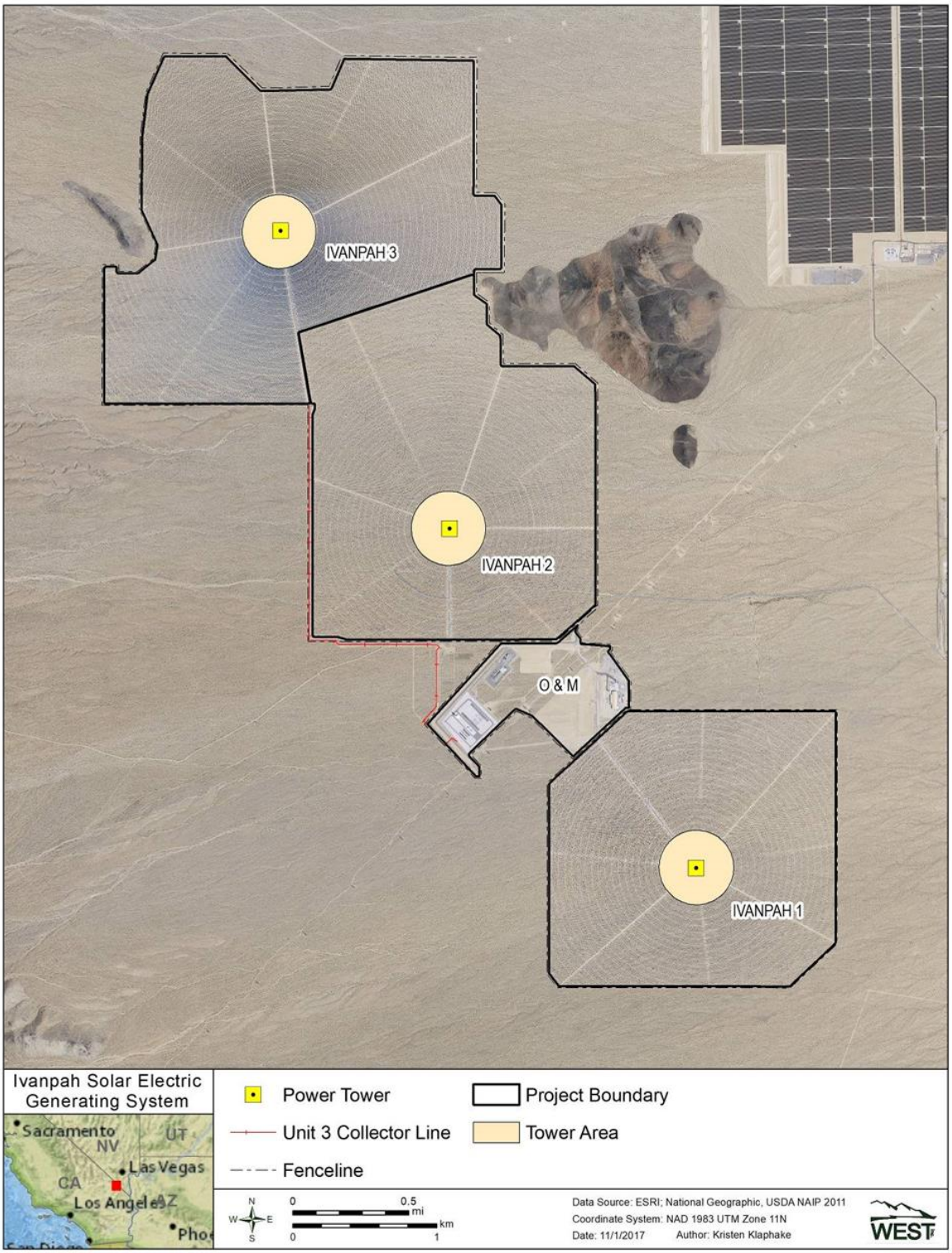
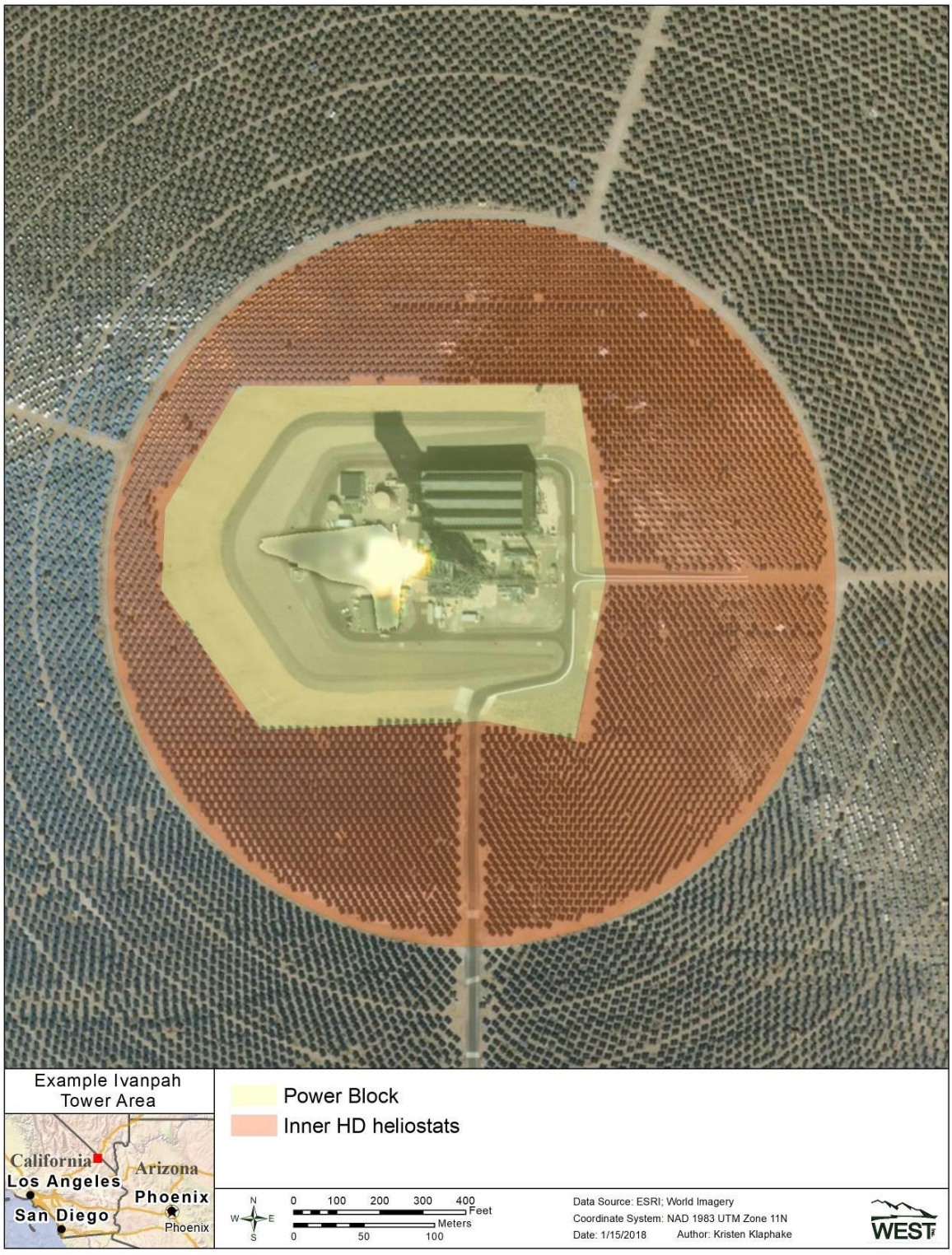


Figure 3.
Powerblock and Inner High Density Heliostat Survey Regions of the Tower Area. The Tower Area is searched 100%



Each powerblock area will be visited on a 14-day interval by surveyors to conduct systematic visual inspections, specifically to look for evidence of avian mortality and injury (e.g., carcasses, feathers, injured birds), including walking transects and internal inspection of the air-cooled condensers (ACC). These visits will be specific to survey for evidence of avian mortality and no other activities will be conducted in conjunction with these surveys. For the powerblock area, a survey form will be provided to onsite personnel that includes descriptions of the areas to be searched and equipment to be inspected during each survey. The powerblock area survey is primarily intended to document the detections affected by acute flux exposure or tower-related collisions. Each inspection will be documented on a survey form and all detections treated as per the training protocols outlined above.

Similar to the powerblock, the inner HD area will be visually surveyed on a 14-day interval. These surveys will consist of systematic visual inspections specifically for evidence of avian mortality and injury (e.g., carcasses, feathers, injured birds). No other activities will be conducted in conjunction with these surveys. The majority of detections occur in the powerblock; so the inner HD area portion of the 14-day interval inspection is primarily intended to identify the remainder of birds that may be affected by acute flux exposure or collisions.

Each of these areas were sampled according to the schedule in Table 1 by walking transects (as shown in Figures 4 and 5) and visually inspecting the area for evidence of avian and bat mortality and injury (e.g., carcasses, feathers, injured birds). Because the areas are generally clear of vegetation and since searcher efficiency rates in this area have been historically high, we continue to expect elevated searcher efficiency. This assumption was confirmed with searcher efficiency being tested during the spring 2018 season. Each survey will result in a complete (100-percent-coverage) assessment of the powerblock and inner HD area. Together these surveys are primarily intended to examine the potential for birds and bats affected by acute flux exposure or collisions.

Table 1
Basic Search Parameters for ISEGS Mortality and Injury Monitoring Study

Topic	Details	Comments
Survey coverage in Powerblock and Inner HD	100 percent	Surveyors will be dedicated only to avian mortality observations. No other activities will be conducted in conjunction with surveys.
Survey interval	Every 14 days	Surveys to occur as closely to 14-day intervals as weather will allow.
Rate of travel	1.7 to 2.2 miles/hour	Slow pace to allow careful visual inspection on each side of transect
Transect spacing*	Standardized at approximately 10 meters apart.	Inner HD area transect timing (early morning, mid-day or afternoon) and spacing may vary for surveyors to maximize visibility considering logistical issues associated with mirror height and position
Transect length	Standard within the powerblock and inner HD area	Parallel to spoke roads within the inner HD area and along the length of the Powerblock area parallel to the berm structure flanks.
Surveyor breaks	Approximately once per hour	Short breaks at one-hour intervals to hydrate, snack, and stay alert; approx. 30 minutes for lunch
Surveyor continuity	Emphasized	Same staff used for each survey (as is practical given staffing constraints) to maximize consistency

Transect spacing of 10 meters is selected based on experience surveying for avian fatalities in areas with no vegetation and flat topography, comparable to conditions present in the powerblock and inner HD

area. Surveying with transects spaced at approximately 10-meter intervals allows thorough visual inspection of these areas. Six to 10 meters is a generally accepted standard for fatality monitoring at other renewable projects in similar vegetation and topography, and the California guidelines recommend 6-meter spacing with adjustments based on vegetation and topographic conditions (CEC and CDFG, 2007). Additionally, the USFWS (2012) guidelines recommend spacing at 4- to 10-meter intervals based on vegetation and topography. Figure 4 and Figure 5 below depict the transects for the powerblock and inner HD area, respectively. This spacing is consistent with Revision 12 and 13 methodology. Note that spacing within the equipment will be maintained to the degree possible and surveyors will maintain the same methods for examining the structures within the powerblock, (e.g., conducting searches in the ACC, etc.).

Figure 4.
Typical Search Pattern in the Powerblock.

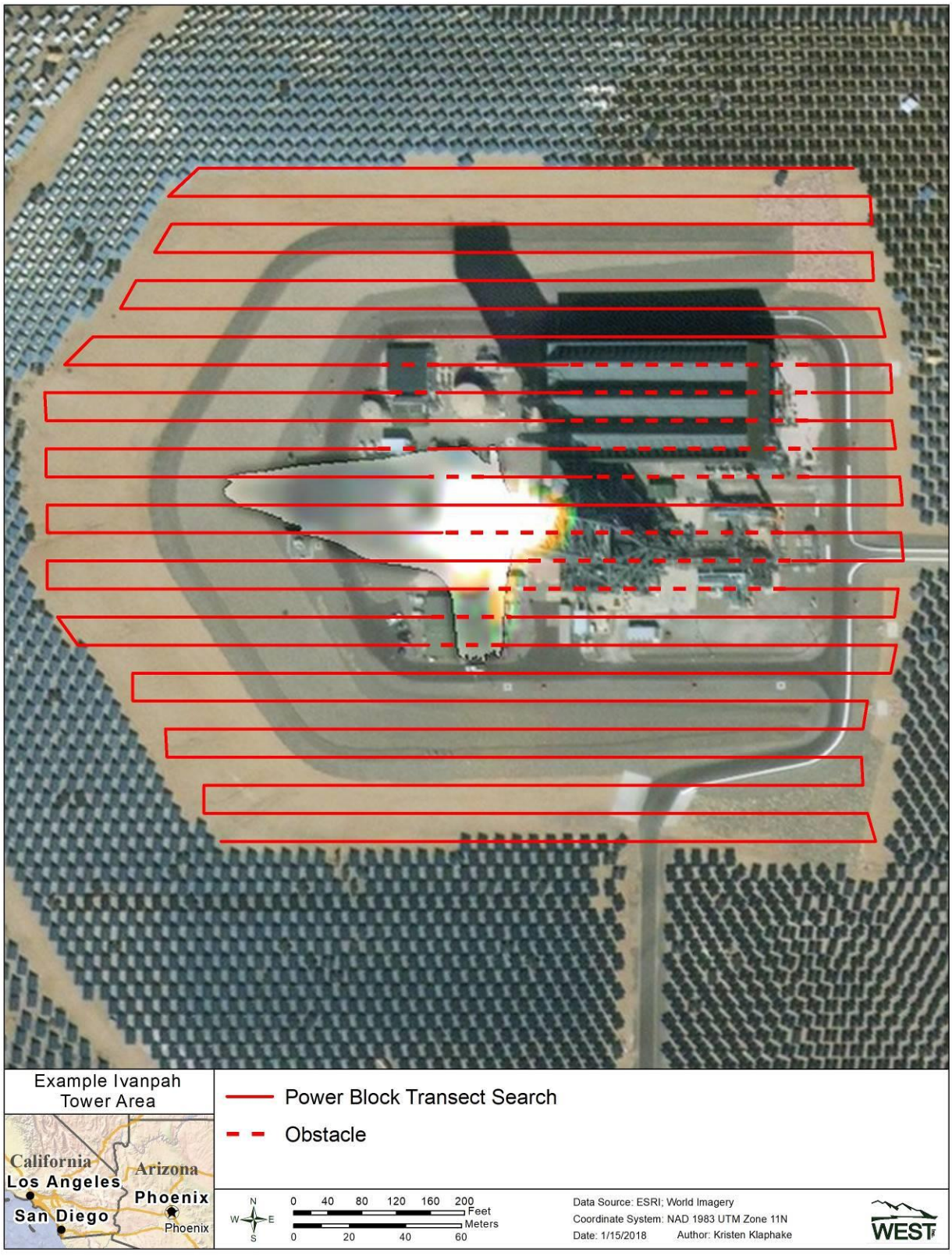


Figure 5.
Typical Search Pattern in the Inner High Density Heliostats.

2.1.3 Data Recordation and Detection Protocols

Avian biologists and the Designated Biologist with the SPUT Permit and California Scientific Collection Permit authorization will collect the detections. The term "detection" is used throughout this document to indicate that observers may find injured birds, intact dead birds, partial birds, and feather spots indicative of avian mortality, as well as injured or dead bats. If surveyors do not have the necessary permits, they will do the data collection described below then mark the detection with a traffic cone or other similar device to prevent scavenging and dispersal of the carcass and the Designated Biologist will be contacted to collect the carcass.

Detections will be photographed, collected, labeled with a unique number, bagged, and frozen for up to one year for future reference and possible necropsy if cause of death cannot be determined upon physical inspection. The TAC agencies will determine whether certain birds detected during the surveys should be removed from the project area so that a third-party wildlife laboratory, under the direction and expense of the USFWS or TAC agencies, may conduct formal necropsy assessments. Copies of all results of any formal necropsy assessment will be provided to the TAC and ISEGS. Detections discovered incidentally outside of the surveyed areas, such as those identified while driving through the site or observed outside a survey area boundary during other project-related activities, will also be documented. An incidental carcass discovery by a surveyor will be documented according to the protocols described in this ABMMP Plan. If a carcass is discovered by someone other than a surveyor, it will be documented following the Wildlife Incident Reporting System (See Section 3.2), and will be reported to the Designated Biologist for retrieval and additional data collection.

For all detections, information about the type of bird, its condition, and the location will be recorded. Field personnel will undertake visual inspection of all carcasses, feathers, and/or body parts discovered in the field. For all detections, data recorded will include species, sex, age, and breeding condition (for example, if a brood patch is present) when possible; distance from observer when detected; date and time collected; GPS location; distance to tower (or structure that caused mortality, if determined); condition (fresh, early decomposition, late decomposition, desiccated, scavenged, intact); and any indication of cause of death, such as type of injury. The forms for data collection have been adapted from those used in Revisions 12 and 13 to maintain data comparability. Data collection forms are included in Appendix C.

All detections will be plotted on a detailed map of the study area that shows the location of the surveyed areas, heliostats, tower, roads, and perimeter fence and photographed, using a digital camera, in situ as well as with full-frame photographs of the dorsal, ventral and head areas of the bird or bat. All collected carcasses will be subsequently inspected by an avian biologist to confirm species identification, singeing grade and to obtain photos. Confirmation inspections will occur prior to each SPUT reporting period to insure accuracy of the information provided.

In the event a dead or injured bald or golden eagle is found, USFWS Office of Law Enforcement (OLE) and the CDFW shall be contacted as soon as possible, but no later than 24 hours after discovery. If a dead eagle is found, the OLE agent will provide instructions on collection and disposition of the eagle carcass. Until then, the carcass will be left in place, unless a project-affiliated biologist has the necessary federal and state permits to authorize handling the carcass in coordination with the OLE. (See section 5.0 for additional required steps).

Any state- or federally listed threatened or endangered species found dead or injured shall also be reported to OLE and CDFW as soon as possible, but no later than 24 hours after discovery. If a federally-listed species is found, the OLE agent will provide instructions on collection and disposition of the carcass. A list of federal threatened and endangered species by state may be found in the USFWS's Threatened and Endangered Species System (TESS) database at: http://www.fws.gov/endangered. A list of California threatened and endangered species may be found at http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf.

Migratory birds, including eagles and threatened or endangered species, that are injured shall be captured, stabilized, and immediately transferred to a licensed veterinarian or federally permitted migratory bird rehabilitator for care. Per agency approvals, since September 24, 2014, injured birds have been transported to Nevada facilities listed in Table 2 below.

All injured birds will be handled by the Designated Biologist or an avian biologist. All injured birds observed within a survey area or elsewhere within the facility will be recorded and treated as detections for analytical purposes.

TABLE 2
Avian Rehabilitation Centers

County	City	Name	Phone
Clark	Las Vegas, NV	Animal Kingdom Veterinary Hospital	702-735-7184
Clark	Las Vegas, NV	Wild Wing Project	702-238-0570

Permitting to Handle Carcasses and Specimens. Handling and collecting carcasses of birds protected by the MBTA requires a permit. At the federal level, ISEGS has obtained a USFWS SPUT Permit that specifically authorizes collection of bird fatalities associated with commercial energy and utility operations.

Handling of migratory birds is also prohibited under the California Fish and Game Code unless specifically authorized by a CDFW Scientific Collecting Permit. These permits generally are issued only to individuals. The Designated Biologist for the ISEGS facility and West Inc. biologist holds this permit.

2.1.4 Study Duration

Operational monitoring within each of the three ISEGS units pursuant to this Plan, will be conducted for the duration of the project, unless modified. After each year, the monitoring program is subject to evaluation by the TAC pursuant to Section 5.

3.0 Reporting

3.1 Reporting

All detections will be recorded in the USFWS SPUT Permit report and submitted to the USFWS and CDFW monthly. An annual monitoring report will be prepared by the Designated Biologist (or other similarly qualified biologist). The report will include a summary of the information and provide a qualitative mortality assessment as per the categories outlined in Section 5.3. The assessment will be based on and compared to the detections and resulting estimates provided in the previous four years of surveys (See Appendix D). The report will also include an appendix that contains the monthly SPUT reports. Photographs of all detections will be separately provided upon request. The annual reports will be provided to the TAC as described in Section 5.2.

3.2 Wildlife Incident Reporting System

In addition to the post-construction fatality monitoring study described above, ISEGS will continue to implement the Wildlife Incident Reporting System (WIRS) and the WEAP for the life of the ISEGS facility. The purpose of the WIRS is to standardize the actions taken by onsite personnel outside of the systematic monitoring conducted as per this Plan. All onsite personnel will be trained to recognize and respond to wildlife incidents encountered in at ISEGS and to fulfill the obligations for reporting wildlife incidents. Onsite personnel will be instructed only to report incidents to the Designated Biologist and not to disturb

any evidence of mortality within the facility. All observed fatalities will be reported in monthly SPUT and annual reports to the TAC agencies. The WIRS will be utilized by site operations and maintenance personnel who encounter dead or injured wildlife incidentally while conducting general facility maintenance activities, such as mirror washing. The WIRS is designed to provide a means of recording and collecting fatalities at the ISEGS project to increase the understanding of power tower solar facilities and wildlife interactions. In addition, this system will specifically train personnel to identify evidence of mortality of rare species, particularly large birds such as eagles.

The WIRS training and system of reporting applies to all personnel at the site. A subset of the staff will be further trained to perform systematic searches at the facility as described in Section 2.1.1. These personnel will collect data and perform systematic searches under the direction of the Designated Biologist and avian biologists.

Any bird found injured within the ISEGS facility will be taken to the nearest appropriate wildlife rehabilitation facility listed in Table 2, as directed in the WIRS. Any incident involving a state- or federally listed threatened or endangered species or a bald or golden eagle must be reported to the USFWS and CDFW within 24 hours of identification. ISEGS maintains an ongoing commitment to investigate wildlife incidents involving company facilities and to work cooperatively with federal and state agencies in an effort to prevent and mitigate future wildlife fatalities. It is the responsibility of ISEGS employees and subcontractors to report all wildlife incidents to their immediate supervisor and to the Designated Biologist as per CEC Conditions of Certification.

4.0 Monitoring Review Schedule

All surveys conducted in this Plan will be reported to and evaluated by the TAC. The surveys described in Revision 14 of this Plan will be completed through the life of the project and include monthly SPUT reports and annual reporting to the TAC. Depending on the findings, the monitoring program is adaptive and may be expanded, reduced, discontinued, or otherwise modified as appropriate. Changes to the monitoring program will be recommended by the TAC in accordance with the decision framework described in Section 5.0, Adaptive Monitoring and Management.

5.0 Adaptive Monitoring and Management

The adaptive monitoring and management program presented in this section provides for the continuation of a TAC to advise the BLM AO and the CEC CPM in the implementation of changes in monitoring or adaptive management measures to protect avian and bat species, and an analytical framework within which to recommend measures related to migratory birds and a process by which to develop a step-wise table of advanced conservation practices and apply for an eagle permit, should take occur.

ISEGS operates under the terms and conditions of the federal Right-of-Way grants, which delegates authority to the BLM's AO. ISEGS also operates under the CEC's Conditions of Certification, under which the decision making authority regarding the facility, this monitoring Plan, and any adaptive mitigation measures resides with the CPM. Therefore, with the concurrence of the BLM and CEC, a TAC has been formed to provide adaptive monitoring and management recommendations. The BLM's AO and CEC's CPM will evaluate any recommendations of the TAC and decide what measure(s), if any, are necessary for modifying the monitoring or for implementing adaptive management of the facility, as per the terms and conditions of the right-of-way grants and CEC Conditions of Certification.

The adaptive monitoring and management program presented in this section defines the TAC membership and authority and provides an objective analysis framework for the TAC to use, so that the TAC can objectively assess monitoring data and recommend future actions, including actions related to

modifying the scope of studies and determining management or mitigation responses that are commensurate with the extent of impacts that may be identified in the monitoring studies.

5.1 TAC Membership, Objectives, and Meetings

The TAC will consist of one member from each of the regulatory agencies—BLM, CEC, USFWS, and CDFW—that oversee compliance activities, with respect to BLM and CEC, or that have issue area expertise, with respect to the USFWS and CDFW. Each agency will provide a member completely at its own discretion. The BLM and CEC TAC members will serve as the designated TAC co-chairs for the duration of the project. The members of the TAC will also be available for annual conference calls or meetings to review the data and analysis provided in the annual reports from the facility. More frequent meetings may be needed and can be called by one or both of the co-chairs. In addition, the TAC, through the TAC co-chairs, may invite an avian expert to sit on the committee, and invite specialists involved in the monitoring effort to specific meetings to discuss results and potential adaptive management responses. Only the four regulatory agencies on the TAC will have voting authority for making changes and determinations.

Two additional members will be provided by the ISEGS facility. One member will be nominated from the Environmental Compliance department and a second from the Operations department. The level of experience with the operation of large-scale concentrating solar power tower technologies is limited; therefore, the Operations member is necessary to provide guidance with respect to facility operations. The Environmental Compliance member will be the main point of contact for the agencies.

The TAC co-chair duties will include ensuring that project data gets disseminated to the TAC, including data on mortality events, setting up and moderating meetings, reviewing mortality data, inviting participation by outside experts, if warranted; and documenting mitigation recommendations for the facility.

5.2 Data Review Process

Annual summary reports will be completed by ISEGS within one month of the end of each year and provided to the TAC members. A webinar or in-person meeting may be scheduled through the TAC co-chairs within 30 days of receipt of each annual summary report. This meeting will include the TAC members and other relevant staff including, but not limited to, the Designated Biologist or avian biologist responsible for collecting the data, the statistician, and other biologists responsible for interpreting the results of monitoring. The meeting will focus on ensuring that all TAC members have a consistent understanding of the content and findings of each annual summary report. The TAC comments on the report and any recommendations regarding implementing adaptive monitoring, management actions, or mitigation measures will be documented by the TAC co-chairs after discussion with TAC members, with any dissenting opinions noted in the decisions and meeting notes. Recordkeeping responsibility for documenting each meeting's content (issues, decisions, outcomes, and action items) and for ensuring completion of any resulting action items will be the responsibility of the ISEGS Environmental Compliance TAC member, in coordination with the TAC co-chairs. Draft meeting notes will be circulated to the TAC for review and comment, and final notes will be circulated to all members for recordkeeping purposes.

5.3 TAC Review Framework

The TAC will review the annual report, meet as requested per Section 5.2 above, and recommend whether additional adaptive monitoring or management actions are necessary. The TAC may meet annually to review the annual report or more often to discuss adaptive management needs if the TAC co-chairs determine that a significant event has occurred. Should the operational monitoring studies indicate significant adverse impacts to avian resources, either to a particular species or group of species at the national, regional or local level, as applicable, ISEGS is committed to taking appropriate action to address

the issue(s). ISEGS is committed to working with the TAC in a collaborative manner to identify and implement measures commensurate in scale with the identified impact.

The TAC shall ensure that management recommendations to mitigate impacts should be directed specifically at identified problems. For example, if heliostats placed in the upright position at night are documented to cause adverse avian impacts, a reasonable action might be to orient the structures horizontally or with varying angles to determine if the observed level of impacts can be reduced, or to assess other strategies that would address the identified problem. If nocturnal migrants are affected by a tower during low-visibility weather events, modifications to the tower lighting scheme could be implemented to evaluate methods for avoiding weather-related issues. Other responses to documented impacts could include conservation or enhancement of certain habitats or habitat modifications in or near the facility to deter affected species from using the facility or adjacent areas. The TAC will assess impacts and identify appropriate responses in a collaborative manner with the Operations and Environmental team at ISEGS for recommendation to the BLM AO and CEC CPM.

The TAC shall consider species impacts according the status of the species. In other words, migratory birds, bald and golden eagles, and endangered species will be considered by the TAC for recommendations as groups, according to their regulatory status. For migratory birds, the TAC shall review the reports, discuss the results of the monitoring, and undertake collaborative decision making in accordance with the criteria described in Table 3. In accordance with the methodology in Appendix D, the annual report shall present an evaluation of detections among years and shall categorize potential migratory bird mortality issues in the tower area as high, medium, or low to provide an appropriate biological basis for TAC review and decision making, and shall reflect 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.

TABLE 3
Adaptive Management Responses

Issue	Management Response	Study Response
High levels of general or species-specific mortality associated with a particular facility feature (for example, heliostats) or characteristic (for example, flux, weather events)	Immediate management action taken if cause can be addressed*	Studies modified, refined, or expanded to better understand and address impact issue and assess effectiveness of management response
Medium levels of general or species-specific mortality associated with a facility feature or characteristic	Management action taken to address impact issue if deemed necessary*	Studies modified, refined, or expanded to better understand and address impact issue and assess effectiveness of response
Low levels of mortality with minimal or no potential to affect local, regional or national populations of a species or group of species.	No management responses taken	Operational studies continue or are reduced

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

The as described high, medium and low classifications are based on assessing impacts to species at the national, regional and local levels on annual basis. Further information regarding the specific methods of assessing these categories is presented in Appendix E.

ISEGS, as a prudent operator, has undertaken several voluntarily initiated best management practices, including installation of deterrence measures for avian species at the facility. These voluntary measures are documented in Appendix F.

For bald or golden eagles, should such a species be taken by the facility, then ISEGS will report within 24 hours, prepare an Eagle Conservation Plan (ECP), and consult with the USFWS to determine the need for an eagle permit; CDFW will be notified in the event of an eagle take. The ECP and/or permit application, if required, shall be prepared in accordance with the current USFWS Eagle Conservation Plan guidance, as relevant to Solar Power Tower Technology. The modified ECP would contain a step-wise table with proposed advanced conservation practices appropriate for a solar power tower facility.

The TAC shall, at all times, identify the most appropriate response to a documented avian impact (including operational management actions) in the best professional judgment of the TAC members, and subject to the following decision criteria:

1. Any response shall be based on the causation of the applicable mortality.
2. All responses shall be commensurate (in terms of factors that include geographic scope, costs, and scale of effort) with identified impacts.
3. If the facility causes impacts to migratory bird species considered to be high or medium after ISEGS has undertaken appropriate measures as recommended by the TAC, ISEGS will use its best efforts to identify for TAC review additional measures, including coordination with other local or regional renewable energy or other projects, that would conserve bird species and that are commensurate with the identified impacts.
4. If the facility causes take of a bald or golden eagle, ISEGS will, within 10 days, develop a step-wise table with advanced conservation practices for TAC review and will consult with the USFWS regarding whether an application for an eagle permit is warranted.

5.4 Addressing Resource Impacts

If, based on the analytical framework above, the TAC identifies significant impacts to avian resources that warrant an immediate response to either change the monitoring/reporting procedures or to protect the resources involved, a recommendation will be developed by the TAC. If the recommendation is adopted and required by the BLM AO and CEC CPM, it will be implemented by ISEGS in a timeframe agreed upon by the parties. If the identified problem cannot be effectively addressed, a follow-up action plan will be developed by ISEGS within 30 days that addresses the resource issue. ISEGS shall be responsible for documenting and implementing the response action or action plan. If no immediate response is needed to address an identified impact, then previously approved and scheduled monitoring and other activities related to this Plan will be implemented without change, subject to modification as may be recommended by the TAC.

Based on the annual monitoring results, the TAC will recommend if and to what extent previously implemented studies may be warranted in subsequent seasons or years. If continued study is recommended by the TAC, the scope and objectives of the planned studies will be evaluated for

adequacy and modifications (e.g., reduction in search area or number of surveys in a season), and recommended changes will be implemented as appropriate if approved at the discretion of the BLM AO and CEC CPM. Any recommended expansion of scope for monitoring would be proportional to the risks and developed in consultation with the TAC (USFWS, 2013).

References

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California Energy Commission (CEC). 2010. *Ivanpah Solar Electric Generating System Commission Decision*. CEC-800-2010-004-CMF. Docket Number 07-AFC-5. September. Available online at: http://www.energy.ca.gov/2010publications/CEC-800-2010-004/CEC-800-2010-004-CMF.pdf

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

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

U.S. Fish and Wildlife Service (USFWS). 2013. *Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy.* Version 2. April. 103 pp. Available online at: http://www.fws.gov/migratorybirds/PDFs/Eagle20Conservation20Plan20Guidance-Module201.pdf.

Appendix A

Training for Onsite Surveyors

Memo on Operations Staff Training and Orientation

Ivanpah Solar Electric Generating System

1 January 2018

Prepared & Implemented by
Cyrus James Moqtaderi
Lead Avian Biologist

Western Ecosystems Technology, Inc.
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Cheyenne WY 82001

Western EcoSystems Technology, Inc. (WEST) will implement a comprehensive training program for all Ivanpah Solar Electric Generating System (ISEGS) operations staff performing tower area surveys under the Avian & Bat Monitoring and Management Plan (Plan) Revision 14. As per this revision, all surveys will be conducted to standards and methodology as specified in the Plan. The purpose of this document is to outline the structure of the program.

All training is reviewed and approved by the WEST Project Manager (Karl Kosciuch, Ph.D.) and will be overseen & implemented by lead avian biologist (Cyrus Moqtaderi) and avian biologist (Ben Zyla), TAC authorized biologists. The Project Manager, lead avian biologist, and avian

biologist must be qualified biologists holding at least a Bachelor's Degree in an environmental field and over five years avian monitoring experience.

1. The avian biologist providing the training will confirm the date each staff member completed the Worker Environmental Awareness Program training. If necessary, training will be renewed by site Designated Biologist. Training will focus on injured bird reporting/rescue/rehabilitation procedures.

2. Onsite personnel will attend a class conducted by the avian biologists to describe survey protocols and methods. Information will include details on search method, search areas, and methods for evaluating what is/is not an avian detection.

3. Classroom training will also include examination and explanation of datasheets associated with the survey and associated field processing of detections. Instruction will be given on proper completion of these datasheets. While onsite personnel will not handle any detection unless they are added to the SPUT Permit and California Scientific Collection Permit, instruction on identifying sensitive/protected species will be provided.

4. After completing the classroom portion of the training, onsite personnel will accompany an avian biologist on a practice survey. During this practice survey, onsite personnel will shadow an avian biologist for a full survey. During this stage, onsite personnel will **not** lead any portion of the survey. Instead, they will act only as observers, during which time they will be able to witness all aspects of survey implementation and data collection.

5. After satisfying this portion of shadow surveying, onsite personnel will be asked to lead an example section of the survey, under the oversight of an avian biologist. During this process, onsite personnel will be tested on understanding of protocol and datasheet completion. If at any point errors are made, the avian biologist will immediately review the action, discuss the mistake, and advise the correct course.

All questions and concerns should be directed to the WEST Project Manager.

Appendix B

Training Log Form

ISEGS OPERATIONAL MONITORING TRAINING – 2018

All participants listed below have successfully completed the ISEGS operational monitoring training course on the date written, under the supervision of a TAC authorized instructor (avian biologist). Notation on this log signifies that the attendee has completed both the in-office/classroom and in-field/survey training sections of the course.

Onsite Personnel	Signature	Date	Avian Biologist	Signature

Appendix C

Data Collection Form

Powerblock

DATE:_____ **SURVEYOR(S)**:_____ **UNIT**: ____ **FLUX ON TOWER**: Y / N
STREET/ALLEY (if applicable):_____ **TIME** START / END:_____ / _____

DETECTIONS:

SPUT #	SPECIES	ACC?	SPUT #	SPECIES	ACC?

INNER HD

DATE:_____ **SURVEYOR(S)**:_____ **UNIT**: ____ **FLUX**: Y / N
TIME START / END:_____ / _____

DETECTIONS:

SPUT #	SPECIES	ACC?	SPUT #	SPECIES	ACC?

ADDITIONAL NOTES

STANDARDIZED AVIAN SURVEY FORM

Fill out one section for each distinct search, by location (e.g. Powerb Block, Inner HD). Fill out all survey information every time, even if no casualties (fatalities or injuries) are recorded. This form is the record of your survey effort.

PROTOCOLS AND CONVENTIONS

Date: Record current date of survey

Surveyor(s): Record all surveyors' initials here

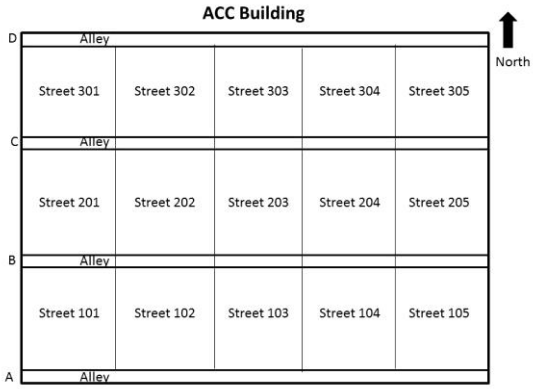
Unit #: 1, 2, or 3; represents which tower area you are searching in. For other locations which are not associated with a unit, record N/A.

Location (pre-filled): Fill out the correct portion for fatalities casualties found in the Powerb Block (Note if ACC), or Inner HD

Start and End Time: Start and end time of search.

Flux: Is flux visible at the tower in the unit being surveyed?

Street/alley: If fatalitycasualty is found in the ACC building, record the street (e.g. 101-105) number, which is located on the emergency shutoff switch near the fan motor, or the alley (A, B, C, D) as shown on the figure below:



Casualties Found:

For each casualty found during a survey at a specific location, fill out the following information:

SPUT #: Unique SPUT ID number assigned to every carcass

Species: 4-Letter code for species found

For each Carcass is discovered, take down the following information:

Species: Species of fatality

ID Tag: Unique ID tag associated with each searcher efficiency trial

Type: Circle one condition for carcass: Whole B.U (Broken Up) FS (feather spot)

ISEGS Avian and Bat Fatality Operator Form

Directions: Complete this form during scheduled surveys of the power block for avian and bat fatalities. Once the scheduled survey is complete call the Designated Biologist phone at 702-533-4876. Give completed form to the biologist, who will collect the birds and bats. If you encounter an injured bird or bat during surveys call the designated biologist immediately. Be sure to draw in the locations of dead birds and bats on the ACC & Power Block maps.

Operator's First and Last Name:_____

Survey Date (DDMMMYY):_____

Unit Number:_____

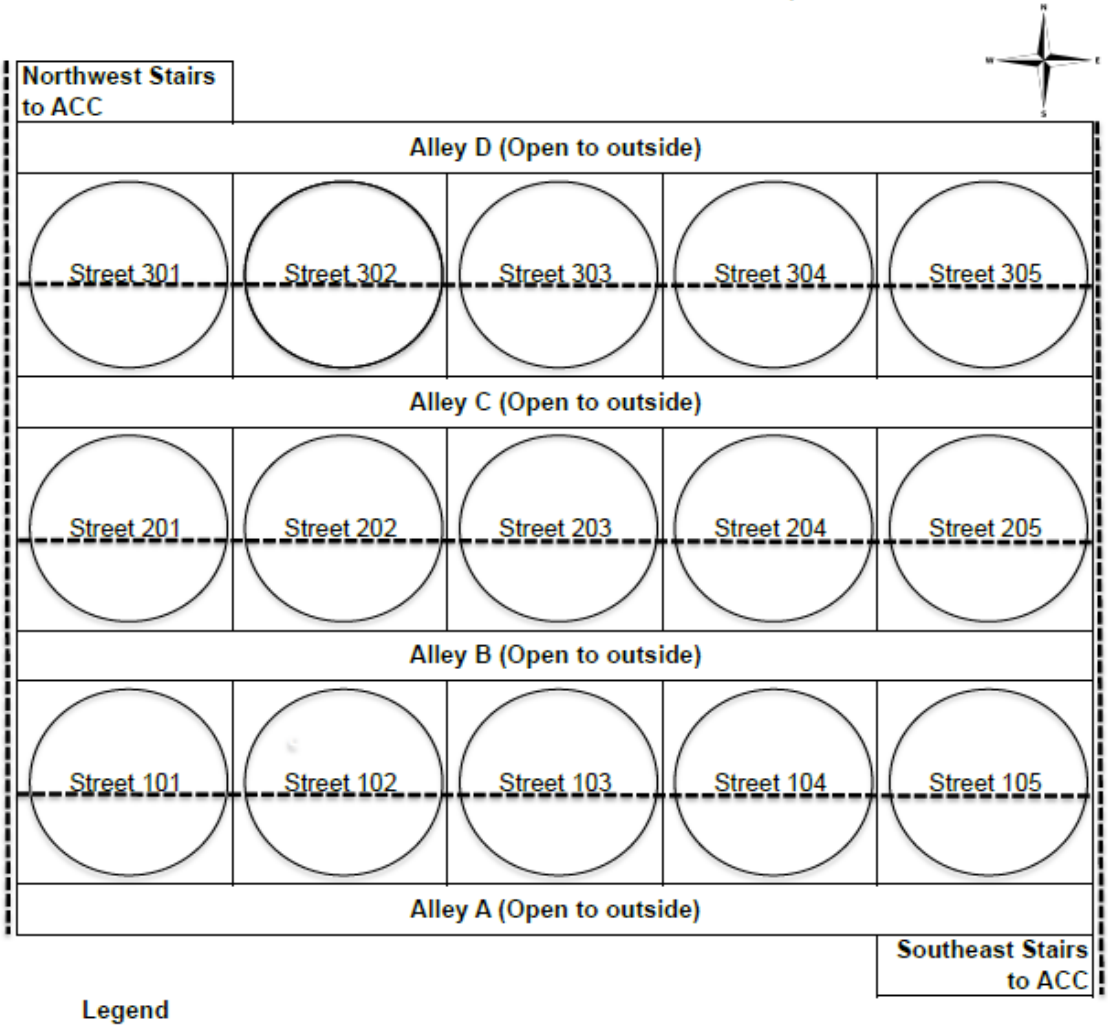
Cone #	# of Birds and Bats	Nearest Structure	Location Description
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Comments:			
Biologist Use Only	**Date Retrieved:**	**Retrieved by:**	

Version:02 February 2018

ACC Building Map

Survey Date (DDMMMYY):_____

Directions: *If possible place a cone over the dead bird or bat and write the cone # where a bird or bat is found in the ACC on the map below. If not possible to place a cone over the dead bird or bat then write N/A on data form for cone # and mark the bird or bat with an "X" on the map below.*



Legend

Walk way

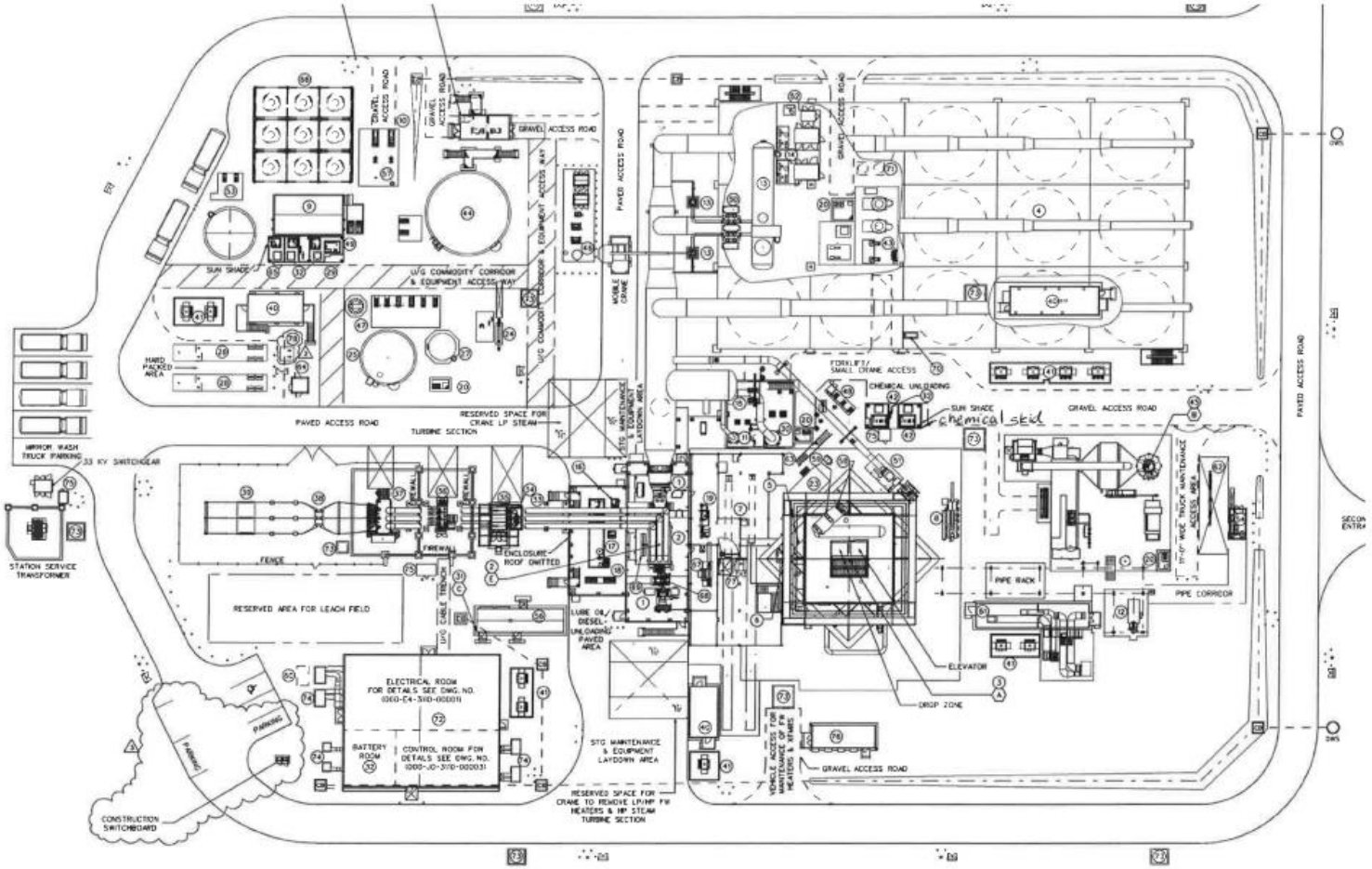
Fan

Version: 02 February 2018

Power Block Map

Survey Date (DDMMMYY):_____

Directions: *If possible place a cone over the dead bird or bat. Highlight or place an "X" at the location where the bird or bat is found in the power block on the map below. If not possible to place a cone over the dead bird or bat then write N/A on data form for cone # and highlight or place an "X" at the location where the bird or bat is found on the map below.*



Version: 02 February 2018

[For Office Use Only]
Date Entered: Checked? (Initials):
Date Scanned: Verified location? (Initials):

ISEGS FATALITY DATA FORM

☐ **Fatality Search** ☐ **Incidental** **Date:** _____ **Time:** _____ **Survey Interval:** 14 Days
Unit #: 1 2 3 **Location:** _____ **Surveyor(s) Initials:** _____ **Taxon:** Bird Bat
Fatality Type (How Detected)**:** Feather Spot Carcass Alive **Inside ACC Bldg** ☐

SPUT #: _____ **Alpha Code / Common Name:** _____

Age: A I J U **Sex:** M F U **Condition:** Dead, Fresh Dead, Semi-Fresh Broken Up Mummified Feather Spot Injured

***Estimated time since death/injury:** 0-8hrs 8-24hrs 2 days 3-6 days 2 wks 1 mth+

Parts Found/ Type /# Feathers: _____ **FS Size:** Small Large

Evidence of collision and/or flux _____

Cause of Death: _____ **Singe effects?** Yes No

Level of Certainty for Suspected Cause: ☐ Observed - 100% ☐ Valid - >90% certainty ☐ Probable - > 50% certain

☐ Possible - < 50%, but > 0% certainty ☐ N/A - 0% certainty or unknown

Carcass Disposition (Office Use Only)

Easting: _____ **Northing:** _____ ☐**Verified:** _____

Nearest Structure _____ **Distance to Nearest Structure (ft):** _____

Azimuth to Nearest Structure (e.g. N, S, SW, etc.): _____ **Additional Notes:** _____

Segment/Street/Alley: _____ **UTM Zone:** 11S **Distance to Tower (m):** _____

Azimuth to Tower: _____ **Feather Spot Diameter (m):**_____

Heliostat imprint present? Describe: Yes No NA _____ **Checked under dissecting scope** ☐

Flux Effect Grade: ☐ Grade 1 (< 50% of flight feathers curled) ☐ Grade 3 (curling/visible charring of contour feathers) ☐ Grade 2 (≥ 50% of flight feathers curled) ☐ Unknown ☐ N/A

***How estimated:** _____

Evidence for Sp. ID:_____

Basis of age/sex determination: _____

Photo ID (which camera?): _____

☐ Top down photo w/wo ruler ☐ Two photos showing location in relation to project elements(s), including where from the tower(office photos)-> ☐ Full-frame dorsal photo ☐ Full-frame head photo ☐ Full-frame ventral photo

ISEGS Common Avian Species 4-letter Codes:

AMKE	AMERICAN KESTREL
AMPI	AMERICAN PIPIT
BAWW	BLACK-AND-WHITE WARBLER
BEWR	BEWICK'S WREN
BRSP	BREWER'S SPARROW
BTGN	BLACK-TAILED GNATCATCHER
BTSP	BLACK-THROATED SPARROW
CACW	CACTUS WREN
COHA	COOPER'S HAWK
COLO	COMMON LOON
CORA	COMMON RAVEN
CRTH	CRISSAL THRASHER
GOEA	GOLDEN EAGLE
GRRO	GREATER ROADRUNNER
GTGR	GREAT-TAILED GRACKLE
HOFI	HOUSE FINCH
LBWO	LADDER-BACKED WOODPECKER
LCTH	LE CONTE'S THRASHER
LOSH	LOGGERHEAD SHRIKE
NOFL	NORTHERN FLICKER
NOHA	NORTHERN HARRIER
PEFA	PEREGRINE FALCON
ROWR	ROCK WREN
RTHA	RED-TAILED HAWK
SAGS	SAGEBRUSH SPARROW
SAPH	SAY'S PHOEBE
SPSA	SPOTTED SANDPIPER
TOWA	TOWNSEND'S WARBLER
VERD	VERDIN
WEME	WESTERN MEADOWLARK
YRWA	YELLOW-RUMPED WARBLER

Appendix D

Rationale for Implementation of Operational Monitoring and Impact Methodology

Background:
The Ivanpah Solar Electric Generating System (Ivanpah), in cooperation with the Bureau of Land Management (BLM), California Energy Commission (CEC), United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW), prepared the Avian and Bat Monitoring and Management Plan (ABMMP). This plan was prepared in accordance with CEC Condition of Approval BIO-21 (Ivanpah Solar Electric Generating System Commission Decision, 2010, p. 21) and BLM mitigation measures BIO-21, and BIO-22 associated with the Right of Way (ROW) grants issued for the project (Final Environmental Impact Statement (EIS) 2010). The requirements and recommendations required by the BLM in BIO-21 and BIO-22 included visual bi-weekly surveys with data reported for three years on a quarterly basis and then annually thereafter. The CEC BIO-21 Condition of Approval required quarterly reporting and monitoring and reporting for one year. The USFWS recommended a specific degree of estimate precision, random stratified monitoring and two years of formal surveys.The agency approved and accepted plan also included specific definitions for migratory bird mortality issues, to be assessed by the avian survey consultants, and for TAC concurrence with these mortality assessments. The categories were defined as follows:

1. High: Assessed 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: Assessed 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: Assessed 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.

Furthermore, the plan also required TAC responses to impacts to be appropriate and proportionate to the impacts assessed as follows:

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

These guidelines and study responses were intended to determine the impacts to migratory species subject to the Migratory Bird Treaty Act. Take of special status species and particularly golden eagles, is considered separately from the assessment of migratory species; however, with

these species the level of effects to populations was also considered and discussed within each quarterly and annual report for each individual species. TAC concurrence of these assessments was also obtained prior to the respective quarterly or annual report publication (See CEC Docket log for Ivanpah at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=07-AFC-05C). Special status species take at the site has been limited and no federally listed species take has been attributed to the project to date.

Field Surveys during Formal Surveys (ABMMP Revisions 12 and 13)

The resulting plan, Revision 12, was approved in November 2013 by all agencies and required avian use and raptor surveys in addition to two years of systematic avian fatality monitoring. Systematic fatality monitoring was required in all project areas: 100% of the tower area (powerblock area and inner high-density (HD) heliostat area), 20% of the heliostat area, 100% of fencelines, transmission lines, and offsite transects.

Based upon the results of the first two years of monitoring under Revision 12, the TAC an in accordance with the TAC response framework, the TAC approved Revision 13 in 2015 (Document available on CEC Docket dated 12-23-2015). The monitoring during Revision 12 documented that the mortality associated with the perimeter fences, transmission lines, and offsite transects was less than five detections a season and the patterns associated with avian and raptor use were consistent over the eight seasons of monitoring. This consistency of the patterns of use and low levels of avian fatalities (e.g., < five per season) facilitated the agency approved discontinuation of the avian use surveys and fatality monitoring of the transmission lines, offsite transects and fence lines, since these surveys would not provide additional information to characterize the avian use or mortality at the site.

Survey Interpretation and Results during Formal Surveys (ABMMP Revisions 12 and 13)

For Revisions 12 and 13 of the ABMMP, statistical methods were used to generate facility-wide estimates of potential avian impacts 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

Fatality estimates were reported as collision, flux, flux and collision, other project impacts, or unknown (as described in Section 2.1) for a minimum of four categories: (1) all birds, (2) small birds, (3) large birds, and (4) raptors specifically. The total number of avian fatality detections identified during the surveys were adjusted for removal and searcher efficiency biases to generate estimates of facility-wide mortality, as well as project-caused avian impacts. All survey area or incidental detections, regardless of species, were reported; however, separate estimates were prepared for the 100-percent tower area survey, the heliostat field, the perimeter fence, and the off-site transect survey areas. These areas were subsequently modified in Revision 13 of

the plan. For details regarding the statistical methods see Revision 12 (HTH, 2014) and Revision 13 (WEST, 2016).

The monitoring during the first two years (Revision 12) documented consistent patterns of on-site and offsite avian use along with "low" potential effects on populations. Surveys were also conducted for two years under Revision 13 of the plan, with the potential effects on populations estimated as "low" during this period. In addition, mortality levels throughout the solar field were determined to be consistent over the first two years and solar field monitoring was subsequently reduced to sampling areas in Unit 2. Per TAC approval, Unit 2 solar field surveys were discontinued in Year 4, since results were consistent (largely overlapping confidence intervals) throughout years 1 to 3.

Thus, the results from the first four years of formal monitoring indicated that based on the estimated fatalities the potential effect on a species or species group was "low" (see annual, quarterly reports and summary below). All reports reflecting this assessment were reviewed by the agencies and agency concurrence was obtained with these assessments prior to docketing the reports.

TAC Approved Three Year Assessment Results For Potential Population-Level Impacts				
Year/ Season	Winter	Spring	Summer	Fall
2013-2014	Low	Low	Low	Low
2014-2015	Low	Low	Low	Low
2015-2016	Low	Low	Low	Low
2017-2018	Low	Low	Low	Low

However, despite the consistently "low" assessments and with no requirement to do so as per the approved Plan, the project implemented deterrence measures with agency approval at the facility on a *voluntary* basis during the first two years of monitoring.

Assessment of the effectiveness of the deterrence was not required during the formal monitoring period, since the potential effect of mortality on populations was not deemed to be above "low". Furthermore, the plan and policies of the BLM and CEC do not require assessment of these measures unless a determination was made by the TAC that additional mitigation or adaptive management was necessary. The BLM BIO-23 (FEIS) requires:

> "If sufficient data are gathered to support the *need for additional mitigation*, the mitigation may ultimately be effective in reducing avian and bat injuries and mortalities, if an effective mitigation measure can be identified in the future."

CEC BIO-21 (Commission Decision) Verification requires:

> "Quarterly reporting shall continue until the CPM, in consultation with the CDFG and USFWS determine whether more years of monitoring are needed and *whether mitigation and adaptive management measures are necessary*."

Although the project did document and attempt to ascertain the effectiveness during the initial implementation of the measures, insufficient evidence was available to reach a robust statistical determination of the deterrence effectiveness. To quantify an effect of the deterrence, either a controlled experiment would need to be conducted or the passage rate of birds moving through the flux area would need to be measured. These controls would be necessary to determine if there was a change in the number of birds exposed to flux or a change in singe risk associated with either the passage rate or the deterrence.

Rationale for Operational Monitoring – Plan Revision 14

The rationale for operational monitoring is built on the foundation of the formal monitoring done for four years between October 2013 and December 2017. The study was designed so that the resulting fatality estimates were sufficiently precise to facilitate the avian consultant evaluation of the impacts and allow the TAC to concur with these results. Having concluded four years of formal monitoring with a consistent evaluation of "low" by the Avian contractor(s) for the potential to adversely affect species at a local, regional, or national level, and with the TAC concurrence of these assessments, there is sufficient evidence to justify the transition to operational monitoring. The objective of this section is to demonstrate the strength of the original (and subsequently adapted) study design and show the consistency of fatality estimates that are unique and attributable to the facility.

The study design employed at the Ivanpah facility was created to achieve specific levels of precision for avian mortality estimates per the recommendations of the USFWS Staff. The ultimate design used a combination of random stratified sampling of certain areas and a census of other areas. As per Rev 12 of the plan, the study was designed so that the coefficient of variation (CV; a measure of precision given by the standard deviation divided by the mean) of estimates in the solar field was no greater than 0.25. Using analysis statistical simulation of fatalities and search effort, it was determined that 20% of the total solar field area would achieve this standard under a range of anticipated conditions and with high, medium or low mortality (WEST 2013).

Concentrated-flux related mortality was identified as the unique source of impact on avian species directly attributable to the facility. Therefore, the tower area of each unit, which includes the ground under elevated levels of concentrated flux, was sampled at 100% to increase the precision of concentrated flux related fatality estimates. Sampling 100% of the tower area resulted in an average CV of 0.125 for annual estimates of singed fatalities across the first four years of monitoring, or a 50% improvement compared to the USFWS targeted precision for the solar field. In other words, the standard error of the estimated number of singed fatalities was on average only about 12.5% of the estimate. Accordingly, the 90% confidence interval width for the tower area estimate was relatively narrow in all years and there is a high degree of

confidence that an estimate of singed annual fatalities in the tower area was, on average, within approximately 209 birds of the actual number of fatalities.

Spatially, the first four years of formal monitoring showed over 98% of the concentrated-flux related detections occurred in the tower area, confirming the study design that called for focused, increased sampling for this effect in the tower area. Furthermore, approximately 95% of the known cause estimated fatalities in the tower area were singed (as opposed to collision, entrapment, or other identifiable causes). Thus, given the high precision of tower area estimates, the spatial distribution of singed fatalities, and monitoring that has been conducted in the tower area at 100% coverage for four years, the estimates from the tower area during formal monitoring provide a robust benchmark for evaluating the unique source of mortality at the facility and for comparing the results of future monitoring.

Therefore, the avian risk that is unique to the facility consists of solar flux risks and surveys have consistently shown this type of fatality is detected within the tower area: i.e., the powerblock and inner HD heliostats. Therefore, as discussed with the TAC, Revision 14 was proposed and approved by the TAC in December 2017. The consistently low potential impacts to populations allow for the transition of surveyors to appropriately-trained on-site operations personnel or to be maintained by biological staff and for impact assessments to be based upon the data collected over the previous four years of monitoring.

Operational Field Survey Methodologies – Revision 14

For the field surveys, Revision 14 continues to maintain systematic surveys within the areas currently monitored in Revision 13, including the powerblock and inner HD heliostat areas. The only changes made from Revision 13 to Revision 14 consist of changing personnel and the sampling interval from a 7-day (spring and fall migration) and 21-day (summer and winter) schedule to a 14-day schedule, year-round. Onsite personnel or approved biologists will conduct the surveys. Any personnel conducting surveys will have been appropriately trained, and their sole task will be to conduct surveys for avian fatalities.

The monitoring methodology in Revision 14 for the tower area is consistent with the monitoring which has occurred in the tower area under Revisions 12 and 13 of the Plan. That is, the spatial coverage is exactly the same (i.e. 100% of the powerblock and inner HD area), and although the search interval will vary slightly (14 days year-round as per BLM ROW requirements, rather than 7 days during the spring and fall, and 21 days during the winter and summer), the same total number of searches will occur annually (approximately 26 per year). The search interval modification is in accordance with BLM ROW requirements.

Operational Survey Interpretation, Fatality Index Development – Revision 14

The following section describes the development of an index that will be used as a basis of comparison from the statistical results obtained during the formal surveys and the detections resulting from the operational surveys. First, this section proceeds to describe how the model was developed in a step-wise process manner; second the verification of the model is demonstrated via the use of data from formal surveys, and third the index is calculated from the data developed during formal surveys. This index will be used for comparison to the detections resulting from

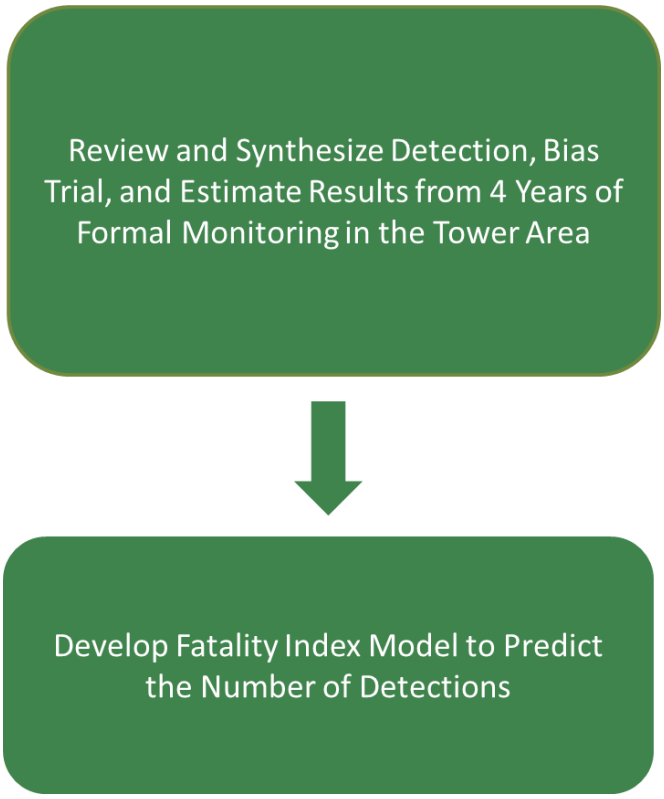
operational surveys. Finally, this section concludes with a discussion of the degree of inference that the index provides during the operational assessment for the life of the project.

The information derived during the operational surveys will not develop estimates of avian mortality, but instead is sufficient to characterize the relative level of avian mortality at the site associated with solar flux as compared to the baseline four years of monitoring. Solar flux is the unique source of mortality associated with the facility, and the clear majority of flux fatalities occur in the area proposed for operational monitoring. Incidental detections of avian mortality will also continue to be reported as per the onsite wildlife incidence reporting system (WIRS, see HTH, 2014 and WEST, 2016). Results under Revision 14 will be reported annually to the TAC. The monitoring proposed in Revision 14 is adaptive and the TAC may recommend modifications to the survey protocols through the BLM Authorized Officer (AO) and CEC Compliance Project Manager (CPM). Similarly, adaptive management responses may also be recommended per Table 3, if necessary, based on analysis of the survey data for avian species detected at the site.

As previously stated fatality estimates will not be calculated under Revision 14. However, statistical methods were developed as per TAC guidance and approval to allow for a robust comparison of the number of annual detections under Revision 14 to those collected under previous plan revisions. The comparison is made via a statistical model which uses data from the first four years of formal monitoring to predict the expected number of detections found annually in the tower area for a given search effort. The model is run a large number of times (e.g. 10,000) to simulate the variable potential scenarios (e.g. number of fatalities, searcher efficiency, carcass persistence rate, number of small vs. large carcasses, etc.) that might occur during a year at the facility. The resulting, predicted number of detections produced by this statistical model is called the ***fatality index***, and serves as a benchmark against which the number of detections found during operations monitoring are measured. In other words, the model has determined the number of detections and a range of precision that would be associated with a low potential for impacts as defined in the Plan and as previously accepted by the TAC for the past four years.

An essential step of the model building process is verification to ensure the model is making appropriate predictions (Neter et al. 1996). To verify the accuracy of the fatality index model, the model was used to "predict" the expected number of detections in the tower area for each previous year of formal monitoring, based on the survey effort expended in those years. The model predictions were then compared to the actual, known number of detections in each year. After the verification step, the model was used to generate a fatality index for operations monitoring to be used in subsequent years. Below, a flowchart shows how the first four years of formal monitoring data were used to develop the fatality index model, verify the model, and how the fatality index can be compared to operational monitoring results in the future.

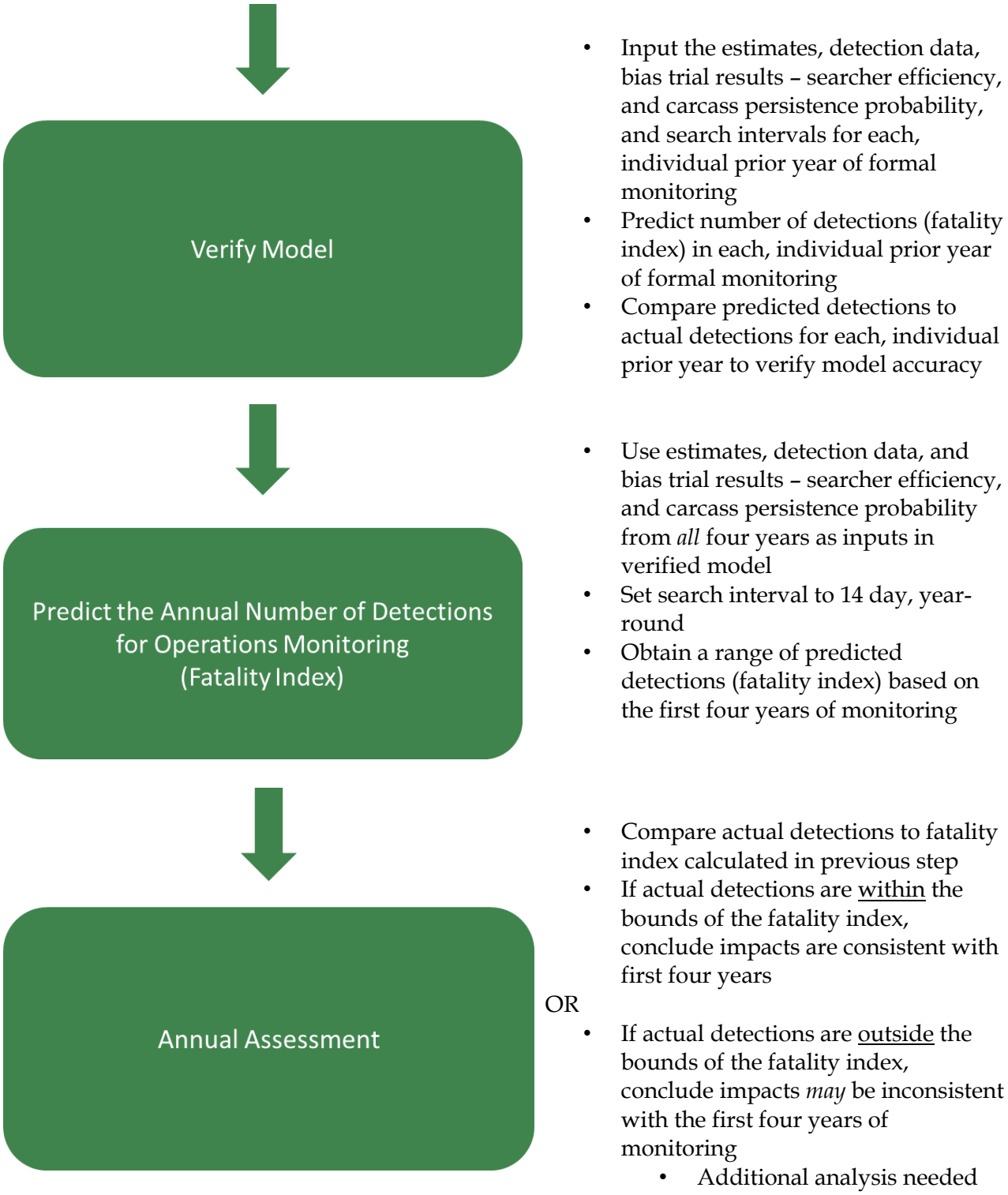
Process Chart – Development of Fatality Index Model



- Composition of detections (Small birds, large birds, feather spots)
- Location of detections (power block, ACC, inner HD)
- Phenology
- Incidental detection rate
- Estimates by year and season
- Bias trials – final searcher efficiency and carcass persistence models

- Input number of fatalities
  - Set 'what, where, and when'
- Set search interval
- Input bias trial results – searcher efficiency, and carcass persistence probability

Process Chart – Development of Fatality Index Model



- Input the estimates, detection data, bias trial results – searcher efficiency, and carcass persistence probability, and search intervals for each, individual prior year of formal monitoring
- Predict number of detections (fatality index) in each, individual prior year of formal monitoring
- Compare predicted detections to actual detections for each, individual prior year to verify model accuracy

- Use estimates, detection data, and bias trial results – searcher efficiency, and carcass persistence probability from *all* four years as inputs in verified model
- Set search interval to 14 day, year-round
- Obtain a range of predicted detections (fatality index) based on the first four years of monitoring

- Compare actual detections to fatality index calculated in previous step
- If actual detections are <u>within</u> the bounds of the fatality index, conclude impacts are consistent with first four years

OR

- If actual detections are <u>outside</u> the bounds of the fatality index, conclude impacts *may* be inconsistent with the first four years of monitoring
    - Additional analysis needed to determine the cause of aberrant results

To use the fatality index model, the actual number of detections found annually under operations monitoring can simply be compared to the fatality index. Annual detections that fall within the 90% prediction interval (i.e. the 5th and 95th percentiles of the simulated distribution of the fatality index) of the fatality index suggest that, after accounting for variability in the data observed during four years of formal monitoring and a 14-day search interval, the results are comparable to the estimated fatalities in the first four years of monitoring with a 90% confidence interval.. Below, we provide a brief example of the model verification step by showing how the fatality index reliably matches previous results (in this case, Year 4 monitoring results).

Fatality Index Verification

To test the predictive capability of the model, the fatality index was verified against all four years of formal monitoring. As an example, below we present the fatality index (i.e., expected number of detections) for the tower area based on the search intervals and fatality estimates for Year 4 (2016-2017) of formal monitoring. Since we know exactly how many detections were found in Year 4 (Table D-1), we can compare the predictions from the model to the actual number of detections to verify the accuracy of the predicted number of detections in the context of previous, known results.

As inputs, the simulation model took estimates and detection data specific to Year 4 and estimates of carcass persistence and searcher efficiency based on the final models derived from the complete four-year bias trial dataset (WEST 2018). The first column of Table D-1 presents the estimated fatalities and 90% confidence interval for Year 4 monitoring, which characterize the range of fatalities allowed to occur within each simulation. The second column presents the fatality index and 90% prediction intervals for the fatality index, based on the input fatalities and the monitoring that occurred during year 4. Effectively, the fatality and subsequent discovery process for fatalities in Year 4 was simulated 1000 times, from which the second column was derived. Finally, the last column of Table D-1 shows the actual number of detections found in the tower area during year 4 of formal monitoring (WEST 2018).

Table D-1.
Year 4 tower area fatality estimates, with 90% confidence intervals, used as inputs to predict the number of detections/fatality index for Year 4, and actual number of detections found during year 4 of formal monitoring.

Input: total tower area estimated fatalities – year 4		**Output: predicted number of tower area detections/fatality index**		**Actual number of tower area detections found during year 4 of formal monitoring**
Total Fatalities	**Total Fatalities 90% Interval**	**Total/Fatality Index**	**Total 90% Interval**	**Total**
1553	(1216-1978)	416	(314-544)	448

The simulation model predicts there should be 416 detections (or a fatality index of 416; 90% prediction interval 314-544) resulting from monitoring 100% of the tower area in all units, with nominal search intervals of 7 days in the spring and fall, and 21 days in the summer and winter, and all input parameters (e.g. fatality estimates, ratio of small to large birds, ration of power block to inner HD detections, etc.) restricted to those generated from year 4 of monitoring. For comparison, the third column of Table D-1 presents the actual number of detections found during Year 4. The fatality index (i.e., predicted number of detections) is approximately 7% low compared to the actual number of detections in Year 4 (448), and has a 90% prediction interval of 314-544, which includes the actual number of total detections. Predictions/fatality indices for years 1-3 a similarly accurate, with no fatality index more than 7% different from the true value, and 90% prediction intervals that always include the true number of detections. Thus, using the simulation model parameterized with all possible values for the first four years of monitoring, and subsequently calibrated to 14-day search intervals, we expect the resulting fatality index and 90% prediction interval to provide a robust means of comparing future operations monitoring to the results of formal monitoring during Years 1-4.

Calculating the Fatality Index for Operations Monitoring

The verified statistical model described was then used to generate a fatality index to compare against future years of operations monitoring, assuming a 14-day search interval, year-round. The model was allowed to take fatality estimates and detection information (e.g. ratio of small to large birds, ratio of power block to inner HD detections, etc.) from any of the first four years of monitoring, as well as random searcher efficiency and carcass persistence values generated from the final models (WEST 2018). All input values were allowed to vary for each simulation, and 10,000 simulations were run; in this way, the resulting fatality index represents the range of potential impacts observed during the initial four years of formal monitoring. The input values and resulting fatality index are presented in Table D-2.

The model shows that on any given year of operations monitoring, we expect 504 detections in the tower area with a 14-day search interval and within the range of bias parameters observed over the past four years, with a 90% prediction interval of 276 to 746 detections. The 90% prediction interval for the fatality index is what the annual tally of detections from operations monitoring are compared against. This interval represents the range of values within which we are 90% confident that fatalities in the tower area are consistent with the first four years of monitoring. In other words, if the number of detections in the tower area is between 276 and 746, then the estimated detections are within the range of the estimates from years 1-4 of the monitoring that were deemed as “low” by the avian consultants and accepted by the TAC.

Table D-2.
Input values and fatality index, with 90% confidence intervals, for operations monitoring.

Input: Fatality		**Output: predicted number of detections/fatality index**	
Total Fatalities	**Total Fatalities 90% Interval**	**Total/Fatality Index**	**Total 90% Interval**
1452	(784-2073)	504	(276-746)

Inference from the Fatality Index

Using the fatality index, the number of detections can be used to understand the potential effects of the facility on birds in the context of the first four years of monitoring and assess the level of effect determination. Typically, the number of fatalities provides little insight into potential population level effects because *the fatality estimate is not known*. However, in monitoring years 1 – 4, it was determined that in each year the facility had a low potential to impact each species or species group at the local, regional, or national scale. Thus, the range of values for the fatality index generated from the first four years of monitoring represents a range of values that were determined by the avian consultants with concurrence from the TAC to have a low potential impact on populations (HTH 2015, WEST 2016, WEST 2017, WEST 2018). If the detection results for a year of monitoring fall within the modeled range of values of the fatality index the determination of the potential impacts to each species or species group at the local, regional, or national scale are within the same as the previous four years and will therefore be deemed "low."

If the detection results fall outside of the range of values for the fatality index, it cannot be concluded that impacts necessarily rise above the classification of low because the upper range of the fatality index does not necessarily represent the upper range of a low potential impact determination. For example, the overall number of detections found in a year could exceed the upper range of the fatality index by a small number (e.g., 10 detections) and the detections could be distributed among 10 species. Therefore, a small increase above the upper range of the fatality index would not necessarily result in a medium potential impact determination. However, it must be concluded that the system has changed in some appreciable way relative to the first four years of monitoring. Detections levels outside of the expected range could indicate any of the following:

- Searcher efficiency has increased/decreased substantially compared to the first four years of monitoring
- Carcass persistence has increased/decreased substantially compared to the first four years of monitoring
- The actual number of fatalities has increased/decreased substantially compared to the first four years of monitoring
- Any combination of the above.

As described earlier, little inference about potential impacts to an individual species can be drawn from the overall number of detections. Thus, should the number of detections exceed the expected range of values for the fatality index, selective further analyses are conducted. For example, further analysis can be used to determine if detections occurred disproportionately in a particular season, or if an unexpected number of detections were found incidentally (as opposed to during fatality searches). Results could be used to inform the assessment of impacts, or modifications to monitoring. Furthermore, additional analyses can be performed on a species by species basis.

Operational Evaluation of Annual Detections Using the Fatality Index in Revision 14

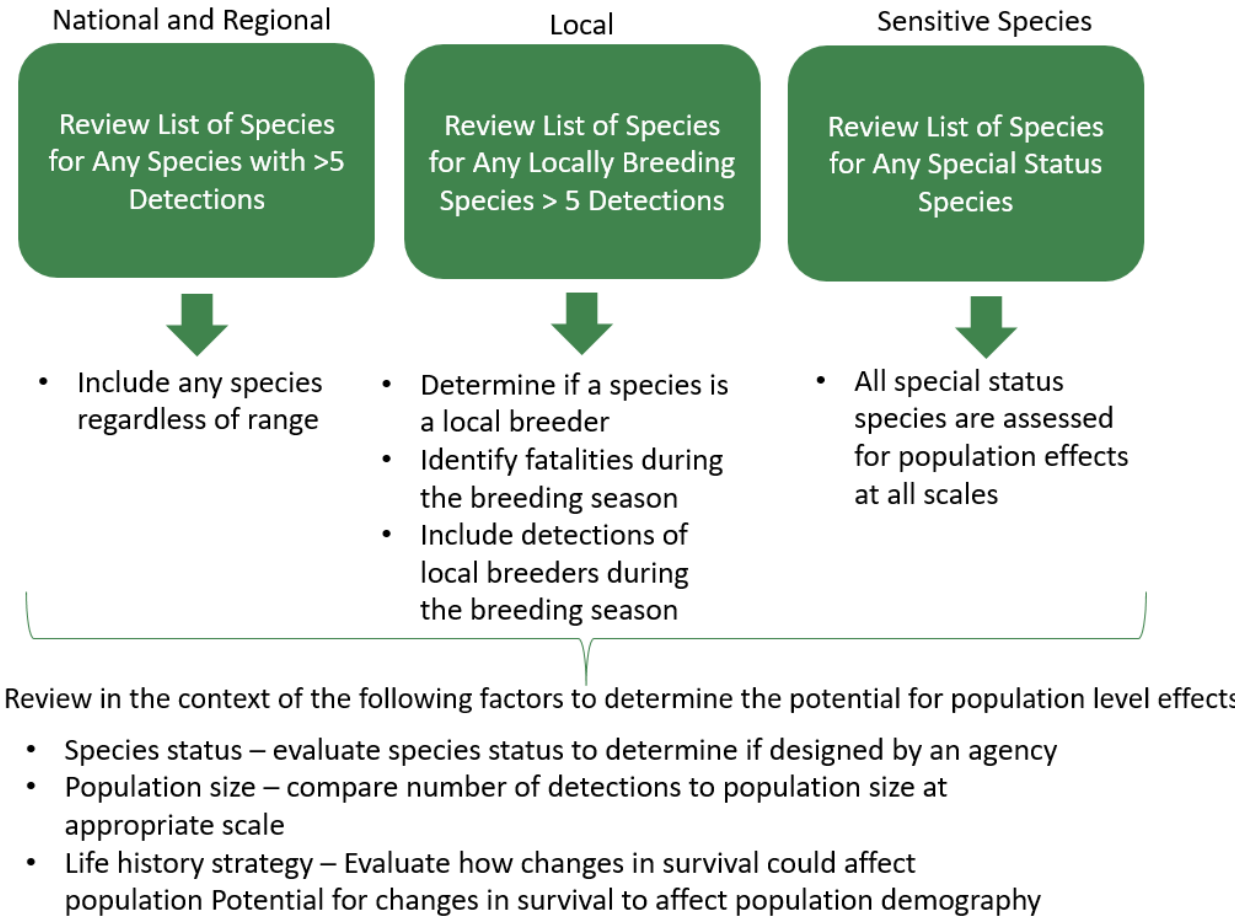
This section describes how operational monitoring survey results will be evaluated for populations at the national (United States), regional (California) and local levels. For the overall assessment of the impacts associated with the facility, Revision 14 continues the approach of previous formal survey assessment methods by providing a range of expected detections to compare on an annual basis with the results of the operational survey. This range of expected detections is based on the previous four years of monitoring that was deemed as "low" potential for impact by the avian consultant with TAC concurrence (see: Operational Survey Interpretation, Fatality Index Development – Revision 14, above). This approach is consistent with the evaluation framework detailed and approved by the agencies in the ABMMP and operates within the limitations of the agreed to data collection as prescribed in the Plan and conforms with current literature on the assessment of wildlife impacts.

Determining Species to Consider for Evaluation

The first step in evaluating the potential for population effects is to determine the appropriate species for consideration. All species with > 5 detections are evaluated at the **national and regional scales** (See process chart below). Although estimates are not produced, >5 detections is used as a threshold for analysis, consistent with the previous four years of assessments (>5 detections was the level where estimates could be reliably produced; however, no estimates will be produced during operational monitoring). There are no restrictions on which species with >5 detections are evaluated because the scale of evaluation is the entire United States and the state of California, and thus it is appropriate to consider migrating birds. For example, the national and regional scale evaluations could include species that only occur as fatalities during spring and fall migration. However, as the scale of evaluation is the entire United States and the state of California, including migrating birds is appropriate.

At the **local scale**, several steps are taken to carefully choose the species evaluated to those that could breed locally and to consider fatalities that occurred during the breeding season (See process chart below). First, range maps are examined to determine if the species could breed locally in habitat that occurs in the vicinity of the Project. Second, the timing of the fatalities was reviewed to determine those that occurred during the species' breeding season, based on information provided in species accounts at https://nrm.dfg.ca.gov/taxaquery/Default.aspx. In some cases, **special status species** do not meet the criteria for consideration described above (e.g., 1 fatality of non-local California species of special concern). However, to ensure that sensitive species are fully evaluated, all sensitive species are assessed regardless of the number of detections or breeding status (See process chart below).

Process Chart – Determining the Number of Detections by Species to Consider for Evaluation



Evaluating the Potential for National, Regional, Local and Special Status Population Effects

Several factors are also considered when determining if a population at the national, regional, or local level could be affected by anthropogenic structures such as the Project. This plan takes the approach of evaluating potential effects according to the following criteria: 1) species status, 2) population size, and 3) life-history strategy.

Species status should be considered as a starting point for determining if impacts from a project should be assessed (Diffendorfer et al. 2017). Thus, the first and most important factor is the status of the species (e.g., listed species, species of special concern) as per the process chart above, these individual species are assessed for impacts irrespective of national, regional or local nature of these individuals. Species that are not special status are also further evaluated, however, these species are assessed at the appropriate scale.

Assessing the population size in comparison to the fatalities at the facility can provide inference into potential population effects (Loss et al. 2012, Erickson et al. 2014). Species with large population sizes such as songbirds are unlikely to be affected by mortality at a single anthropogenic structure (Arnold and Zink 2011, Erickson et al. 2014). For example, fatalities of a common and widely distributed species with a population in the millions that is actively hunted as a game bird such as mourning dove is unlikely to reach a potential to affect determination because fatalities from one project would have a very small contribution to the overall population and would be minimal in the context of the harvest of mourning dove (900,000 in California in 2016; Raftovich et al. 2017).

For all species at the respective level of assessment, the life-history strategy of a species is another factor that is used to determine the potential effect of fatalities on a population. Populations of birds that are short-lived and are highly fecund (e.g., songbirds) are less sensitive to changes in adult survival compared to birds that are long-lived and have low fecundity (e.g., raptors), which are more sensitive to changes in adult survival (Stahl and Oli 2006, Diffendorfer et al. 2017). An analysis of a marked population of wood thrush (a short-lived, high reproductive output), with robust survival estimates from the wintering grounds in Central America and the breeding grounds in Illinois, concluded that population growth was more sensitive to fecundity than survival (Rushing et al. 2017). Conversely, a study of black vultures (long-lived, low reproductive output) in Virginia found that population growth was more sensitive to survival than fecundity (Runge et al. 2009). As such, life history strategy is used as part of the assessment of potential population level effects for each species or species group.

Taken together, species status, population size at the scale of interest, and life history strategy can be used to assess the potential of mortality at the Project to affect national, regional, or local populations of birds. Specific means of assessment that will be used in the operational monitoring assessment are detailed below.

Evaluation of Effects to Species at the National and Regional Levels

Considering the non-special status species, first a review of the number of fatalities in the context of the population size is conducted for the national and regional assessments of effects. To compare the fatalities to the population, the data from the Partners in Flight (PIF) bird population database (PIF 2013) are appropriate to assess potential affects at the national and regional scales. Data from the PIF database at the national level and regional (state) level. Locally, PIF Bird Conservation Region 33, which contains the Project is used for context to understand population with which local species interact.

For the annual operational assessment of non-special status species, the top 10 species detected will be compared to the regional and national populations in a tabular format as consistent with previous practice. The occurrence of the species as spring or fall migrant, or resident will be listed. The number of total detections will be listed and compared to the estimated population at the appropriate national or regional scale. Any special status species will be denoted and assessed separately (see below).

Evaluation of Effects to Species at the Local Level

For the assessment of the effects to local populations, first a determination is made as to whether the species is a local breeder near the project. Non-special status species with >5 detections are reviewed to determine those that could breed locally near the project. As per previous practice >5 detections are used as a threshold for analysis, consistent with four years of baseline quantitative assessments (HTH 2015, WEST 2016, WEST 2017, WEST 2018).

The timing of these specific detections is then reviewed to determine those that occurred during the species breeding season, based on information provided in species accounts at https://nrm.dfg.ca.gov/taxaquery/Default.aspx. This framework assumes that if a fatality is found during the breeding season and the fatality is of a locally breeding individual these detections are locally breeding species. The remaining species from this analysis are then listed along with the number of detections for each of these species.

As per the decision framework, these species are then compared to species status, potential population size and survival strategy. Any locally breeding special status species are then individually assessed as part of the special status species evaluation section (see those methods, below). The number of detections of these species is then compared to the best estimate of the local population, the Mojave Desert in California and Nevada (Bird Conservation Region (BCR) 33) – obtained from the Partners in Flight database. Finally, the survival strategies of each of these species is considered to also determine the potential effect for the local population. Taken together, this qualitative approach is used to determine the potential for the effects to local populations.

Evaluation of Effects to Specials Status Species

All special-status species are always considered for potential population level effects for any number of detections. Each species is listed and the number of detections for each enumerated. The status of each species is also recorded (California Species of Special Concern, State Threatened, Bird of Conservation Concern, etc.). The range of each species is considered as is the listing status, overall national and regional populations and the survival strategy of the species as per the assessment framework. From these factors, a qualitative assessment is made of the potential for the effects to these populations.

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Appendix E

Voluntary Best Management Practices and Deterrence Measures

Ivanpah Deterrence and Best Management Practices

As discussed in the annual reports for the Ivanpah project, the monitoring conducted to date has consistently shown that avian fatalities, particularly those related to flux, occur with more frequency near the power towers at the facility (HT Harvey, 2015; WEST, 2016). Regardless, avian mortality impacts to species populations has never exceeded the determination of "Low" as defined by the Avian and Bat Monitoring and Management Plan (Plan), where "estimated avian mortality or injury levels have minimal or no potential to negatively affect local, regional, or national populations within a particular species or group of species." The determination of "Low" as per the Plan does not require the implementation of adaptive management measures; however, the Ivanpah facility, as a prudent operator, elected to implement avian deterrence and best management practices from the outset of operations.

Ivanpah commenced investigating the use of various best management practices to reduce avian mortality concurrent with the initial detections of flux-related avian fatalities at the facility in 2013. These initial investigations resulted in a list of potential deterrent technologies/practices, many of which have been subsequently deployed on a voluntary basis in coordination with the Technical Advisory Committee (TAC) for the project. Progress reports detailing the dates and locations of installed deterrence and initiation of best management practices have periodically been provided to the TAC (See TAC notes and annual reports as docketed on the California Energy Commission website: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=07-AFC-05C).

The measures have been monitored to confirm they are in working order and have been updated when warranted by additional research and best available science. However, the fatality surveys at the site were not designed to determine the effects of deterrence measures deployed; rather, the surveys were designed to measure mortality at the site and determine the level of avian impacts. Effectiveness of the deterrence measures is subject to confounding variables that may mask the effects of the deterrence. For example, the frequency of avian species transiting the area subject to deterrence may vary from season to season or year to year; hence, limiting the inference from comparison of the fatality estimates over time or space to determine the effects. Therefore, no speculation is presented regarding the effectiveness of these measures.

Deterrence Technologies and Best Management Practices at Ivanpah		
Technology	Installation Location	Results
Bird Spikes/LED Lighting	Unit 1	Installation confirmed in 2015

Tower Lights out at Night	All Units	Protocol has been confirmed in place since 2015; with exceptions only for emergency activity
Heliostat Re-programming	All Units	Complete in 2017. Worked with Sandia National Laboratories 2015-2017 to minimize flux diffusion near tower and minimize glare; work concluded and further revisions deemed infeasible due to the limited slew (vertical and horizontal turning) response times associated with heliostats and the periodic need to have all heliostats available for power generation due to reflectivity issues
Heliostat Stow Position	All Units	Stow is now at random angles. Complete in 2017
Bird Buffer Chemosensory Deterrence	All Units	Pilot installation in 2014 confirmed no adverse effects; installation at all units 2015; best available science indicated upgrades to system available; upgrades installed on all units in 2017
BirdGard Acoustical Deterrence	All Units	Pilot installation in 2015 confirmed no adverse effects; installation at all units 2015; best available science indicated upgrades to system available; upgrades installed on all units in 2017
Fence Escape Routes	All Units	Pilot installation in 2016 used camera to confirm roadrunner use; installation complete in 2017; monitoring confirms installed escape routes remain in working order.
Bat Ultrasonic Deterrence	All Units	Pilot installation in 2014 confirmed no adverse effects; installation complete in 2015; monitoring confirms units are in working order; added a protocol in 2015 to ensure units remain plugged in.