GUIDELINES FOR SOLAR DEVELOPMENT IN ARIZONA

ARIZONA GAME AND FISH

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Figures and Tables

Acronyms

ACC: Arizona Corporation Commission
ACP: American Clean Power Association
ADEQ: Arizona Department of Environmental Quality
ADWR: Arizona Department of Water Resources
AFWA: Association of Fish and Wildlife Agencies
APLIC: Avian Power Line Interaction Committee
AWCS: Arizona Wildlife Conservation Strategy
AZDA: Arizona Department of Agriculture
AZGFD: Arizona Game and Fish Department
BESSs: Battery Energy Storage Systems
BFDs: Bird Flight Diverters
BLM: Bureau of Land Management
BMP: Best Management Practice
CSP: Concentrating Solar Power
DOI: U.S. Department of the Interior
EPA: Environmental Protection Agency
ERT: Arizona Online Environmental Review Tool
ESA: Endangered Species Act
HDMS: Heritage Data Management System
IPaC: Information for Planning and Consultation
MBTA: Migratory Bird Treaty Act
MET: Meteorological Evaluation Towers
NEPA: National Environmental Policy Act
NFPA: National Fire Protection Association
PEP: Project Evaluation Program
PV: Photovoltaic Solar
ROW: Right-of-way
SGCN: Species of Greatest Conservation Need
USFWS: U.S. Fish and Wildlife Service
USGS: U.S. Geological Survey
WCS: Wildlife Conservation Strategy

Suggested Citation

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Executive Summary

The mission of the Arizona Game and Fish Department (AZGFD), acting on behalf of the Arizona Game and Fish Commission, is to conserve Arizona's diverse wildlife resources and manage for safe, compatible outdoor recreation opportunities for current and future generations. These guidelines are intended to act as a voluntary framework for solar energy project proponents (i.e., developers, owners, operators, and biological consultants) to facilitate deployment and operation of utility-scale solar while minimizing adverse effects to Arizona's wildlife and their habitats. Project proponents are encouraged to use these guidelines in coordination with the AZGFD when planning facility siting, site assessment methods, conservation measures, and monitoring efforts to derive recommendations on a case by case basis. Additionally, local governments are encouraged to adapt zoning codes, conditional use permit criteria, or site plan review processes to incorporate best practices and reflect regional environmental conditions.

These guidelines reflect the current state of knowledge about the impacts of solar energy development on wildlife as of the publication date noted on the cover. The AZGFD will review and update these guidelines at least once every 10 years but may revise sooner based on new research findings or user feedback. For questions about these guidelines or to contribute information to the current body of knowledge, please contact the Project Evaluation Program at PEP@azgfd.gov.

Introduction

Solar energy development within Arizona has grown rapidly over the past few decades. This growth presents both challenges and opportunities for wildlife conservation. As development expands across the state, thoughtful site selection, design, and the implementation of conservation measures are essential to minimize impacts to wildlife and their habitats. These guidelines were intended to assist solar energy proponents (i.e., developers, owners, operators, biological consultants, and permitting entities) in identifying and addressing potential impacts to wildlife and wildlife habitats from proposed projects. They provide recommendations, guidance and/or alternatives to avoid, minimize, and/or offset adverse effects, and are designed to be used in coordination with the AZGFD throughout project planning, construction, operations, and decommissioning.

These guidelines are split into six chapters:

- Chapter 1, "Solar Energy and Wildlife," describes how to initiate coordination with the AZGFD and offers a brief introduction to solar energy in Arizona, implications for wildlife, the permitting process, and wildlife protection laws.
- Chapter 2, "Preliminary Area Evaluation," discusses the recommended actions a project proponent can take to assess the biological resources of a potential solar energy project location. The chapter is designed to assist in making macro-siting decisions.
- Chapter 3, "Site Characterization and Design," discusses preliminary surveys to assess potential impacts on wildlife and habitat, and best management practices or conservation measures that can be incorporated into the project to avoid, minimize, and offset these impacts.
- Chapter 4, "Pre-construction Surveys and Preparation for Construction," identifies surveys and other steps that can be taken prior to the initiation of construction (i.e., grading and/or clearing vegetation) to prevent direct impacts to wildlife species.
- Chapter 5, "Operations and Post-Construction Monitoring," provides standardized survey and monitoring techniques for facilities that are collecting, interpreting, and reporting wildlife fatalities and wildlife use data after construction.
- Chapter 6, "Decommissioning and Habitat Reclamation," provides recommendations to consider during removal of equipment and restoration of the site to natural conditions.

Chapter 1: Solar Energy and Wildlife

While solar is being developed across the country, it is important to recognize the individual needs and challenges of each state. These guidelines aim to support the adoption of best management practices (BMPs) and conservation measures that help project proponents avoid or minimize impacts to wildlife and habitats in Arizona, while fostering continued communication and collaboration with the AZGFD.

1.1 AZGFD Coordination

For the benefit of project proponents and state agencies, the Association of Fish and Wildlife Agencies (AFWA), American Clean Power Association (ACP), and the Energy and Wildlife Action Coalition (EWAC) have developed a Solar Communications Framework. The framework includes recommendations for communication at different stages of the development of a solar project (AFWA et al. 2024). These recommendations are designed to facilitate the communication and coordination between the project proponent and state wildlife agency throughout the life of a solar project. Project proponents are encouraged to use this framework when coordinating with the AZGFD and applying recommendations within these guidelines to their specific project.

The first step is to contact the AZGFD early when the conceptual design is still flexible (prior to the selection of a site when practicable) to provide affiliation, contact information, and identify any potential impacts to Species of Interest[1] in the Area of Interest (AOI). Providing baseline maps of the AOI (preferably in the form a shapefile or KMZ) and any preliminary facility layout plans would aid in the review. The AZGFD encourages permitting agencies and project proponents to continue coordination from site selection through facility decommissioning to ensure that impacts to wildlife are avoided or minimized to the extent practicable, and that the best available data on wildlife presence are incorporated into planning and decision-making.

To initiate a collaborative process and minimize impacts to wildlife and their habitats, contact the AZGFD's Project Evaluation Program at the following:

Arizona Game and Fish Department
Project Evaluation Program
WMHB – Habitat, Evaluation, and Lands Branch
5000 W. Carefree Hwy
Phoenix, AZ 85086
(623) 236-7600
PEP@azgfd.gov

[1] "Species of Interest" is defined in Appendix C of this document

1.2 Brief Overview of Solar Technologies

Photovoltaic (PV) is the most commonly used solar technology. Within recent years, the number of new solar PV projects has increased exponentially, with more than 100 solar PV projects proposed[2] in Arizona since 2021. Arizona is also home to at least four concentrating solar power (CSP) facilities, but few new CSP projects have been proposed since the early 2000s. These guidelines focus on PV solar; however, many of the recommendations provided are also applicable to CSP facilities. Additional CSP-specific guidance can be found in Appendix D.

PV solar panels are usually grouped together, as they are modular and the size and shape of solar fields can often be modified according to power needs, land availability, topography, and resource avoidance. In addition to the solar field, utility-scale PV facilities often include other components such as battery energy storage systems (BESSs) to store surplus energy for times of low production or high demand, substations and gen-tie lines to transfer energy to the grid, and access roads that allow for routine maintenance and cleaning . Panel arrays and any auxiliary buildings, BESSs, and substations are usually surrounded by a security fence, as required by the North American Electric Reliability Corporation (NERC) and local safety requirements.

1.3 Implications for Wildlife

Solar development contributes to statewide and national efforts to reduce greenhouse gas emissions, which helps support long-term ecosystem and wildlife resilience. Additionally, with thoughtful site selection and design features, there are opportunities for some solar facilities to provide habitat for certain species. However, solar development also has the potential to negatively impact wildlife species and their habitats. When considering an area for solar energy development, it is important to consider potential adverse effects of the facility on wildlife and habitat and whether these effects can be avoided or minimized during the earliest stages of the process prior to site selection and permitting processes through coordination with local state wildlife agencies. Understanding these potential impacts can guide both macro and micro siting decisions, as well as the development of conservation measures and BMPs.

Potential adverse effects of solar development on wildlife and their habitats include:

1.3.1 Habitat Loss and Degradation

Utility-scale solar projects require large areas of land. Prior to 2020, the majority (>92%) of solar projects that the AZGFD became aware of were less than 1,000 acres in size. As of the drafting of these guidelines, proposed projects range in size from 100 to more than 25,000 acres, with most of the newer projects larger than 4,000 acres. The majority of these proposed projects are typically in undisturbed natural habitat distanced from developed communities, which results in

[2] These include projects the AZGFD is aware of through coordination with project proponents or permitting agencies, or via publicly available information (e.g. project websites, United States Geological Survey (USGS) United States Large-Scale Solar Photovoltaic Database).

a loss and degradation of wildlife habitat. As of 2024, approximately 61% of built and proposed solar projects in Arizona are situated on native desert scrub vegetation, 12% are on desert or semi-desert grasslands or shrub-steppe vegetation, 13% are on agricultural land, and only 4% of projects are sited within urban or already developed areas (AZGFD Unpublished Data).

The area within the perimeter of a facility's security fence generally represents the largest contiguous area of direct habitat loss or degradation. The extent of impact varies depending on whether design features such as wildlife compatible fencing and vegetation management practices are implemented, as there may be opportunities for smaller and more adaptable species to use the site. Additional impacts to habitat can occur through the construction or expansion of substations, BESSs, transmission lines, and associated access and maintenance roads.

Solar facilities can alter habitat or the use of habitat through the following means:

- Construction and routine maintenance of panels, substations, and roads involves the use of machinery and soil disturbance. Invasive species are easily transferred by unwashed equipment and soil disturbance facilitates their growth (Fleming 2005; Orbán et al. 2021).
- Temporary noise during construction or maintenance activities and artificial lighting may affect wildlife biophysiology, social behavior, scavenging behavior, and communication (Sordello et al. 2020; Candolin 2024).
- Overuse of herbicides can alter biodiversity and remove important nectar resources for pollinator species (Anderson et al. 2024).
- Solar panels can influence the spatial distribution of precipitation reaching the ground and modify other abiotic conditions such as solar radiation (Bajehbaj et al. 2024). These microclimatic shifts can influence moisture availability and vegetation composition beneath and adjacent to arrays. Deep-rooted desert shrubs such as creosote may be less affected by the loss of soil moisture directly under PV panels, while shallow-rooted shrubs such as white bursage may experience stress due to decreased water availability (Karban et al. 2024).
- In some circumstances species-specific behavioral avoidance of solar facilities can indirectly result in functional habitat loss that extends well beyond a facility's perimeter fence. Where functional habitat loss is anticipated, developers are encouraged to coordinate with the AZGFD to identify potential species-specific recommendations.

Loss of Recreation Resources

With more than 800 wildlife species and 30 million acres of public land, Arizona provides some of the best wildlife related recreational opportunities in the nation. The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation conducted in 2022 showed 39.9 million anglers, 14.4 million hunters, and 148.3 million participants in wildlife watching across the U.S. that year with $45.2 billion spent on hunting, $99.4 on angling and $250.2 billion on wildlife

watching; the costs were generally split among traveling, supply, and licensing/permitting costs (USFWS 2022). A 2011 USFWS survey showed the following annual statistics for Arizona alone:

- 637,000 anglers with expenditures of $755 million.
- 269,000 hunters with expenditures of $338 million.
- 1.6 million wildlife watchers with expenditures of $936 million.

Construction of a solar facility can affect wildlife related outdoor recreation by restricting access to public lands. The AZGFD requests coordination from project proponents to minimize potential restriction to recreation and other wildlife-related activities.

1.3.2 Habitat Fragmentation and Loss of Connectivity

Habitat fragmentation occurs as larger blocks of contiguous habitat are split into smaller disconnected blocks that are separated by barriers such as fences, roads, or development. As habitat becomes fragmented, a species' ability to move across the landscape is reduced or lost, representing a loss of connectivity. Species must be able to traverse their environments to access resources such as water, forage, shelter, and mates and to complete life processes. These movements may be short-distance daily movements, long-range dispersal movements, seasonal migrations, or opportunistic migrations to access resources or avoid stressors. While additional research is needed to understand the extent of impacts in the southwest, solar development has the potential to be an impediment to movement and gene flow for some species, including ungulate species (e.g., pronghorn and mule deer) and desert tortoise (Lovich 2011).

1.3.3 Hydrology

Panel surfaces and compacted soils at utility scale solar facilities can block or reroute surface flows. The resulting changes in drainage patterns and storm water runoff may have the potential to alter wildlife habitat.

1.3.4 Injury to Wildlife

Wildlife can be directly injured or killed during the lifespan of a solar facility through the following mechanisms:.

- During construction, animals may be crushed, trapped in their burrows, or otherwise be injured during any mowing, grading, and grubbing.
- The "lake effect" hypothesis suggests that some birds are attracted to photovoltaic solar facilities because polarized light reflected from the panels can mimic the appearance of water, causing birds to attempt to land on or near the arrays. Fatalities of avian species have been recorded across utility-scale photovoltaic solar facilities in the Southwest U.S. (Kagan et al. 2014; Kosciuch et al. 2020). The extent at which the lake effect occurs is believed to be species-specific and context dependent, with some research showing fatalities of aquatic habitat birds at solar facilities in arid environments due to collisions

with the panels or the inability of some species to take off from the site in the absence of water (Diehl et al. 2024; Kosciush et al. 2021). However, other research has not observed bird collisions at solar facilities in the Southwest and suggests that previously reported fatalities may be associated with older technologies that are no longer representative of modern facilities (Kosciuch et al. 2025; Hamada et al. 2026).

- Wildlife may become trapped or entangled in the security or boundary fencing and potentially suffer injury or death (Harrington and Conover 2006). If wildlife cannot find a location to cross, they could expend their limited energy searching for places of passage (Jones et al. 2018; Peaden et al. 2017). Additionally, adults may be able to cross a fence line, but their young may be unable to do so (Harrington and Conover 2006; Paige 2015).

1.3.5 Cumulative Landscape-scale Effects

Although each solar project individually may have a minimal impact on the broader landscape, these projects cumulatively could result in a loss of habitat, impact wildlife movements, and affect wildlife related recreation. Additionally, research indicates that species such as pronghorn exhibit avoidance behaviour in response to solar development, suggesting that long-term effects to wildlife can extend several kilometers beyond the footprint of a solar project area (Sawyer et al. 2025). Recognizing these cumulative effects is essential for state and local planning efforts as renewable energy continues to be developed across Arizona.

As of the date of publication, the AZGFD is aware of a total of approximately 81,000 acres of built solar on the landscape, 69% of which is located on private lands, 16% on state lands, and 13% on federal lands. Solar facilities are often clustered, as ideal locations typically occur on large, flat areas of land away from densely populated areas. As a result, the impacts of solar development are not evenly distributed across the landscape and frequently occur in relatively unfragmented wild landscapes.

Cumulative landscape-scale effects may also impact species that do not primarily inhabit the topographically flatter areas suitable for solar development, but instead pass through these areas during dispersal and other regional or seasonal movements. The reduction of functional wildlife movement corridors and habitat connectivity could result in the isolation of some species such as the Sonoran desert tortoise that rely on connectivity between areas of rocky or higher elevation terrain in which they inhabit.

The loss of habitat from solar development, combined with losses from infrastructure development associated with human population growth, has the potential to result in the population declines of many species that are currently common on the landscape. The USFWS may take habitat loss and fragmentation associated with energy and infrastructure development into account when considering listing species under the Endangered Species Act (ESA).

It is important to consider a landscape-level approach when assessing potential impacts of a solar project on wildlife and their habitats. The AZGFD is available to assist project proponents in evaluating projects within the broader landscape context, as well as provide conservation measures that can be implemented to help address these impacts.

1.4 The Permitting Process

A solar project must go through various permitting processes prior to construction depending on a variety of factors including, but not limited to:

- Location. The project proponent may need to submit an application for a zone change, construction permit, special use permit, and/or any other applicable permit to the city or county depending on the project's jurisdiction.
- Land ownership. There are different application and environmental compliance requirements depending on whether the project will be sited on Arizona State Land Department, federal, tribal, or private land.
- Associated infrastructure. Solar facilities requiring above-ground transmission lines 115kV or higher with at least five structures spanning more than one mile must make an application with the Arizona Corporation Commission (ACC) for a Certification of Environmental Compatibility (CEC).
- Changes to air and/or water quality and project materials that may be considered hazardous waste. A solar facility may need to receive approval, certification, or permits from the Arizona Department of Environmental Quality (ADEQ) and/or the Environmental Protection Agency depending on construction and operation activities. ADEQ's website provides a list of permits the project proponent may need to apply for depending on the nature of the project.

Most permitting processes require the project proponent to identify the proposed facility's potential impacts to wildlife and consider design features to minimize or avoid these impacts. Additionally, some jurisdictions have streamlined processes for renewable energy development that ensure that projects are not located in biologically sensitive areas. It is recommended project proponents coordinate with the AZGFD to identify these impacts and develop and/or implement minimization or avoidance measures. It is also recommended that the project proponent and permitting agency coordinate with the AZGFD regarding wildlife resources and wildlife related recreation throughout the development of any permit conditions.

1.5 Wildlife Protection Regulations

Various laws regulate the permitting requirements for solar energy development in Arizona. A summary of key regulations can be found in Appendix C, including the AZGFD's authorities to manage wildlife in the state. As laws and regulations are subject to change, it is the responsibility of the project proponent to understand and comply with all laws pertaining to their project.

Chapter 2: Preliminary Area Evaluation (Desktop Assessment)

Solar energy developers typically assess the biological sensitivity of a proposed project site early in the site selection and development process. The AZGFD requests that project proponents coordinate with the AZGFD's Project Evaluation Program to aid in identifying biological constraints and Species of Interest potentially occurring within the AOI. Early coordination allows project proponents maximum opportunity to seek alternative development strategies if unavoidable impacts seem likely.

It is recommended that project proponents communicate with the AZGFD during the preliminary phase regarding affiliation, contact information and the nature of the potential development activity. Check-in frequency and preferred methods of communication can also be established during this initial phase. Please reference Section 1.1 for instructions on how to initiate the coordination process.

2.1 Site Selection

Thoughtful site selection is the most effective strategy in avoiding or minimizing impacts to wildlife and habitat from renewable energy development. Project proponents are encouraged to seek previously disturbed areas for development. It is recommended that proponents avoid areas with sensitive wildlife resources (e.g., riparian areas, water resources, and other habitat features that are used by Species of Interest) and large areas of unfragmented habitat, which can be identified through the resources described in Section 2.2 in addition to early coordination with the AZGFD.

2.1.1 Land Use

The AZGFD recommends that utility-scale solar facilities are sited on existing degraded and/or disturbed areas, such as retired or abandoned croplands, brownfields (abandoned or underused industrial and commercial facilities available for re-use), abandoned mines, capped landfills, or other areas that may be less likely to provide quality wildlife habitat and/or landscape connectivity, when practicable. The Environmental Protection Agency's (EPA;(n.d.) RE-powering mapper provides the location of contaminated lands, landfills, and mine sites for potential renewable energy development.

2.1.2 Public Access and Recreation

It is recommended that project proponents coordinate with the AZGFD early in the planning process to avoid potential conflicts with wildlife related outdoor recreation. The AZGFD emphasizes maintaining access to public lands for the purpose of recreation and encourages prioritizing locations for solar development that minimize overlap with recreation activities.

As solar projects are constructed around the state, there is a possibility they may impede or restrict access to public lands by siting a project over known travel routes. In order to maintain access to public lands, and prevent the creation of illegal roads by irresponsible recreators, coordination with the AZGFD is recommended. Placing signs to indicate travel routes during and after project construction can help direct traffic. The AZGFD requests coordination regarding the creation and life of any such developed travel routes, especially where disturbance to wildlife and their habitat may occur as a result of public use of the road or during hunting seasons when recreational access is expected to increase.

2.1.3 Wildlife and Habitat Resources

Prior to selecting a site, project proponents are encouraged to coordinate with the AZGFD to determine sensitive wildlife and habitat resources potentially occurring within the AOI. These resources include topographic features, wildlife movement areas, large blocks of unfragmented habitat, riparian areas, bodies of water, eagle nests, and other habitat features that are used by Species of Interest. The AZGFD recommends that project proponents avoid these resources to the greatest extent practicable when siting facilities. Furthermore, the AZGFD also encourages project proponents to site facilities that do not obstruct wildlife access to water catchments maintained by the AZGFD or other entities on the landscape. Section 2.2 and Section 3.1 of these guidelines provide resources to assist project proponents in a desktop analysis of the proposed site and preliminary site screening protocols, respectively.

2.2 Data Resources for Biological Information

During the preliminary area evaluation, continued communication with the AZGFD is encouraged due to the data and tools the AZGFD has available to assist project proponents with the process. The AZGFD encourages project proponents to use these resources during site planning and preliminary screening.

2.2.1 AZGFD Tools and Resources

The AZGFD's Natural Heritage Program, Heritage Data Management System (HDMS) is an efficient and free source of biological information. It identifies elements of concern in Arizona and consolidates information about their status and distribution throughout the state.

- The AZGFD encourages that the Arizona Online Environmental Review Tool is used during the site screening of a project (AZGFD n.d.b). The ERT uses HDMS data to create lists of special status species and resources within a buffered distance of the AOI. However, it should be noted that simply obtaining a species list does not constitute a review of the project by the AZGFD. Occurrences are only recorded in HDMS if the site has been previously surveyed during the appropriate season, a detection was made, and the observation was reported and entered into the database. As such, a lack of records in the ERT report for a project cannot be inferred as the absence of special status species. It is also important to evaluate known occurrences of Species of Interest and habitats near

the site and in comparable adjacent areas. Additionally, some permitting agencies have their own lists or stipulations that may need to be considered as well. Coordination with relevant permitting agencies is encouraged to obtain and meet these requirements.

- Species abstracts and species lists are available at the AZ Natural Heritage Program (AZGFD n.d.c) website.

The AZGFD (2022) has developed the Arizona Wildlife Conservation Strategy (AWCS) which can be used by project proponents to identify species and threats within their habitats. The AWCS includes a list of Species of Greatest Conservation Need (SGCN) in Arizona by habitat type, outlines threats to species and habitats, and recommends actions to address those effects.

The AZGFD is engaged in an ongoing process to identify wildlife movement corridors within the state to ensure wildlife movement and genetic diversity are maintained. Efforts are focused on maintaining movement corridors across developed areas, including urban, rural, and renewable energy installations. Because research is ongoing, not all corridors are known and mapped. However, project proponents can find many known movement corridors mapped within the AZGFD's ERT.

The AZGFD regularly collects wildlife telemetry and GPS data across the state. Project proponents are encouraged to coordinate with the AZGFD to obtain current, site-specific, wildlife-related data. Coordination with the AZGFD, as recommended in Section 1.5, provides an opportunity to review wildlife movement data which is not available publicly and to identify appropriate studies to address data gaps as per Section 3.1.2.

Note: An absence of information should not be interpreted as the absence of wildlife or wildlife resources and may represent a gap in available data.

2.2.3 AZGFD Staff as Resources

Early coordination with the AZGFD assists project proponents in evaluating the project in the context of applicable laws, including the ESA, Bald and Golden Eagle Protection Act (BGEPA), Migratory Bird Treaty Act (MBTA), and Arizona State Statutes addressing wildlife protection. While USFWS is responsible for administering the ESA, BGEPA, and MBTA, the AZGFD is available to work with project proponents to address these acts and implement conservation measures. Contact information for the six AZGFD regional offices and headquarters can be found in Appendix A and on the AZGFD Directory website.

2.2.4 Other Resources

Many useful tools and databases can be found online and are often publicly available. These resources can be used to supplement and bolster data from federal and state sources. Resources such as eBird and iNaturalist rely on community science efforts, with records reported from users worldwide to create a free database of wildlife sightings. This information could help with project planning and siting.

Other helpful sources of information include contacts with biologists familiar with the area, including staff from universities, colleges, and bird conservation organizations (e.g., National Audubon Society). National Audubon Society Christmas Bird Count Data and North American Breeding Bird Survey Data can provide useful information about species and abundance of birds during winter and spring in portions of Arizona. The Partners in Flight Avian Conservation Assessment Database contains the biological data and scores used and generated by the Partners in Flight species assessment process to evaluate the conservation status of more than 1,600 species of North American birds. Cities and counties may also have useful information on local wildlife populations.

Audubon Southwest, in partnership with the AZGFD, has designated 48 areas in the state that are considered Important Bird Areas (IBAs). Each mapped IBA includes key habitat characteristics, identifies priority bird species, and recommends conservation opportunities.

iMapInvasives is an online GIS-based data management tool that allows professional and community scientists to report information about invasive species. Project proponents can obtain maps detailing reports of invasive species at given locations across the state. Early Detection and Distribution Mapping System (EDDMaps) is another resource that provides mapped distributions of invasive species. Additionally, project proponents can refer to AZDA's website for a list of prohibited and restricted noxious weeds and the Arizona Native Plant Society for information on identification and recommendations on control methods.

Project proponents are encouraged to reach out to the AZGFD to obtain site specific resource recommendations. The AZGFD recommends that project proponents fully document all coordination and contacts made with local experts and others regarding wildlife related information pertinent to a proposed project.

Chapter 3: Site Characterization and Design

Once data from the initial site screening desktop analysis has been compiled, it is recommended that preliminary biological surveys are conducted, potential impacts to wildlife and habitat are assessed, and conservation plans are developed. Section 1.2 identifies important considerations for evaluating potential effects to wildlife and habitat. The AZGFD encourages project proponents to avoid impacts to wildlife and habitat to the maximum extent practicable. When avoidance is not feasible, BMPs and other conservation measures to minimize impacts can be incorporated into the project plans to counter project-related effects on wildlife and their habitats. Where impacts to wildlife and habitat cannot be avoided or minimized, project proponents can voluntarily offset impacts through conservation opportunities.

The AZGFD recommends project proponents document the approach and findings of this stage, as well as any measures planned to avoid, minimize, and offset potential development-related impacts, which may include:

- Design features and other BMPs or conservation measures described in this chapter.
- Pre-construction surveys described in Chapter 4 to avoid direct impacts on wildlife.
- Post-construction monitoring described in Chapter 5 to evaluate impacts and the effectiveness of conservation measures at the facility.
- Decommissioning Plan described in Chapter 6 that includes wildlife BMPs and reclamation of habitat.

Project proponents are encouraged to develop a decommissioning plan prior to operations as a proactive measure to ensure proper end-of-life management of project components and restoration of disturbed habitats. These plans are driven by a facility's leases or other landowner agreements and must abide by their terms. While the AZGFD understands that decommissioning may not occur for decades, developing a plan in the early stages of the project helps ensure responsible planning, anticipate potential impacts to wildlife and habitat, and supports the effective management and restoration of the site following operations. Technologies are constantly advancing, therefore it is recommended that the decommissioning plan is flexible to adequately adapt to any changes or updates to current technologies.

Note: The AZGFD requests that a scientific activity license be obtained for survey activities that include collecting dead animals (salvage), conducting surveys using vocal playback, or monitoring using trapping and handling.

3.1 Preliminary Biological Surveys

Once a desktop analysis has been completed, it is recommended that project proponents arrange for a qualified wildlife biologist, who is knowledgeable about the wildlife and habitat in the region of Arizona where the project is proposed, to conduct reconnaissance surveys. Additionally, some focused surveys for species with the potential to occur onsite may be necessary to inform the development of avoidance and minimization measures, as well as any potential conservation opportunities. Review of the ERT and other tools discussed in Section 2.2, coupled with coordination with the AZGFD, can give project biologists an idea of what species and resources could be present in the AOI[3] and what focused surveys may be needed to inform planning, development, and monitoring.

3.1.1 General Wildlife and Plant Surveys

As a part of the site screening process, the AZGFD recommends that project proponents conduct a general survey for wildlife and plant species situated within the proposed site. General wildlife and plant surveys should be of sufficient duration and intensity to adequately address all habitat types in the AOI and provide a basis for predictions about species occurrence at the area throughout the year. It is recommended that this survey documents wildlife and plant species detected including date and location, a map of vegetation communities, and any sensitive habitat resources (see Section 2.1.3). These data can help confirm the presence of potential Species of Interest and their habitats, determine whether species-specific surveys should be conducted, and inform conservation measures to avoid or minimize impacts. As timings can vary based on location, project proponents are encouraged to contact the AZGFD to coordinate the best times to conduct general wildlife and plant surveys.

Given the nocturnal and/or elusive nature of many wildlife species, it is recommended that surveys include searches for sign (scat, tracks, etc.). Additionally, project proponents can consider the use of other methods to detect wildlife species within the AOI, such as remote camera monitoring and track plates.

3.1.2 Wildlife Movement Studies and Surveys

For project areas where wildlife movement data are lacking and potential impacts to movement have been identified, the AZGFD may recommend addressing these data gaps by collecting wildlife movement data during the planning process. These data can inform site configuration and incorporation of appropriate wildlife movement accommodations. The target species, duration, and scale of movement studies are dependent upon the ecology of the area, and the scale and timeline of the project. Through ongoing consultation, the AZGFD can provide input to support the development of robust study designs.

[3] It should be noted that absence of a species in a database report does not mean that the species is absent.

3.1.3 Species-specific Surveys

The AZGFD may recommend species-specific surveys during the planning phase based on the habitat types present within the AOI and the nature of proposed project activities. Information collected during these surveys can be used to inform both permitting and development of conservation measures for the project. The following list includes some Species of Interest commonly found in areas proposed for solar development in Arizona (see Appendix B for survey protocols for these species); surveys for additional species might be recommended, based on project location and potential resources in the area:

Birds

- Bendire's and LeConte's thrashers.
- Burrowing owls.
- Pinyon jays.

Reptiles

- Mojave desert tortoise.
- Sonoran desert tortoise.

Mammals

- Gunnison's prairie dogs.
- Kit foxes.

3.1.4 Protected Native Plants

Many native Arizona plants are protected under Arizona Native Plant Law regulations and cannot be removed from private or state land without a permit from the Arizona Department of Agriculture (AZDA). According to Arizona Native Plant Law, a Native Plant Inventory should be conducted to identify and record protected species within the project footprint, so that plant salvage efforts can be coordinated prior to construction. The AZGFD recommends that surveys occur during the blooming season, or when species are readily identifiable, for species that have potential to occur in the project footprint. Multiple visits may be necessary to identify and document species that bloom during different seasons to allow the salvage of annual plants. Landowners have the right to remove plants growing on their land but are typically required to give notice to AZDA 60 days prior to the plants removal (AZDA n.d.).

The applicable land management agencies can be consulted regarding guidelines for revegetation efforts. Additionally, the AZGFD has developed Best Management Practices for Saguaro Translocation and Replanting.

3.1.5 Identification of Invasive Species

Solar facility development provides an advantageous opportunity for invasive plants. The process of this development involves the disturbance of large areas of land, priming the soil for invasive species. Surveys are recommended to determine what invasive plant species occur within the AOI and to map their distribution. These surveys should occur during the blooming season of the invasive species that have potential to occur, or during seasons where the species are readily identifiable outside of the blooming season. Multiple visits may be necessary to identify and document species during different seasons.

Key tools that assist in the identification of invasive species can be found in Section 2.2.4.

3.2 Facility Design Features

Solar PV systems, in some cases, can be designed to avoid effects to Species of Interest and their habitats. The AZGFD recommends that sensitive wildlife and habitat resources within the project vicinity are mapped during preliminary biological surveys to inform the layout of roads, fences, and other infrastructure to minimize habitat fragmentation and disturbance. The following sections provide design feature recommendations to assist the project proponent in avoiding and minimizing impacts to wildlife and habitat:

3.2.1 Facility Configuration

Design Features to Maintain Habitat Connectivity

Maintaining habitat connectivity is a priority for the AZGFD, and wildlife movement corridors are important for wildlife to respond to changing environmental conditions. Coordination with the AZGFD prior to site selection and throughout the planning process enables habitat connectivity and wildlife movement needs to be appropriately addressed (as mentioned above in Section 2.1).

The AZGFD recommends incorporating open unfenced corridors across the project area into the project design to facilitate wildlife movement, including within upland habitats as well as maintaining the ephemeral washes that occur in the project area in their natural state without fencing or other barriers to wildlife movement. These washes serve multiple functions in the ecosystem, including landscape-level conveyance corridors for wildlife movement.

Project proponents can coordinate with the AZGFD to determine appropriate corridor widths and placements based on the size, configuration, and location of the project. A minimum corridor width of approximately 1,300 feet[4] is generally recommended to provide adequate space for ungulates to move through fragmented habitat such as bottlenecks, around human development,

[4] The AZGFD is currently conducting studies within the state to determine effective corridor widths at solar facilities.

or natural barriers (Merkle et al. 2023). If the length of the corridor through the project exceeds two miles, the proposed facility design may consider accommodating greater widths up to 2,000 feet. The AZGFD is available to coordinate on corridor widths for specific projects if these widths are not feasible due to project constraints.

The following design features can help maintain habitat connectivity through solar facilities:

- Instead of fencing the entire site, the AZGFD recommends that individual components (i.e. panel fields, substations, and maintenance sheds) be fenced individually to allow for wildlife movement across the open corridors in between components.
- The AZGFD also recommends that there are no "dead ends" in security fencing. As seen in Figure 3-1, these dead ends occur when a section of a fence extends inward creating a long, thin "U" shape. These dead ends can occur where drainages and washes originate within the project footprint, or when the geometry of the solar development footprint is not continuous and an adjacent land owner's parcel bisects a portion of the project. Wildlife can enter these dead ends and become disoriented and unable to leave the dead end section, potentially leading to fatalities. The Department recommends that contiguous corridors are incorporated in the facility design. However, if a contiguous corridor cannot be achieved through the facility, fencing should be designed to exclude large mammals from dead-end sections.
- To encourage wildlife movement through any wildlife corridors incorporated into the facility design, project proponents can consider implementing angled or funnel-shaped fencing at corridor entrances (Sawyer and Holst 2024).
- Many parcels of land ideal for solar development are square-shaped plots surrounded by plots of different ownership creating a checkerboard pattern. "Rounding" or "cutting" corners off of these plots by removing some of the panels, especially in known migration corridors, allows for continued movement of wildlife (see Figure 3-2).

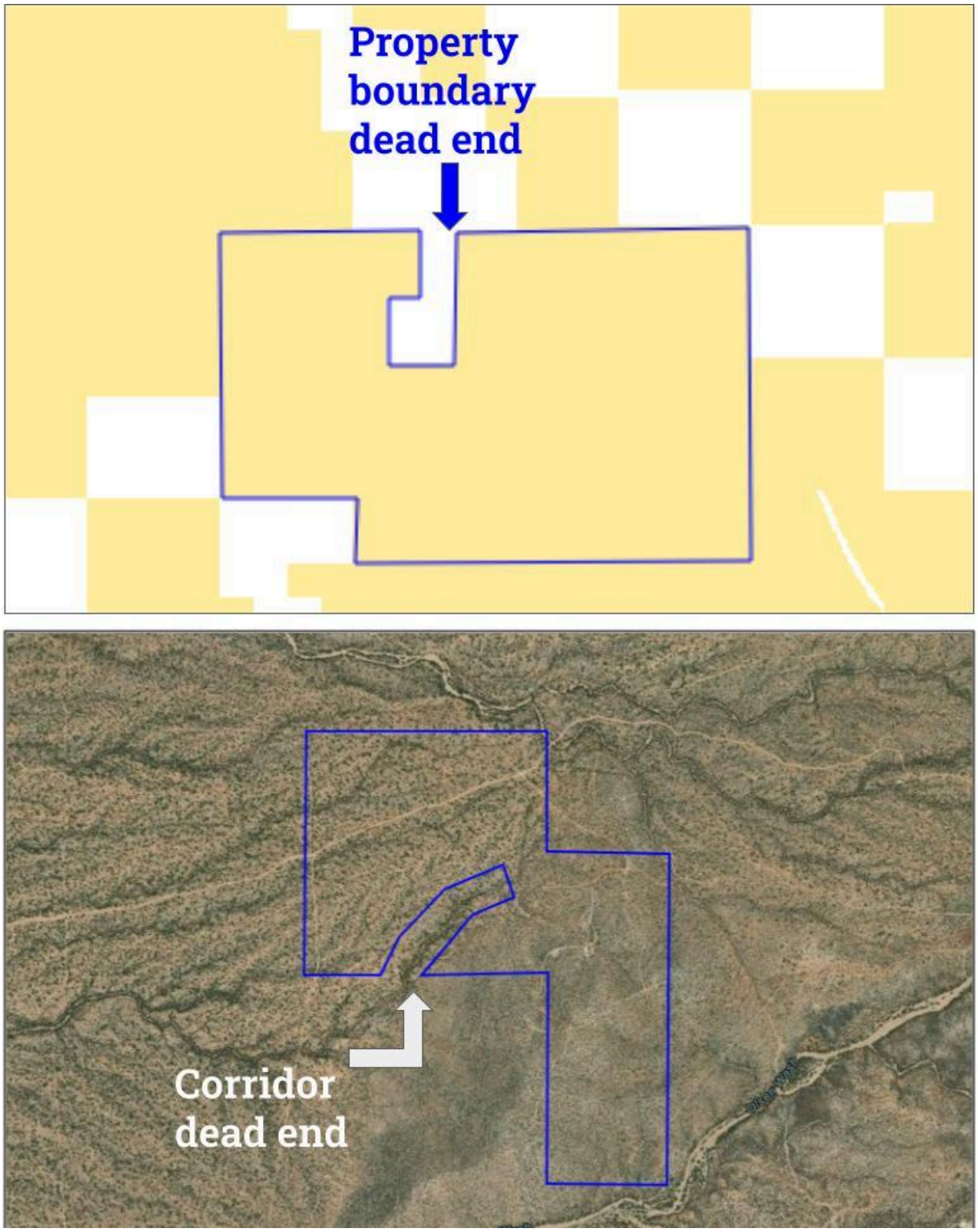

Figure 3-1. Examples of "dead ends" in security fencing to avoid.

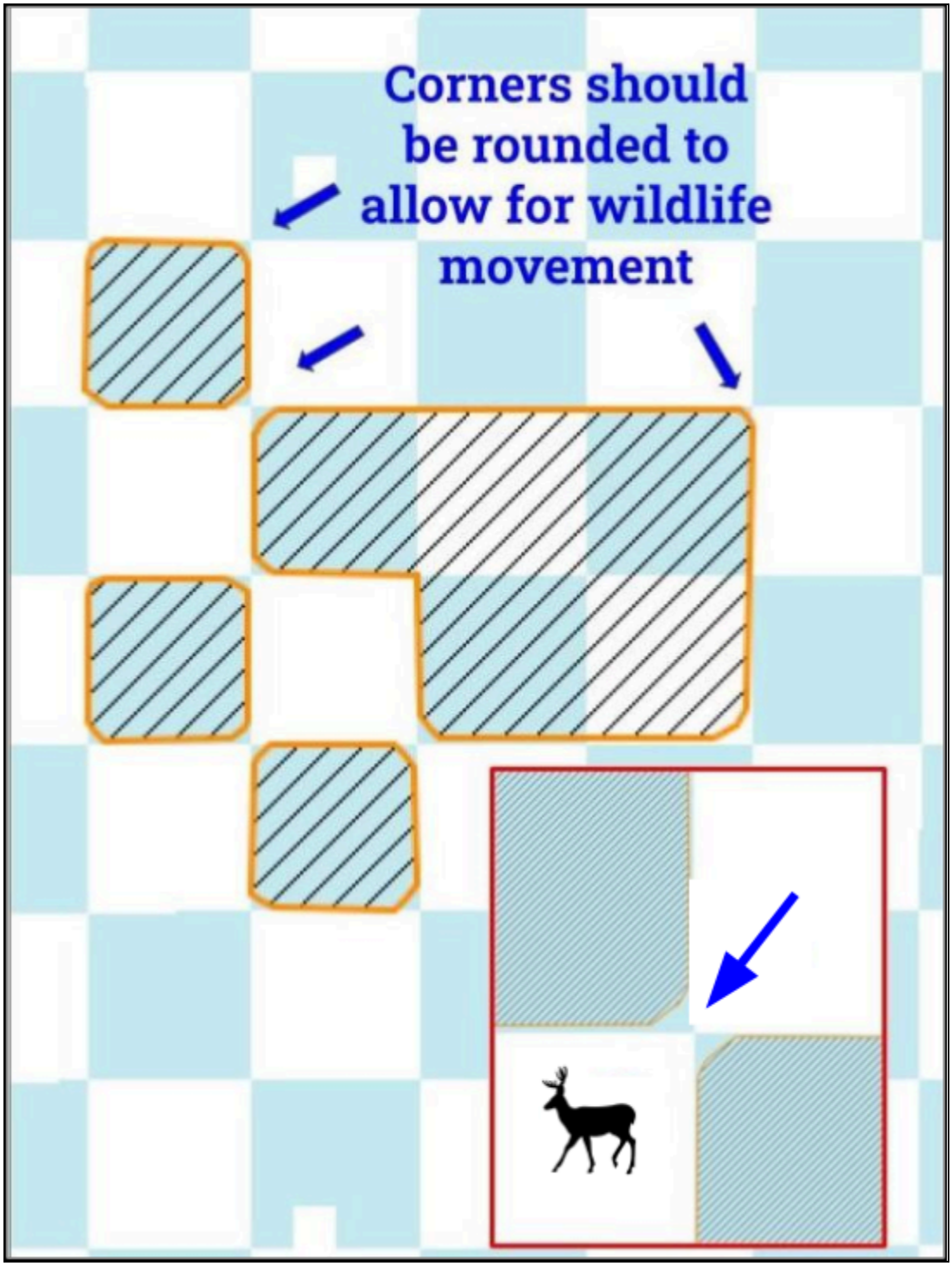

Figure 3-2. Example of rounding the corners to prevent wildlife entrapment.

Roadway Setback

To minimize the risk of wildlife-vehicle collision, it is recommended that the project be set back a distance from the roadway to ensure adequate space for wildlife to safely move around the facility (Sawyer and Holst 2024). The AZGFD can assist project proponents in determining the appropriate distance for roadway setbacks.

Other Setbacks

It is recommended that project proponents coordinate with the AZGFD to identify wildlife habitat within the project vicinity and determine appropriate setbacks to avoid or minimize impacts to these habitats.

3.2.3 Security Fencing

In compliance with the National Fire Protection Association's (NFPA's) National Electrical Code (NFPA 2020), the AZGFD understands that security fences around solar facilities are required to be at least 6–7 feet tall; typically constructed with woven wire or chain link fencing in remote areas or brick in urban locations. Additionally, the NFPA requires that three or more barbed wires be placed above the fence to extend the height by a foot. Fences may also be designed to align with the requirements of the relevant authority in the area where the facility is constructed (Murray 2023). Although fencing at solar facilities can impose an obstacle to wildlife , there are ways to modify these fences to improve permeability for some species while still maintaining compliance with NFPA.

- The AZGFD recommends incorporating the following design features into the security fence (See Figure 3-3, 3-4, and 3-5 for examples of recommended fence designs):
    - It is recommended that security fencing is at least eight feet in height. If barbed wire is necessary along the top, it can be cantilevered out, at eight feet or above, to deter deer and other large game from jumping the fence.
    - It is recommended that a continuous 6–8 inch tall gap is incorporated under the security fence to allow for smaller species to move freely through the area and make use of any habitat within the project boundary; this gap is still small enough to serve the security purposes of the fence.
    - If a 6-8 inch gap cannot be incorporated underneath the security fence, it is recommended that the fence material incorporates 6-8" tall by 18-24" wide gaps every 20 foot length of security fencing.

  If the above design features cannot be incorporated, it is recommended that project proponents coordinate with the AZGFD on design alternatives that allow for the permeability of smaller species and exclusion of ungulates.
- Additional recommendations on security fencing can be found in the AZGFD's Wildlife Compatible Fencing Guidelines.

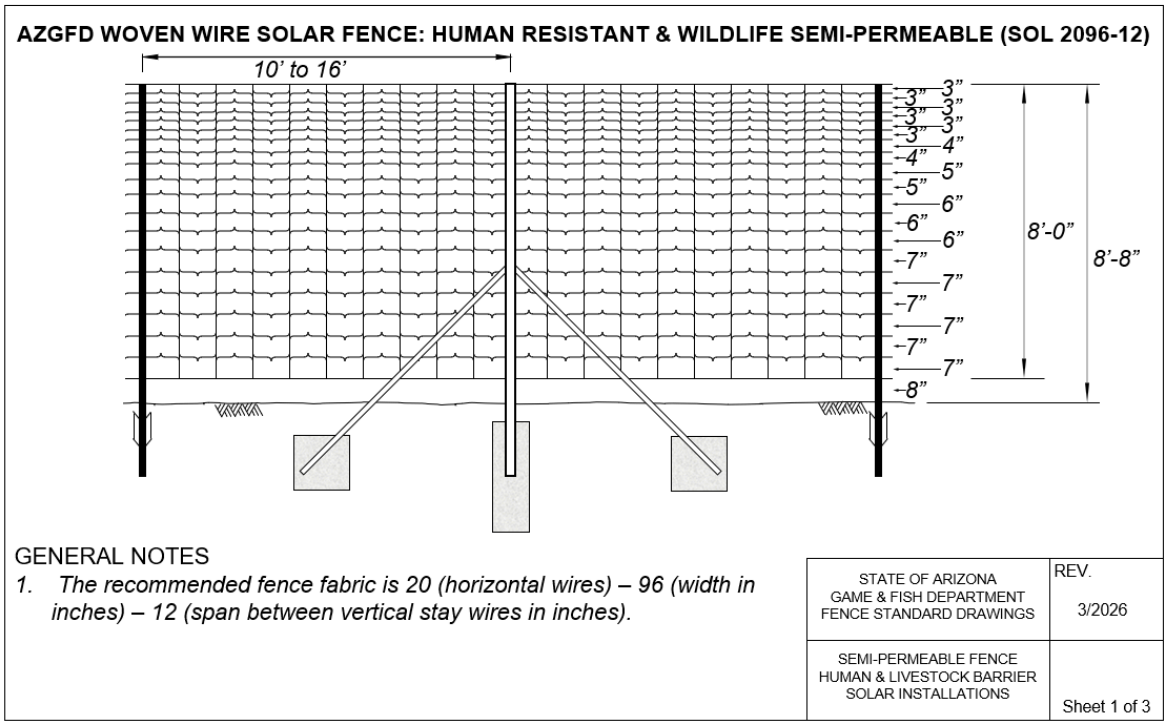

Figure 3-4. Example of a recommended woven wire fence design.

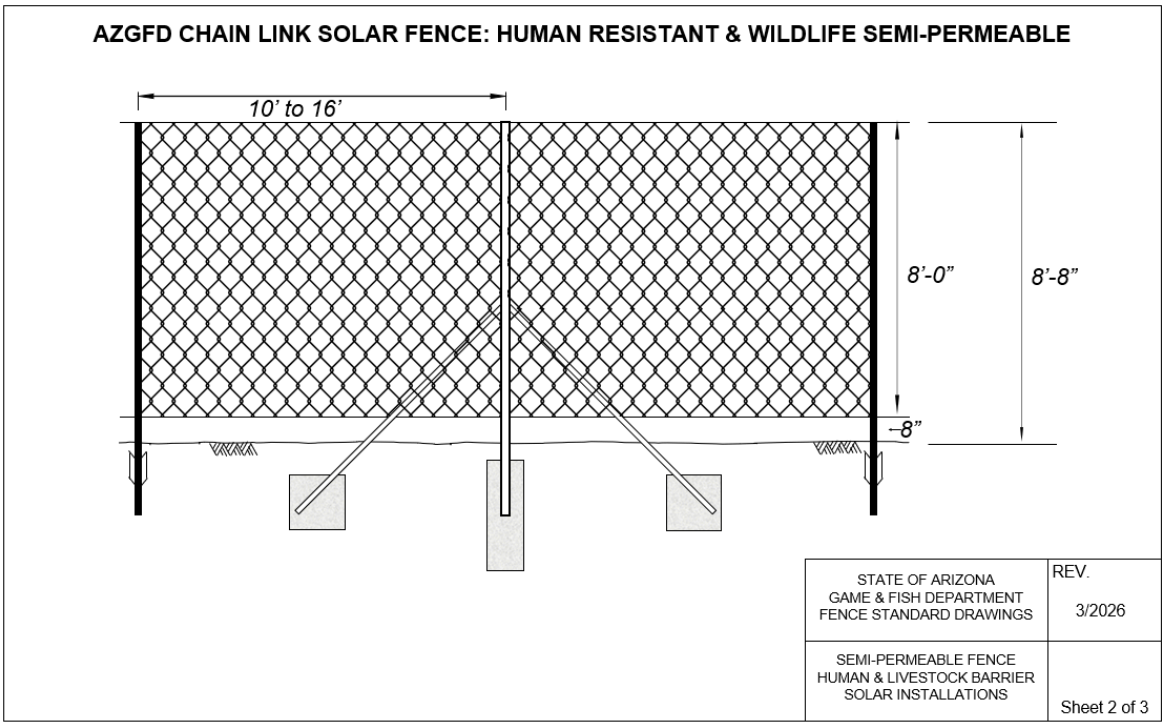

Figure 3-. Example of a recommended chain link fence design.

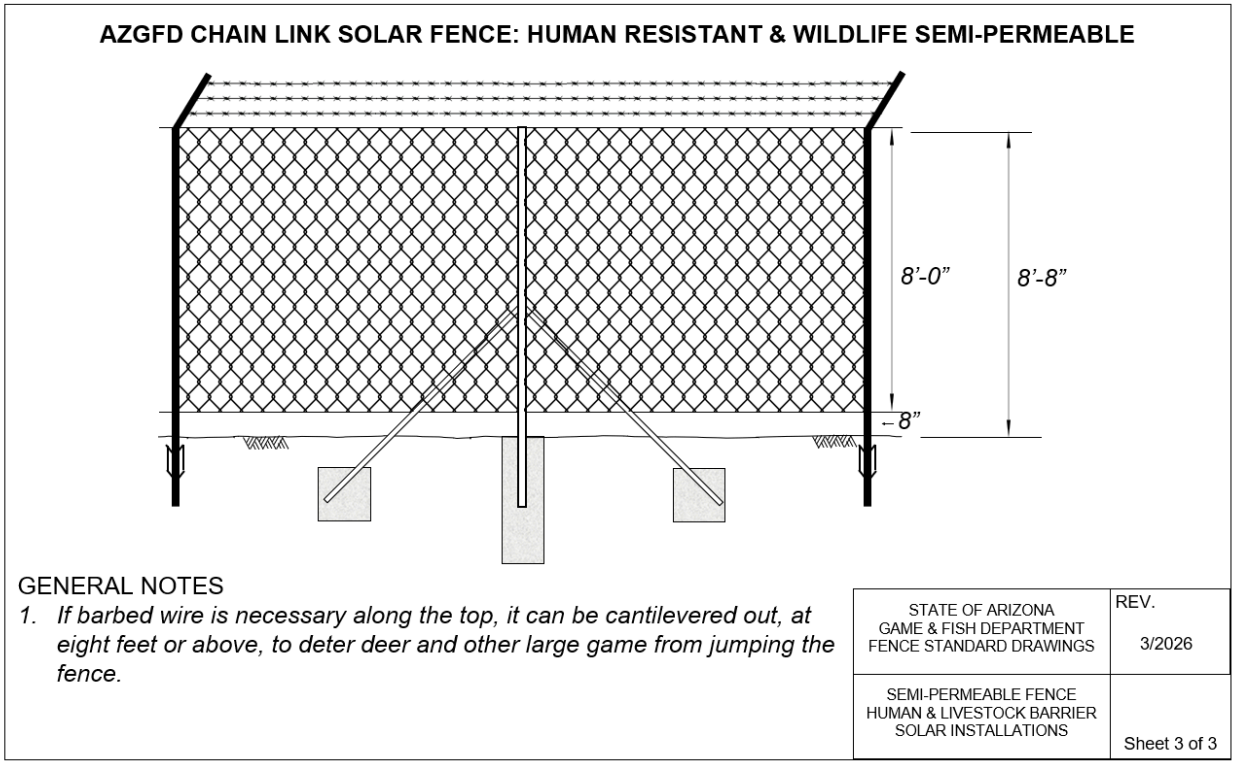

Figure 3-5. Example of a recommended chain link fence design with barbed wire at the top.

3.2.4 Project Access Road Configuration

The AZGFD recommends that project proponents consider the following as temporary and permanent access roads are planned for the construction and operation of the facility:

- It is recommended, to the extent practicable, that existing roads are utilized for construction and access to the project site.
- If new roads are proposed, habitat fragmentation can be minimized by:
    - Creating the road through cross-country travel versus blading (check local land management agency for cross-country travel regulations).
    - Constructing the minimum footprint (i.e., road width) and number of roads needed to maintain the facility.
- It is recommended that project proponents close, obliterate, and revegetate any roads constructed for the project which are not necessary for facility maintenance or required to stay per landowner agreements after construction including those areas not needed within the road right-of-way (ROW).
- It is recommended that new roads are designed to minimize alteration of the natural surface flow of water and any potential dewatering of existing swales, depressions, and/or dirt tanks.

3.2.5 Facility Lighting

Artificial lighting could impair the ability of nocturnal animals to navigate (e.g., owls, migratory birds, bats, and other nocturnal mammals) and may affect wildlife behavior and populations. The AZGFD recommends using only the minimum amount of light needed for safety. If feasible, "warmer" narrow spectrum lighting (amber, orange, red) is wildlife-friendly and should be used to the extent practicable to minimize the number of species affected by lighting. It is also beneficial for wildlife to have all lighting shielded, canted, or cut to minimize the amount of upward shining light that can impair the ability of nocturnal wildlife to navigate. For additional artificial lighting BMPs visit the U.S. Fish and Wildlife website.

3.2.6 Transmission Lines and Distribution Lines

Where feasible, it is recommended that project proponents bury distribution lines associated with the solar development. Buried lines should follow existing disturbed areas to minimize habitat alterations. For above ground transmission lines and distribution lines, the AZGFD recommends following the Avian Power Line Interaction Committee (APLIC) guidelines for new power lines, which can be found in the current version of *Suggested Practices for Avian Protection on Power Lines and Reducing Avian Collisions with Power Lines* to reduce avian collisions and electrocutions. Large bodied birds, such as hawks, owls, vultures, and eagles, may be vulnerable to line strikes and electrocution during construction and operation of power lines and substations; power poles can also serve as perches for large-bodied birds. These potential impacts can be avoided or minimized by following the APLIC guidelines which include designing power lines with enough space between energized components to reduce the likelihood of a bird electrocution or installing bird flight diverters in sections of line where elevated bird strikes are anticipated (e.g., lines over water bodies or in the path of colonial roosting locations). AZGFD personnel can provide further information on specific design features and best management practices.

Transmission lines are a well-documented collision hazard for birds (Jenkins et al. 2010; APLIC 2012). Migratory sandhill cranes, marsh birds, and waterfowl are particularly vulnerable to collisions, due to factors such as large body size, flocking behavior, poor maneuverability, or low-altitude flight (Jenkins et al. 2010; APLIC 2012). If the project intersects with daily or seasonal flight paths, the AZGFD recommends the use of both bird diverters and near-ultraviolet light Avian Collision Avoidance Systems (ACAS) on any new power lines. Providing a combination of bird diverters (or floppy tags), which are useful in daytime/full light scenarios, and near-ultraviolet ACAS, which are useful in nighttime/low light scenarios, has been shown to reduce the occurrence of sandhill crane strikes (Dwyer et al. 2019).

The AZGFD also recommends considering wildlife movement corridors when siting transmission corridors. If a transmission line is sited within a wildlife movement corridor,

minimizing ground disturbance and vegetation suppression will reduce impacts on wildlife that move through the area. Mapped corridors are available in the ERT.

3.2.7 Hydrologic Resources

Much of Arizona's wildlife and habitat is dependent on the hydrologic resources of the arid southwest. Changes to hydrologic resources, groundwater, surface water, or surface water flow may impact vegetation and potentially change wildlife species distributions and abundance in the given area. Early coordination about hydrologic resources with the AZGFD can aid in minimizing impacts to wildlife and their habitat.

- AZGFD encourages that streams, wetlands, and ephemeral washes are avoided.. Where practicable, the AZGFD recommends a buffer of ¼ mile for streams, lakes, riparian areas, and other perennial wetlands, and approximately 200 feet for ephemeral washes. These recommendations are informed by the U.S. Bureau of Land Management (BLM)'s Riparian and Wetland Avoidance and Setbacks within the Desert Renewable Energy Conservation Plan (2016). For all streams and ephemeral washes within facility boundaries that are part of an established wildlife corridor, it is recommended that the corridor widths specified in Section 3.2 or determined through coordination with the AZGFD are implemented throughout the entire length of the corridor.
- It is recommended that project proponents locate access roads to minimize stream crossings and to minimize impacts where crossings cannot be avoided. If stream crossings are necessary, project proponents are encouraged to implement the following:
    - Cross streams at right angles to the main channel on rocky portions of the channel if practical, and design roads to minimize runoff into the stream.
    - Time construction activities to protect aquatic/riparian species. These timing windows can vary; coordinate with the AZGFD to identify sensitive reproduction time periods.
    - To minimize erosion and altering aquatic habitat, stabilize the side banks of a road during construction; this may require mesh or other stabilizing material in addition to planting and/or seeding and other structural measures.
    - Project proponents are encouraged to consider culvert designs that do not impede fish and wildlife movement. Refer to AZGFD's guidelines for Bridge and Culvert Construction to accommodate fish and wildlife movement and passage.

3.2.9 Trenching

If trenching is required at the project site, it is recommended that trenching and backfilling crews are close together to minimize the amount of open trenches at any given time. Avoid leaving trenches open overnight as they can be effective traps for wildlife. Where trenches cannot be back-filled immediately or covered, escape ramps can be constructed at least every 300 feet. Escape ramps can be short lateral trenches or wooden planks sloping to the surface. The slope should be less than 45 degrees (1:1). It is recommended that trenches that have been left open

overnight are inspected daily, prior to work beginning, and any animals removed. Prior to backfilling, it is recommended that trenches are inspected and any animals removed. The AZGFD encourages the development of a monitoring schedule for each segment of underground power line installation to minimize potential impacts to wildlife.

3.2.10 Open-topped Pipes

Open-topped vertical pipes over 1.5 inches in diameter have the potential to entrap and eventually result in the fatality of birds, reptiles, and mammals. Wildlife could inadvertently fall into these pipes or enter them while looking for roosting/nesting spaces or in search of food or cover. The AZGFD recommends that open pipes are capped or covered when not actively in use to prevent wildlife mortality.

3.3 Vegetation Management

The AZGFD encourages project proponents to avoid completely grading a site. Instead, it is recommended that grading within the project footprint is limited to the degree feasible and vegetation is only mowed as necessary for construction and operation to ensure that the panels are not obstructed and safety/fire risk management requirements are met; it is recommended that vegetation be limited to no less than six inches above the ground surface to retain important root structures and top soil, etc. Grading associated with construction of solar facilities can create soil disturbance, erosion, and runoff, which can adversely affect wildlife and leave the site vulnerable to non-native or invasive vegetation growth. Burrowing owls, most native bee species, small mammals, and many reptile species are some of the many organisms that burrow in Arizona's soil and can be affected by grading.

Additionally, grading a site can remove important biological resources found in the topsoil. Soil seed banks are reserves of viable seeds present on the soil surface and in the soil; the seed bank consists of new seeds recently shed by nearby plants as well as older seeds that have persisted in the soil for several years (Northern Arizona University 2024). Grading of the site can also remove important mycorrhizae, which are fungi that live in soil and form symbiotic relationships with plant roots that aid in nutrient uptake, soil structure, stress tolerance, and disease resistance (University of Nevada 2024).

Project proponents are encouraged to develop a plan to manage vegetation within the facility (e.g., vegetation management plan), in consultation with the applicable permitting agency. This plan typically includes details on how implementation of grading, topsoil salvage, habitat restoration, weed management, and other vegetation management considerations as discussed below:

3.3.1 Revegetation/Restoration

For any temporary soil disturbance that does occur, restoring the vegetation by planting/seeding native species can minimize potential impacts listed above. The Arizona Native Plant Society has many resources on their website to develop a species list and find plant materials. The AZGFD recommends each facility:

- Retain or plant native shrubs or trees in a buffer or along the perimeter of the facility for food and cover of wildlife and pollinator species.
- Document pre-disturbance vegetation characteristics and soil conditions during wildlife and plant surveys conducted during preliminary biological surveys. Photo-points and/or drone imagery are useful tools to document pre-disturbance conditions.
- Develop a plan to restore vegetation at the site that uses only weed free plant species that are native to the project vicinity (i.e. local genetic material that is adapted to Arizona's hot and arid climate). Where native species cannot be incorporated, the AZGFD is available to assist in identifying appropriate non-invasive, naturalized species. It is recommended that the plan establishes goals for plant species diversity and composition, and mirrors native habitat from the pre-disturbance project footprint, or appropriate nearby reference area. It is recommended that the plan includes the following:
    - Background information on the area.
    - Goals for revegetation efforts.
    - Approach.
    - Implementation schedule.
    - Monitoring and reporting.
    - Any applicable conservation measures.
    - An adaptive management component to address necessary changes to meet revegetation goals.
- Plants to be salvaged under the Native Plant Law (see Section 3.1.4) provide an opportunity for revegetation of temporary use areas, ROWs, and other disturbed areas post-construction. Any plants that are salvaged such as mesquite, cacti, yucca, ocotillo, and agave can be taken to an onsite nursery for later reclamation of disturbed areas. Revegetating with salvaged plants will enhance the natural reclamation due to them being adapted to the site specific habitat and climate, as well as provide structure for wildlife within the disturbed area.
- If complete grading is required on any portion of the facility, it is recommended that the topsoil (generally the 6–12 inches of soil) is removed; if the topsoil is host to minimal invasive species (as determined during initial site surveys), it can be stored nearby in piles no taller than four feet high to prevent the death of soil biota.
- Reestablish soil stabilization, erosion control, restoration, and vegetative cover. Contour the soil to match the original topography as much as practicable.

- Re-spread the scraped top-soil over the re-contoured area to be reclaimed. Apply the seed following re-spreading (preferably the same day as a hardened soil crust will form from wind and/or rain).
    - Use certified seed sources, free of weeds and non-native herbs and grasses (e.g., intermediate wheatgrass, pubescent wheatgrass, crested wheatgrass, and smooth brome).
- Hydro-mulching is the preferred method of seed application.
    - Seeding success rate is greatly improved using this method, as hydromulch contains a tackifier that enhances water retention and sticks the seed to the ground which results in increased germination rates due to enhanced soil-seed contact, and reduces seed predation by rodents, birds, and ants, and dispersal by the wind.
- Contact the applicable land management agency regarding guidelines for revegetation efforts including planning for weed and/or invasive species management.
- Where practicable, push brush and surface rocks into multiple scattered piles across the project area and consider incorporating branch segments. These natural materials will provide habitat for many wildlife species, help reduce erosion, and degrade over time, returning nutrients to the soil.
- It is recommended that livestock be fenced out of newly reclaimed areas until proper vegetation cover is achieved. If fencing is utilized, it is recommended that project proponents refer to the AZGFD's Guidelines for Wildlife Compatible Fencing.

These recommendations can be used when restoring a decommissioned facility as well, as described in Section 6.3.

3.3.2 Maintaining Pollinator Habitat

Pollinators are essential to biodiversity and food security as nearly 90% of flowering plants worldwide depend on or are enhanced by them for successful reproduction and genetic diversity (The Nature Conservancy and Pollinator Partnership 2023). Arizona is host to many pollinator species, including invertebrates (butterflies, bees, beetles, flies), birds, and even bats. When native habitat is disturbed by the development of a solar facility, BMPs can help reduce impacts:

- The AZGFD recommends using native, pollinator friendly vegetation where practicable. The best pollinator habitat includes nectar resources, shelter and nesting sites, and safety from pesticides and pathogens (McKnight et al. 2018). Ideally, the plant palette/seed mix should reflect native vegetation in the area and include a variety of flowering species that bloom during different times of the year to ensure that nectar resources are available at any point during the growing season (McKnight et al. 2018). Resources to find an appropriate plant palette/seed mix, and nurseries where these species can be obtained, include, but are not limited to the following:
    - Arizona Monarch Collaborative.
    - Arizona Native Plant Society.

    - Xerces Society's pollinator-friendly native plant lists.
- Pollinators need shelter to survive and incorporating the correct habitat features can help them flourish. Because overwintering pollinators are generally immobile and because many bee species in Arizona are ground nesting, complete grading of a project site is not recommended (McKnight et al. 2018). Instead, the AZGFD recommends mowing plants to no less than six inches above the ground surface.
- Avoid using gravel mulches that block access to the soil for ground-nesting bees. These mulches can also prevent other small animals from burrowing in the soil.
- As with most wildlife, connectivity between habitat patches is greatly beneficial to pollinator species (McKnight et al. 2018). While connectivity needs vary among species, project proponents are encouraged to implement larger, continuous patches of habitat when practicable.
- Timing is an important consideration in the management of pollinator habitat. Project proponents are encouraged to manage vegetation at a time outside of peak use and/or migration. Refer to Section 3.4 for timing restriction details for birds and invertebrates.
- On unused portions of land within the project site, the AZGFD encourages the establishment of pollinator habitat on areas that have been disturbed, and if feasible, enhancement of existing native vegetation to incorporate additional nectar sources.

3.3.3 Noxious and Invasive Weed Management

It is recommended that solar facilities adopt measures to prevent spread and undergo management of noxious or invasive plants during the life of the project. The AZGFD recommends the following:

- Develop a plan to manage weeds that includes:
    - Monitoring the project site to detect the presence of noxious weeds.
    - Removing or treating weeds to prevent spread.
    - Reducing possibility of contamination or introduction of non-native and noxious plants.
    - A post-construction weed removal plan for the life of the project.
    - Additional measures included below.
- An immediate response is recommended when noxious weeds are detected.
- It is recommended that the use of herbicides is limited to the target species, and not broadcast sprayed within native areas or revegetation sites.
    - If pre-emergent use is necessary to maintain unvegetated areas (parking or staging areas, etc.), it is recommended that application is conducted during low or no wind conditions to minimize drift.
    - It is recommended that application of herbicides follow material labels and be applied by licensed/certified applicators.
- Thoroughly wash all surfaces and undercarriages of vehicles and equipment before moving to the project site to remove any noxious or non-native invasive plant seeds. This

will reduce the possibility of transporting noxious or non-native plants from one site to another. Detailed protocols can be found in Vehicle Cleaning Technology for Controlling the Spread of Noxious Weeds and Invasive Species by Fleming (2005). These practices can prevent invasive and noxious species from gaining a foothold and causing issues in the project site's future.

- To prevent invasive species seeds from leaving the site, it is recommended that the contractor inspect all construction equipment and remove all attached plant/vegetation and soil/mud debris prior to leaving the construction site. The AZGFD recommends that all vehicles and earth moving equipment are thoroughly washed prior to leaving the construction site.
- It is recommended that all disturbed soils that would not be landscaped or otherwise permanently stabilized by construction are seeded using native species (preferred) or, where native species are not practicable, non-invasive, naturalized species appropriate to the project vicinity.

3.4 Seasonal Timing Considerations

Many wildlife species migrate to some degree, whether it be long-distance, regionally, or locally. For non-migratory species, habitat may still be used differently depending on the season (i.e. breeding, wintering, etc.). Construction of solar projects could temporarily or permanently displace wildlife, and this disturbance could have adverse effects to wildlife depending upon the season or action that is being disrupted.

Due to the difference in elevation and habitat types across Arizona, wildlife species breed, migrate, and use seasonal habitat at different times across the state. Therefore, project proponents are encouraged to work with the AZGFD to identify site-specific breeding and seasonal habitat timing for migratory birds and other Species of Interest. Incorporating these timelines into construction planning helps reduce potential impacts to Species of Interest.

Where practicable, construction activities should be scheduled to avoid disturbance during sensitive periods. If work cannot avoid the bird breeding season, AZGFD recommends pre-construction nesting surveys to inform avoidance, minimization, or conservation measures prior to vegetation removal and/or construction activities. Depending upon location, some notable sensitive periods for wildlife include the following:

3.4.1 Birds

- Raptor breeding season: As early as December 1st and as late as August 31st.
- Migratory bird breeding season: See Table 3-1 below for typical peak breeding seasons.

Table 3-1. MBTA Typical Peak Breeding Seasons by Habitat and Location

*Habitats	Primary Counties/Region	Elevation (ft.) Range	Peak Breeding Season
Sonoran and Mojave desert scrub	Maricopa, Mohave, Pinal, Pima, La Paz, Yuma	< 3,000	15 January to 30 June
Desert grassland, chaparral, pinyon pine-juniper	Apache, Coconino, Gila, Greenlee, Mohave, Navajo, Yavapai	3,000 to 6,000	15 March to 30 July
Ponderosa pine, mixed-conifer, pine-oak, spruce-fir	Apache, Coconino, Gila, Greenlee, Mohave, Navajo, Yavapai	> 6,000	15 April to 15 August
All habitats	SE. AZ: Cochise, Graham, Pima, Pinal, Santa Cruz	All elevations	15 February to 30 September

*For urban, rural and other human-altered landscapes, refer to elevation and counties to determine the best time frame to avoid.

3.4.2 Ungulates

Terrestrial migrations and use of seasonal ranges may vary between species and region and can be addressed directly with the AZGFD on a per project basis.

- American pronghorn fawning season: May through July.
- Sonoran pronghorn fawning season: February through May.
- Bighorn sheep lambing season: December 1 through May 31.
- Local ungulate herd spring and fall migrations.

3.4.3 Invertebrates

Another migratory species that inhabits Arizona is the monarch butterfly. This butterfly typically migrates through Arizona in the spring as it is leaving its overwintering grounds (either the California coast or Mexico) and travels to inland breeding grounds. In the fall, monarchs migrate back through Arizona to return to their overwintering grounds. In areas where milkweed is present, it is recommended that vegetation removal and mowing is limited during the spring and fall migration when monarchs could be breeding to reduce potential impacts to eggs and caterpillars. Refer to the Southwest Monarch Study's peak fall migration dates to plan around active times in Arizona.

3.5 Reducing Hazardous Materials

Potential hazardous materials associated with photovoltaic solar energy facilities may include hydraulic fluids and lubricants used in tracking systems, coolants in inverters or transformers,

and end-of-life batteries in associated BESSs. End-of-life solar panels may also be considered hazardous waste, depending on the concentration of heavy metals they leach (EPA 2025). Most hazardous materials can be contained through facility design, emergency planning, prudent operating practices, and proper disposal. The AZGFD understands that facilities that meet EPA regulatory thresholds must prepare a Spill Prevention, Control, and Countermeasure (SPCC) Plan in accordance with 40 CFR Part 112, however, the AZGFD recommends that all solar facilities develop a basic spill prevention and/or contingency plan to reduce potential impacts to wildlife and habitat.

3.6 Conservation Opportunities

Project proponents and permitting agencies are encouraged to incorporate the appropriate measures described above into the planning and construction of the project to avoid or minimize impacts to wildlife and their habitat to the extent practicable. If these measures are insufficient to avoid significant net loss of habitat or negative impacts to wildlife, habitat connectivity, or water resources, project proponents are encouraged to coordinate with the AZGFD on conservation opportunities to offset these impacts outside of the project boundaries. The AZGFD will work with the project proponent to identify appropriate voluntary conservation opportunities for a project; the list below includes examples of actions that can conserve and protect wildlife populations or contribute to research to inform conservation efforts and avoidance/minimization measures when properly designed and implemented. The AZGFD is open to additional ideas for conservation opportunities as they become available or are proposed by industry.

Opportunities to Conserve Wildlife and Their Habitats

- Removing invasive species and planting locally appropriate native species outside of the project boundaries.
- In coordination with the AZGFD, consulting with the local jurisdiction, public parks, or other conservation land management entities to acquire and maintain land that provides nesting and foraging habitat for species within the vicinity of the project.
- Creating natural screening around the facility by planting native plant species that also provide wildlife habitat.
- Coordinating with the AZGFD to create or maintain water sources (e.g., water catchments) outside of the facility boundaries for wildlife.
- Restoring habitat in the vicinity of the project to offset impacts to wildlife habitat within the project footprint.
- Collaborating with neighboring developers to explore unified offset approaches.

Opportunities to Maintain or Improve Connectivity

- Removing or modifying fence to follow AZGFD's Guidelines for Wildlife Compatible Fencing to improve connectivity outside of the facility boundaries.

- Identifying and conserving key wildlife corridors for landscape connectivity outside of the facility boundaries.

Opportunities to Promote Wildlife Related Recreation

- Maintaining or improving access to the areas surrounding the facility for hunting and wildlife related recreation. This may include improving access to otherwise landlocked parcels of public land.

Research Opportunities

- When considering research as a conservation opportunity, coordinate with AZGFD to determine research needs and to design investigations. See Appendix E for examples of research needs.

3.7 Reporting

It is recommended that project proponents document the results from the desktop analysis and initial reconnaissance visits as described in this chapter. Submitting this documentation to the Project Evaluation Program (PEP@azgfd.gov) for review gives the AZGFD the opportunity to provide refined recommendations for the project to reduce potential impacts to wildlife and habitat.

It is recommended that documentation is sufficient to make informed decisions about impacts and potential measures needed to minimize those impacts, including the following:

- A description of the vegetation community or communities and major topographical features.
- Information gathered from state and federal agencies on wildlife populations and other resources in the area, including any threatened and endangered species.
- Results of the general wildlife and plant surveys, as well as any focused surveys that were conducted.
- Any information on known or suspected movement corridors for wildlife.
- Analysis of potential impacts and potential conservation measures to avoid impacts to wildlife.

Where to Submit Wildlife Data and Reports

The AZGFD encourages data owners to share raw data, reports, and other information by submitting results to PEP. A complete dataset with metadata and reports can be emailed to PEP@azgfd.gov.

Please specify any viewing restrictions or applications required, as well as any information that may be considered proprietary or confidential. The AZGFD requests the following necessary elements of data submittals: 1) species or other resource and number observed, 2) date

documented, 3) geographic locations of biological observations including projected or geographic coordinate system and datum, 4) attributes defining observational data, 5) metadata, and 6) monitoring reports. Data are requested as a CSV or geodatabase, and reports are preferred in PDF format.

Chapter 4: Pre-construction Wildlife Surveys and Preparation For Construction

In contrast to the preliminary biological surveys that include a habitat assessment and, if necessary, focused surveys for Species of Interest, pre-construction surveys are conducted directly before construction to aid in the avoidance of species that may be nesting or otherwise cannot readily move out of harm's way when construction begins. Additionally, the AZGFD may recommend the exclusion or translocation of some species. Below are some of the recommended clearance surveys intended to be performed directly prior to construction.

4.1 Pre-construction Surveys

Migratory Bird Clearance Surveys

The vegetation within the project area may provide nesting opportunities for avian species that are protected under the MBTA. It is recommended that vegetation clearing, or other activities that could disrupt active nests, is conducted outside of the breeding season for most avian species in the project area (see Section 3.4 for typical breeding seasons). The AZGFD recommends conducting surveys for nesting birds prior to vegetation removal and/or construction activities that occur during the breeding season.

General Burrowing Species Clearance Surveys

Burrowing species (e.g., badger, kit fox, tortoise, and burrowing owl) could occur within the project area and could be influenced by construction activities and by loss of habitat. Surveys for burrowing species are recommended to determine their presence and to inform pre-construction activities. AZGFD personnel are available to assist in identifying suitable conservation measures, such as one-way exclosures on burrows, that allow wildlife to exit the burrows and disperse to adjacent lands in advance of construction.

Species-Specific Clearance Surveys

If Species of Interest are identified within the project area during the preliminary biological surveys, a clearance survey may be recommended by the AZGFD prior to construction. Appendix B provides clearance survey protocols for species commonly found in areas proposed for solar development in Arizona; surveys for additional species may be recommended based on the site:

Birds

- Bendire's and LeConte's thrashers.
- Burrowing owls.
- Pinyon jays.

Reptiles

- Mojave desert tortoise.
- Sonoran desert tortoise.

Mammals

- Gunnison's prairie dogs.
- Kit foxes.

4.2 Pre-Construction Survey Reporting

The AZGFD requests the results of pre-construction surveys be shared as part of coordination efforts. The AZGFD would like to discuss survey results and assist the project proponent in determining the next steps, including applicable permits and methods to avoid, minimize, or offset impacts to Species of Interest occurring within or adjacent to the project area. The AZGFD also encourages project proponents to share raw data from pre-construction surveys for incorporation into the AZGFD's Heritage Data Management System.

4.3 Environmental Awareness Training

Prior to any environmental disturbance activities (e.g., ground, noise, dust, vegetation, etc.), project developers are encouraged to provide environmental awareness training to all persons active on site during construction and operations (contractors, subcontractors, volunteers, public, etc.). It is recommended that environmental awareness training remains ongoing throughout the life of the solar facility as new personnel or contractors begin work on the project. The AZGFD recommends that training curriculums include the following information:

- Applicable laws, regulations and overview of the project-specific BMPs and conservation measures that were developed during the permitting process.
- It is recommended that environmental education materials are provided to all personnel.
- Clear direction regarding avoidance areas and limits of work; it is recommended that the meaning of staking and different colored flagging is clearly articulated to ensure compliance.
- Identify a clear chain of command for questions and communication if any questions or concerns arise regarding Species of Interest, BMPs or other environmental issues.
- Identification of Species of Interest and processes for handling encounters.
- Fire protection measures.
- Identification and protection of biological resources.

Environmental awareness training can help reduce impacts to wildlife during construction, operation, and decommissioning process of the solar facility.

Chapter 5: Operations and Post-Construction Monitoring

Once a facility becomes operational, project proponents are encouraged to communicate with the AZGFD regarding the unanticipated presence of any Species of Interest, unexpected impacts on Species of Interest resulting from facility operations, and proposed changes that may affect Species of Interest or their habitats. Depending on project location, wildlife resources present at the project site, and conversations with the project proponent, the AZGFD may recommend that some facilities conduct post-construction monitoring. The purpose of post-construction monitoring is to obtain data that can be compared with pre-construction survey data, evaluate the effectiveness of conservation measures, and/or assess fatalities at utility-scale solar developments.

5.1 Trail Camera Monitoring of Wildlife Movement Accommodations

Where wildlife movement accommodations such as movement corridors have been incorporated into design footprints, the AZGFD recommends implementing trail camera monitoring protocols to document target species' use of corridors. Coordination with the AZGFD is recommended during development of monitoring protocols to ensure that camera mounting and placement are appropriate to detect Species of Interest. Ongoing monitoring of wildlife movement features provides confirmation that features are functioning as intended and allows for adaptive management solutions to promote use where function is impaired.

5.2 Invasive Species Surveys

Monitoring the diversity and composition of vegetation within and adjacent to the solar facility can help prevent the spread of noxious weeds and invasive species. Early detection and removal of these species increases the likelihood of successful control and prevents the re-establishment of invasive species (AZGFD 2022). To successfully detect invasive species, monitoring of the site is recommended. The frequency of monitoring can be determined in coordination with the AZGFD. This monitoring could be implemented alongside other survey protocols, such as carcass searches.

5.3 Carcass Searches for Birds

The AZGFD may recommend the implementation of post-construction monitoring for avian injuries/fatalities for facilities sited near large bodies of water or where large congregations of birds are anticipated. Recommendations for monitoring design and frequency can be found in the USGS 2016 Mortality Monitoring Design for Utility-Scale Solar Power Facilities. The AZGFD recommends that the site is surveyed for carcasses for a minimum of one year following construction, and up to three years if warranted by monitoring results. Any avian injuries/fatalities should be reported both to the AZGFD (PEP@azgfd.gov) and the USFWS by using the USFWS Injury and Mortality Reporting website. Project proponents are also encouraged to submit carcasses to the Renewables-Wildlife Solutions Initiative, which is a

program developed by USGS that collects and catalogs deceased wildlife found at renewable energy facilities to better understand population-level impacts and species vulnerability. A Special Purpose Utility Permit (SPUT) from the USFWS and Scientific Activity License from the AZGFD is required for the collection of carcasses. AZGFD personnel are available to assist in developing monitoring protocols and to further refine monitoring and reporting recommendations to develop feasible and repeatable protocols to be implemented during operations.

Chapter 6: Decommissioning and Habitat Reclamation

Upon completion of the economic life or permit expiration for a solar project, the project proponent can decide whether to apply for a new permit with the possibility of updating the existing technology, or remove the facility through the decommissioning process. As mentioned in Chapter 3, the AZGFD recommends that a decommissioning plan be developed early in the project planning process. These plans are driven by a facility's leases or other landowner agreements and must abide by their terms. It is recommended that the plan is made flexible to incorporate any decommissioning technology or research that might be developed during the lifetime of the facility.

Decommissioning of a solar facility involves both the removal of the equipment and the restoration of the site to natural conditions (ACP 2021). Although the AZGFD recognizes that complete restoration to natural conditions could be difficult, it is recommended that project proponents strive to restore natural conditions, using the pre-construction plant diversity and composition of vegetation, as well as that of surrounding natural landscape, as the restoration success criteria.

6.1 Decommissioning

Decommissioning involves the removal and subsequent reuse, recycling, or disposal of the equipment comprising the solar project. Project proponents are encouraged to create a protocol for responsible disposal of decommissioned solar panels prior to facility construction. Many of the BMPs recommended for construction, especially those involving heavy equipment and machinery, are also recommended for decommissioning activities, including but not limited to:

- Minimize ground disturbance to the extent feasible.
- Plan for decommissioning activities to occur outside of sensitive periods for wildlife (such as those identified in Section 3.4).
- Refer to Section 3.2 for recommendations on habitat restoration and minimizing the spread of noxious or invasive species.

Furthermore, it is recommended that all facility components and fencing be removed from the site to reduce impacts to local wildlife and habitat, helping the reclamation process. If any fencing will remain following decommissioning, it is encouraged that the project proponent coordinate with the AZGFD to ensure that the remaining fence will not negatively impact wildlife. After the project materials are removed, habitat reclamation can begin.

6.2 Habitat Reclamation and Restoration

Prior to construction, the AZGFD recommends capturing photographs of the proposed project site to use as a reference for habitat reclamation during the decommissioning process. As the decommissioning process typically occurs decades after the construction of the facility, these

reference photos help in determining historical native species, habitat features, and landscapes that will be restored once components are removed. It is recommended that the site (including topography, soils, and vegetation) is restored to pre-disturbance conditions to the greatest extent feasible.

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U.S. Geological Survey (n.d.). Renewables-Wildlife Solutions Initiative. Retrieved November 8, 2024, from www.usgs.gov/centers/forest-and-rangeland-ecosystem-science-center/science/renewables-wildlife-solutions

Glossary of Terms

Adaptive management – A scientific approach that: 1) recognizes uncertainty that is inherent in natural systems (for example, how ecological systems function, or how they might respond to management actions), 2) capitalizes upon change and improvement in data gathering and analysis techniques, and 3) treats actions in an experimental framework in which learning becomes an inherent objective and alternative hypotheses are evaluated (AZGFD, 2012).

Area of Interest (AOI) - The area that a project proponent has identified as potentially suitable for a solar project and in which the physical footprint of a project may be located.

Critical habitat – Specific geographic areas that are deemed essential by the United States Fish and Wildlife Service for the conservation of species listed under the Endangered Species Act. https://www.fws.gov/sites/default/files/documents/critical-habitat-fact-sheet.pdf

Cumulative impacts – The impact on the environment which results from the incremental impact of an action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other action.

Direct impacts – Wildlife mortalities resulting from collisions with solar panels, transmission lines, and other infrastructure or vehicles associated with project implementation, operations and maintenance.

Endangered species – Species that are in danger of extinction throughout a significant portion or all of its range. https://www.fws.gov/laws/endangered-species-act/section-3

Evaluation – Study specifically designed to determine whether a particular management intervention achieved the desired effect.

Habitat block – An area that is large enough to sustain healthy wildlife populations and support essential biological processes into the future.

Habitat fragmentation – The process by which previously intact contiguous areas of habitat are divided into smaller disconnected areas by roads, development, and other barriers.

Indirect impacts – Those impacts that do not directly result in the death of individuals but rather through such factors as the disturbance of local populations, displacement from or avoidance of the project site, and disruption to migratory or daily movement patterns.

Monitoring – Repeated measurement of an environmental variable, either at regular intervals, or before and after an intervention.

Riparian areas – “Riparian areas are defined as vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of

perennial, intermittent, or ephemeral surface or subsurface water drainage (Arizona Riparian Council 1994)". https://awcs.azgfd.com/chapter-7-habitat-profiles/aquatic-and-riparian-ecosystem-group

Special status species – Includes species that are threatened and endangered, Forest Service and the BLM sensitive species, and AZGFD's Species of Greatest Conservation Need (SGCN).

Species of Greatest Conservation Need (SGCN) – Those species that the State identified as most in need of conservation actions.

Species of Interest – Species of Interest within Arizona include Species of Greatest Conservation Need, Species of Economic and Recreational Importance (Game Species), Federally Threatened or Endangered Species, and Tracked Species. Project proponents are encouraged to work with the AZGFD to identify Species of Interest potentially occurring within the AOI and reduce adverse effects on these species and their habitats.

Take – Pursuing, shooting, hunting, fishing, trapping, killing, capturing, snaring or netting wildlife or the placing or using of any net or other device or trap in a manner that may result in the capturing or killing of wildlife.

Tracked Species – Tracked Species are species that the AZGFD has identified as being of particular interest for evaluating interactions with solar energy development, due to known or potential sensitivity to habitat changes, or because research or data collection has indicated project-related impacts.

Threatened species – Species that are in imminent danger of becoming endangered and listed under the Endangered Species Act.

Wildlife – All wild mammals, wild birds and the nest or eggs thereof, reptiles, amphibians, mollusks, crustaceans, and fish, including their eggs or spawn.

Appendices

Appendix A: Contact Information

Arizona Game and Fish Department, Project Evaluation Program

For general email inquiries or to send documents to the AZGFD's Project Evaluation Program, please use PEP@azgfd.gov.

Arizona Game and Fish Department
Project Evaluation Program
WMHB – Habitat, Evaluation, and Lands Branch
5000 W. Carefree Hwy
Phoenix, AZ 85086
(623) 236-7600

United States Fish and Wildlife Service- Arizona Ecological Services

For general email inquiries or to send documents to the AZ Ecological Services office, please use incomingAZcorr@fws.gov.

Phoenix
9828 N. 31st Ave, Suite C3
Phoenix, AZ 85051-2517
Phone: (602) 242-0210

Tucson
201 N. Bonita Avenue, Suite 141
Tucson, AZ 85745
Phone: (520) 670-6150

Flagstaff
2500 S. Pine Knoll Drive
Southwest Forest Science Complex
Flagstaff, AZ 86001-6381
Phone: (928) 556-2118

Appendix B: Species-Specific Survey Protocols

Some species can be difficult to detect during multi-species surveys. The AZGFD recommends project proponents follow the below protocols if the following species have potential to occur in the AOI. This information will be used to inform the project's environmental compliance and development of any conservation measures:

Birds

Bendire's and LeConte's Thrashers

LeConte's thrashers are found in some of the driest portions of the Mojave and Sonoran deserts of Arizona, while Bendire's thrashers typically occupy areas of little relief and sparse vegetation from desert scrub, grassland and savanna habitats to neighborhood parks and rural areas. Both thrashers are an SGCN that are regulated under the Migratory Bird Treaty Act (MBTA). These species were identified as "tipping point" species in the U.S. Northern American Bird Conservation Initiative (NABCI)'s 2025 State of the Birds Report and have lost more than 50% of their populations within the past 50 years.

Preliminary Surveys: The AZGFD recommends conducting a preliminary site screening for determining the likelihood of Bendire's or LeConte's Thrasher (hereafter collectively referred to as "desert thrasher") occupancy through a desktop analysis and on-site surveys following Conservation of Bendire's and LeConte's Thrashers at Solar Development Sites developed by the Desert Thrasher Working Group (DTWG). DTWG has published a shapefile of identified desert thrasher priority areas for use in desktop analyses. If suitable habitat for either of these species is deemed to be present within or adjacent to the AOI, occupancy surveys are recommended using the Thrasher Clearance Protocol developed by the DTWG. Refer to the Conservation of Bendire's and LeConte's Thrashers at Solar Development Sites for project design and construction recommendations to minimize impacts to key thrasher habitat features (e.g., desert washes).

Pre-Construction Clearance Surveys: If the species is found to be present, it is recommended that construction during the breeding season is avoided. If construction occurs during the breeding season, it is recommended that nest surveys are conducted prior to construction. While nests of all species protected under MBTA should be considered during nest surveys, the breeding periods for these species based on location (as provided in the Conservation of Bendire's and LeConte's Thrashers at Solar Development Sites) should be taken into consideration during survey planning.

Burrowing Owls

The western burrowing owl is a SGCN that is regulated under the Migratory Bird Treaty Act (MBTA). Burrowing owl habitat frequently overlaps with areas suitable for solar development as this species typically occupies open, sparsely vegetated land.

Preliminary Surveys: If suitable habitat for burrowing owl is present within or adjacent to the AOI, the AZGFD recommends recommends conducting occupancy surveys for this species in advance of the design phase to understand distribution of burrowing owls in the project site; avoidance of a large burrowing owl population may be advisable over removal or other conservation measures. Guidelines for conducting this survey are found in the Burrowing Owl Project Clearance Guidance for Landowners. Please note that the survey should be conducted by a surveyor who is certified by the AZGFD or has similar training and qualifications. If an active burrowing owl burrow is detected, please contact the AZGFD and the U.S. Fish and Wildlife Service for direction, in accordance with the guidelines.

Pre-Construction Clearance Surveys: As detailed on Table 1 of the Burrowing Owl Project Clearance Guidance for Landowners, if unoccupied burrows, or occupied burrows and/or owls, were detected during initial surveys, a pre-construction survey should be conducted either 90 or 30 days prior to construction. If owls or active burrows are detected, coordination with the AZGFD prior to initiating ground-disturbing activity will facilitate compliance with the applicable laws, and allow for avoidance strategies (for nesting owls) or translocation efforts to take place prior to construction.

Pinyon Jays

The pinyon jays is an SGCN that is a primarily a year-round resident throughout the northern half of Arizona. They are most closely associated with pinyon-juniper woodlands, but they also use adjacent grasslands and are sometimes found in ponderosa pine forests. Pinyon jays have been declining at an annual rate of about 2% in most regions and throughout their range, and the species has been petitioned for Federal listing under the ESA (Colegrove et al. 2023).

Preliminary Surveys: If suitable habitat for this species is present within the project area, , the AZGFD recommends conducting discovery surveys during the breeding season (approximately mid-February through late May) in accordance with the Arizona Pinyon Jay Project-Level Protocol to inform project design. The AZGFD recommends that the project design avoids breeding areas for pinyon jay to the greatest extent practicable. Pinyon jay surveys should be conducted by a biologist who has been trained in using the protocol, this is especially important for conducting searches of breeding colonies, as nesting groups are very sensitive to disturbance and predators can clue in on colonies.

Pre-Construction Clearance Surveys: If pinyon jays are present within the project area, it is recommended that construction avoids the breeding season (approximately mid-February through late May). If work must occur during this period and colonies will not be avoided, it is recommended that a clearance survey (as described on page 6 of the Arizona Pinyon Jay Project-Level Protocol) be conducted prior to construction. Pinyon Jay surveys should be conducted by a biologist who has been trained in using the protocol, this is especially important for conducting searches of breeding colonies, as nesting groups are very sensitive to disturbance and predators can clue in on colonies. If active nesting colonies are detected, please contact the AZGFD and the U.S. Fish and Wildlife Service for direction.

Reptiles

Mojave Desert Tortoise

The Mojave desert tortoise (*Gopherus agassizii)* is federally listed as threatened under ESA, and is found in Arizona primarily north and west of the Colorado River.

Preliminary Surveys: The Mojave Desert Tortoise Pre-project Survey Protocol published by the USFWS (2018), provides recommended protocols for determining the presence of Mojave Desert Tortoises, their number and information on habitat conditions of the area. The USFWS differentiates between three separate surveys (Quantitative Surveys, Small Project Surveys, and Linear Project Surveys) depending on the size and location of the action area.

Pre-Construction Clearance Surveys: The Clearance Survey Protocol for the Mojave Desert Tortoise is designed to ensure the safe removal of tortoises from project areas, protecting them from harm during construction or land disturbance activities. The USFWS requires surveys in areas where desert tortoises are known to be present. After surveys are completed, all findings must be reported to the USFWS. It is recommended that findings are also shared with the AZGFD. If tortoises are found post-clearance, the same handling protocols apply, and their locations should be documented. In cases where tortoises cannot be safely removed or if additional surveys are needed due to inaccessible burrows, coordination with the USFWS is required.

Sonoran Desert Tortoise

The Sonoran desert tortoise (*Gopherus morafkai*) is a SGCN primarily found east and south of the Colorado River; many state and federal organizations are signatories to this species's Candidate Conservation Agreement (CCA). Fleckenstein et al. (2025) reported that approximately 46 percent of the Sonoran desert tortoises's modeled potential distribution overlapped with areas identified as suitable for solar energy development.

Preliminary Surveys: If desert tortoises have been found in the AOI or nearby areas of similar habitat, the species can be presumed present. If presence is questionable, it is recommended that

surveys are conducted focusing on microsites with the greatest potential for supporting tortoises. To determine the presence and location of desert tortoises in a proposed project site, preliminary surveys conducted by a qualified biologist are recommended. These surveys vary slightly depending on the size of the proposed project. The Sonoran Desert Tortoise Conservation Guidelines developed by the AZGFD provides protocols for both "small" (less than 200 hectares/494.2 acres) and "large" (above 200 hectares/494.2 acres) project sites.

Pre-Construction Clearance Surveys: The Sonoran Desert Tortoise Conservation Guidelines by the AZGFD outline clearance survey protocols to be conducted by a qualified biologist in line with the AZGFD handling procedures. These surveys require 100% coverage of the project area, focusing on locating tortoises both above and below ground. Surveys should be completed immediately before surface disturbance or after constructing a tortoise-proof fence around the project area to prevent re-entry. It is recommended that tortoise findings are reported to the AZGFD and the appropriate management agency.

Burrowing Mammals

Gunnison's Prairie Dogs

The Gunnison's prairie dog is a SGCN species that inhabits the grasslands in Northern Arizona. This species has been regularly evaluated to determine whether protection under the ESA is warranted, and the AZGFD continues to monitor and manage populations within the state. If prairie dogs are detected during General Wildlife and Plant Inventories, the AZGFD recommends that colonies are mapped following the AZGFD's Perimeter Mapping Protocol for Gunnison's Prairie Dogs in Arizona to inform project design and construction. If prairie dog colonies cannot be avoided through project design, it is recommended that project proponents coordinate with the AZGFD for conservation measures that can be implemented to minimize impacts on this species.

Kit Foxes

Kit fox is a Tracked Species commonly found in arid and semi-arid habitats within Arizona. Impacts on this species are amplified due to their burrowing behavior and overlap with areas generally considered suitable for solar development.

Preliminary Surveys: It is recommended that project proponents initiate preliminary site screening for kit foxes as early as possible in the project planning phase. Surveys should be conducted by qualified biologists. If kit foxes are detected during preliminary site screening, trapping or relocation may be recommended.

Surveyors should survey the entire planned project site when practicable , searching for burrows or kit fox sign. If surveying the entire site is not feasible, surveys should be conducted in transects spaced 10 meters apart across the entire site. Detected burrows should be marked with a

painted stake and GPS coordinates should be noted. To determine if the burrow is active, a game camera is typically established at detected burrows and used for 2–3 nights, with footage being checked daily. Once the status of the burrow is detected, further plans for excavation or relocation can occur, in coordination with the AZGFD.

Prior to Construction: If kit foxes were detected during the site-screening phase, they may need to be excluded and/or relocated away from the project site prior to construction.

If construction will not affect the immediate location of an active kit fox burrow, relocation may not be necessary; the AZGFD recommends a flagged 100 meter buffer around all active burrows and the reduction of speed limits in their vicinity, 15 mph during the day and 10 mph during the night.

If burrows cannot be avoided and relocation is deemed necessary, whether through passive or active relocation, the project proponent is encouraged to coordinate with the AZGFD to identify the qualified biologist(s) that will conduct the relocation, and discuss details of relocation methodology.

- Passive relocation is the preferred method to exclude kit foxes from the project site. One-way doors are installed at the primary entrances by qualified biologists. One to three wildlife cameras will be placed around the one-way door and the dirt around the burrow entrance will be smoothed. Once an entire 24 hour period with no camera captures and no fresh evidence in the dirt surrounding the burrow has passed, the cameras are removed and the burrows collapsed.
- Although passive relocation is the ideal process, it may not be as effective for kit foxes. If kit foxes do not respond to passive relocation, active relocation could be required. Handling of wildlife and conducting relocations require permits from various agencies including the AZGFD and the USFWS and should only be performed by qualified biologists.

Appendix C: Wildlife Protection Regulations

Federal Regulations

The following federal regulations may apply to protecting wildlife from the impacts of solar energy development or require federal agencies to coordinate or consult with the Arizona Game and Fish Department.

- The National Environmental Policy Act (NEPA) and the regulations promulgated thereunder (42 U.S.C. § 4321, et seq., 40 CFR § 1500.1, et seq.) require the federal government to assess the environmental impacts of any "federal action," which includes actions undertaken (1) on federal land, (2) by a federal agency, (3) with federal funds, or (4) where the federal government will be issuing a permit. Examples when federal agencies must prepare a NEPA document for a solar development include the following: locating the facility on the BLM lands; locating transmission lines across the BLM land; using Western Area Power Administration (WAPA) transmission lines or obtaining a Clean Water Act 404 permit. NEPA requires federal agencies to cooperate with state and local agencies in analyzing environmental impacts of proposed federal actions. More details on NEPA can be found at https://ceq.doe.gov/laws-regulations/laws.html.
- The Endangered Species Act, 16 U.S.C. §1531, et seq., executed by the U.S. Fish and Wildlife Service (USFWS) provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. The ESA, among many other things: 1) authorizes the determination and listing of species as endangered or threatened; 2) prohibits unauthorized take, possession, sale, and transport of endangered species (including land-use activities that "harm" or "harass"); and 3) authorizes the assessment of civil and criminal penalties for violating the Act or regulations. Taking provisions apply to private lands. ESA authorizes permits for the take of protected species if the permitted activity is for scientific purposes, is to establish experimental populations, or is incidental to an otherwise legal activity. Section 7 of the ESA requires federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Section 10 allows for the development of Habitat Conservation Plans and the issuance of an incidental take permit on private lands. The USFWS consults with the state wildlife agency on Section 7 and 10 consultations. More information on the ESA can be found at https://www.fws.gov/law/endangered-species-act.
- The Migratory Bird Treaty Act, 16 U.S.C. § 703, et seq., prohibits taking, killing, possessing, transporting, and importing of migratory birds, including their eggs, parts, and nests, except when specifically authorized by the USFWS. Slightly more than 400 species of birds that are protected by the MBTA are either resident or at least occur annually in Arizona during certain seasons of the year (winter, summer, or during migration). The MBTA authorizes permits for some activities, including but not limited to scientific collecting, depredation, propagation, and falconry. No permit provisions are

available for incidental take for any project-related incidental take, including take associated with solar energy development. MBTA prohibition on take may require seasonal limitations on construction activities. For more information on the MBTA, go to https://www.fws.gov/law/migratory-bird-treaty-act-1918.

- The Bald and Golden Eagle Protection Act, 16 U.S.C. §668, et seq., protects the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the take, possession, and commercial use of such birds. More information on the BGEPA can be found at https://www.fws.gov/law/bald-and-golden-eagle-protection-act.
- The Sikes Act, 16 U.S.C. §670g, et seq., requires DOD to coordinate with state wildlife agencies in the development of comprehensive plans for the conservation of wildlife. These plans may restrict uses of DOD lands, or require a plan amendment to allow an otherwise restricted use. DOD will coordinate plan development and plan amendments with the state wildlife agency.
- The Fish and Wildlife Coordination Act, 16 U.S.C. §662, et seq. (FWCA) 1946 amendments, requires consultation with the Fish and Wildlife Service and the state fish and wildlife agencies where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted . . . or otherwise controlled or modified" by any agency under a federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources."
- The Federal Land Policy Management Act, 43 U.S.C. §1701 (FLPMA) is the organic act for the BLM. Section 102 declares that it is the policy of the United States that (9) "the public lands be managed in a manner…that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use." Section 202 (9) requires that the BLM provide meaningful public involvement with state and local agencies on land use decisions.
- Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act) 33 U.S.C. §1251 et seq. Section 401 permits are administered by the Arizona Department of Environmental Quality (ADEQ) under authority of the Environmental Protection Agency. Solar projects may require an Arizona Pollution Discharge Elimination System (AZPDES) and/or a Stormwater Runoff permit from ADEQ. More information can be found at the ADEQ website at https://www.azdeq.gov/SWPPermitting.
- Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act) 33 U.S.C. §1251 et seq. Section 404 requires a permit to dredge or put fill into a water of the U.S. 404 individual permits require a NEPA impact analysis and a FWCA consultation. Section 404 permits in Arizona are administered by the Los Angeles District of the Army Corps of Engineers. More information can be found at https://www.spl.usace.army.mil/Missions/Regulatory/Jurisdictional-Determination/Section-404-of-the-Clean-Water-Act/.

Arizona Game and Fish Department Regulations

Arizona state statutes have been established to conserve, protect, restore, and enhance fish and wildlife populations and their habitats. It is recommended that project proponents are familiar with these statutes to ensure their projects are consistent with the intent of these laws. Violation of these laws can result in criminal prosecution and/or civil liability.

- Pursuant to A.R.S. § 17-102, wildlife is the property of the state and can be taken only as authorized by the Arizona Game and Fish Commission.
- "Wildlife" is defined in A.R.S. § 17-101(A)(22) as "all wild mammals, wild birds, and the nest or eggs thereof, reptiles, amphibians, mollusks, crustaceans, and fish, including their eggs or spawn."
- "Take" is defined in A.R.S. § 17-101(A)(18) as "pursuing, shooting, hunting, fishing, trapping, killing, capturing, snaring or netting wildlife or the placing or using of any net or other device or trap in a manner that may result in the capturing or killing of wildlife."
- A.R.S. § 17-235 authorizes the Arizona Game and Fish Commission to regulate the taking of migratory birds in accordance with the MBTA.
- Under A.R.S. § 17-236(A), "it is unlawful to take or injure any bird or harass any bird upon its nest, or remove the nests or eggs of any bird, except as may occur in normal horticultural and agricultural practices and except as authorized by commission order."
- No state or federal lands can be closed to hunting or fishing without the consent of the Arizona Game and Fish Commission, and no person may lock a gate blocking access to state lands pursuant to A.R.S. § 17-304 and Arizona Administrative Code R12-4-110. Permittees should contact the AZGFD Ombudsman at AZGFD Headquarters for information regarding filing a petition with the Arizona Game and Fish Commission where a project requires the closure of state or federal lands to hunting or fishing.

Other State Regulations

- The Native Plant Law, A.R.S. § 3-901-907 is administered by the Arizona Department of Agriculture (AZDA). The law lists plants protected under the law. Information on protected plants and permitting procedures can be found at the AZDA website https://agriculture.az.gov/plantsproduce/native-plants.
- State Water Laws are administered by the Arizona Department of Water Resources (ADWR). A.R.S. §45-152 establishes the need and procedure for obtaining a permit to appropriate surface water. A.R.S. Title 45 Chapter 2 establishes groundwater code. The type of well drilling permit required to use groundwater depends on location.
- The Arizona Department of Environmental Quality (ADEQ) issues approvals, certifications and general and individual permits through its three divisions: Air Quality, Waste Programs and Water Quality. Because of the individual nature of each project it is recommended that project proponents work with ADEQ to determine which permits are required. https://legacy.azdeq.gov/function/permits/renew.html

Appendix D: Guidance for CSP Solar

Solar tower CSP facilities impact avian wildlife through exposure of concentrated solar energy. Surrounding mirrors (heliostats) reflect sunlight towards the central receiver tower, and temperatures of the focused rays can reach as high as 800°F (Kagan et al. 2014). Birds flying through these flux fields can experience feather and soft tissue damage, collisions, and even death (Kagan et al. 2014). Even when birds survive exposure, damage to the feathers and soft tissues greatly affects the bird's flight and foraging abilities.

Many of the BMPs and conservation measures described within this document are also applicable to CSP solar facilities. Project proponents are encouraged to reach out to the AZGFD to obtain site-specific recommendations for their CSP project. Steps on how to initiate the coordination process can be found in Section 1.1. The following general measures are provided to help reduce impacts to wildlife and habitat at CSP facilities:

Evaporation Ponds at Concentrating Solar Facilities

Arizona's wildlife is highly dependent on any available surface water. Wildlife, especially waterfowl, are attracted to any form of open water, even evaporation ponds associated with concentrated solar power, which could lead to inadvertent poisoning due to concentrated salt and other minerals, or accidental drowning. Therefore, the AZGFD has the following recommendations regarding brine ponds toxic to wildlife:

- Locate ponds in an area undesirable to wildlife, such as high use/highly disturbed areas.
- Ponds can be fenced on the perimeter and the top screened to prevent unsuitable and possibly fatal use by wildlife.
- If screening is not feasible, create steep pond sides to minimize shallow areas that would be used by wading birds. Ensure that the perimeter is fenced to prevent species from entering the pond and being unable to exit.
- Monitor ponds for wildlife mortality and have a contingency plan for wildlife mortality incidents. If waterfowl die-off is observed, it is recommended that the AZGFD and the USFWS are contacted as soon as possible.
- Monitoring the toxicity of the ponds over time is recommended along with a remediation plan ready for implementation when toxicity levels rise. It is recommended that this plan includes short term and long term measures to deter wildlife from the area.

Reducing Hazardous Materials

More hazardous materials are associated with concentrated solar energy facilities compared to PV solar. These materials include heat transfer fluids (i.e., oils), molten salts, and coolants. Most hazardous materials can be contained through facility design, emergency planning, prudent operating practices, and proper disposal. CSP facilities typically require development of a Spill Prevention, Control, and Countermeasure (SPCC) Plan in accordance with 40 CFR Part 112.

Post Construction Mortality Monitoring

The AZGFD recommends that all solar tower CSP facilities conduct post construction wildlife mortality monitoring. Recommendations for monitoring design and frequency can be found in the USGS's 2016 Mortality Monitoring Design for Utility-Scale Solar Power Facilities. The AZGFD recommends that the site is surveyed for carcasses for a minimum of one year following construction, and up to three years if warranted by monitoring results. Any avian injuries/fatalities should be reported both to the AZGFD (PEP@azgfd.gov) and the USFWS by using the USFWS Injury and Mortality Reporting website. Project proponents are also encouraged to submit carcasses to the Renewables-Wildlife Solutions Initiative, which is a program developed by USGS that collects and catalogs deceased wildlife found at renewable energy facilities to better understand population-level impacts and species vulnerability. Coordination with the AZGFD is encouraged to support the development of effective monitoring plans and adaptive management measures.

Appendix E: Research Needs

All recommendations and procedures presented in these guidelines are based on current scientific understanding of the best ways to avoid and minimize effects to wildlife. The following research needs are intended to build upon current knowledge to refine the AZGFD's recommendations for future solar energy projects. These research needs provide a framework for the AZGFD, project proponents, and other entities to collaborate as opportunities present themselves.

To evaluate the research needs below, obtaining both pre- and post-construction data is necessary. Project proponents are encouraged to work with the AZGFD to assess the most immediate need relative to the specific project/area and to discuss methodologies.

Localized Habitat Quality Impacts

The development and operation of solar facilities may have impacts on the quality of habitat present at and adjacent to the project site (e.g. introduction of invasive species, noise, artificial lighting, and dust). Further research is needed to understand the extent of these impacts. Outlined below are research needs focused on addressing the effects of solar facility construction and operation on habitat quality:

- Assess the effective avoidance distance outside of the facility fence line.
    - How do edge effects relate to different taxa?
    - How far do edge effects extend?
    - What effect do different facility components have on edge effects?
- Assess the behavior and survival for smaller wildlife species that are able to access the facility before and after construction.

Habitat Fragmentation/Connectivity

The construction of a utility scale solar facility can impact habitat connectivity due to the size and position of its components as well as the anthropogenic disturbances that occur during construction and operation. Research questions regarding the effects of utility scale solar facilities on wildlife movement and design features that retain connectivity are listed below:

- Determine what corridor designs are most functional for different groups of species:
    - Evaluate the tolerance of different groups of species to different corridor dimensions.
    - Determine corridor interval needed to facilitate wildlife permeability based on facility size and landscape context.
    - Determine how corridor design features (e.g., fence type, buffers, screening, etc.) affect wildlife passage.
    - Evaluate how wildlife utilization of the landscape is affected by comprehensive exclusion (contiguous fencing of the entire installation) versus component exclusion (islands of fenced panel array blocks).

- Conduct multi-species movement studies within a variety of habitat assemblages that are considered high-value for solar across the state to assess the effectiveness of implemented conservation measures. Pre-construction data in anticipation of future development would also be valuable to allow for pre- and post-construction assessments across the state.
    - For example, an AZGFD project was developed in coordination with the BLM to assess Sonoran pronghorn, mule deer, bobcat, and kit fox movement in relation to proposed, under construction, and completed solar facilities in lower Sonoran desert scrub.
    - Other areas of interest within the state might include the Sky Islands, grasslands, and high elevation forested habitat.
- Determine the most effective fence permeability designs (e.g. dimensions of cutouts, raised fence heights, etc.) that facilitate wildlife movement through the facility for different target species.

Species-Specific Research Needs

Some species habitats overlap with areas that are often selected for solar development within Arizona. As a result, these species may be more susceptible to habitat loss and reduced connectivity. Below are key research needs aimed at improving conservation strategies for species frequently affected by solar development:

- Determine the functional size of habitat blocks for species that are impacted by solar development to inform buffer distances. For example, Bendire's and LeConte's thrashers use large intermittent washes for movement. Additionally, these washes are a key element in their winter and breeding territories. A specific use and size of breeding territories needs to be identified to further refine recommendations for buffer distances around washes.
- Assess the movement and long-term survival of on-site and translocated kit foxes, burrowing owls, desert tortoises, prairie dogs, and other species vulnerable to displacement.
    - Evaluate survival of individuals relative to different translocation and exclusion strategies relative to individual survival.
    - Assess the population level effects on species displaced through exclusion or translocation.
- Assess the impact of solar development on various desert species whose habitats frequently overlap with these projects, specifically for those which limited research exists. This includes species such as desert quail (e.g., Gambel's quail and scaled quail), cottontails, jackrabbits, and kangaroo rats.

Effects of Polarized Light Reflection off Panels on Wildlife ("Lake Effect")

As mentioned in Section 1.2, The "lake effect" hypothesis suggests that some birds are attracted to photovoltaic solar facilities because polarized light reflected from the panels creates an optical

illusion of water. Although studies suggest that this illusion may contribute to the fatalities of some water-obligate avian species in the desert southwest, further research needed to understand the mechanisms behind the "lake effect", quantify avian fatalities at solar facilities, and develop conservation strategies to reduce these impacts (Diehl et al. 2024). Listed below are research needs to address these information gaps:

- Determine what specific features draw avian species to solar facilities and result in collisions.
- Determine if temporal factors (i.e. time of day or year) influence frequency of bird fatalities at solar facilities.
- Assess how different factors (e.g., size of the facility, spacing between the panels, and tilting of the panels) may influence bird fatalities at the facility.
- Determine if the placement of solar panels next to or above water sources (such as canals) results in increased fatality rates at solar facilities.

Vegetation Management and Restoration

Proper vegetation management procedures at solar facilities can help increase biodiversity, reduce the risk of invasive plant introduction, and avoid disruption to a wide range of native Arizona species. Below are some key research needs in relation to vegetation management:

- Determine the most effective seeding and revegetation practices in desert southwest.
- If native habitat is maintained by mowing instead of grading, determine what native pollinator species are persisting within the solar facility.
- Assess the effects of solar panel height on plant growth.

Transmission Lines and Substations

Bird fatalities can occur due to collisions with, or electrocutions by, power lines that transfer generated energy from utility scale solar facilities to the electrical grid. Additional research is necessary to understand the cumulative impact of these incidents and to explore methods for reducing the risk of collisions and electrocutions for various species. Below are some identified research needs related to transmission lines and substations:

- Assess the population level impacts of transmission line collisions on avian species. Sandhill cranes are particularly of concern due to their tendency to fly at low altitudes during their daily movements.
- Evaluate the effectiveness of existing practices and identify opportunities to improve measures to avoid transmission line collisions and electrocutions,especially for non-raptor species like sandhill cranes.

Decommissioning

Impacts of the solar facility decommissioning process on wildlife in the desert southwest remain unresearched. Research into wildlife interactions at a decommissioned site would allow agencies such as the AZGFD to provide refined recommendations for decommissioning practices. Listed below are some of these key research needs:

- Assess the long-term effects of decommissioning on species composition and diversity at the site.
- Assess how quickly wildlife move back into the area after decommissioning and/or habitat restoration.

Cumulative Landscape-level Effects

Many cumulative impacts to species, populations, landscapes, and habitats resulting from solar development in Arizona are unknown. Project proponents are encouraged to share data collected during wildlife and habitat surveys as it can help inform wildlife agencies by expanding knowledge of local populations of wildlife, their movement, and a variety of other parameters. Project proponents are also encouraged to make electronic data depicting their general property boundaries available as well, so that it can help inform an overall understanding of the size and location of development projects in the region.

Providing these data can aid the AZGFD in providing more precise and detailed recommendations to project proponents. The following are some key research needs that shared data could assist with:

- Evaluate the cumulative effects of habitat loss on individual species.
- Evaluate the cumulative effect of solar installations and other infrastructure on landscape integrity and related wildlife permeability.