United States Department of the Interior
Bureau of Land Management

Scoping Report

Gemini Solar Project (N-84631)
DOI-BLM-NV-S010-2018-0051-EIS

Las Vegas Field Office

U.S. Department of Interior
Bureau of Land Management
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BUREAU OF LAND MANAGEMENT

Public Scoping Report

Gemini Solar Project (N-84631)

September 21, 2018

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ACRONYMS

BLM	Bureau of Land Management
BWPC	Bureau of Water Pollution Control
CFR	Code of Federal Regulations
DLAs	Designated Leasing Areas
DOI	Department of the Interior
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
kV	Kilovolt
LADWP	Los Angeles Department of Water and Power
MW	Megawatt
NEPA	National Environmental Policy Act
NOI	Notice of Intent
OHV	Off-Highway Vehicle
PV	Photovoltaic
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right -of-way
VRM	Visual Resource Management

1 INTRODUCTION

1.1 SUMMARY OF PROPOSED ACTION

Solar Partners XI, LLC has filed an application (serial number N-84631) for a right-of-way (ROW) grant to construct, own, operate, and decommission the Gemini Solar Project (Project or Proposed Action). The Project includes the construction, operation, maintenance, and decommissioning of an approximately 7,100-acre photovoltaic (PV) solar project and ancillary facilities that would generate approximately 690 megawatts (MW) of electricity. The project would be located approximately 25 miles northeast of Las Vegas along the Interstate-15, near the Apex Industrial Complex, in Clark County, Nevada. Apex is located approximately 10 miles south of the Project. The elements of the proposed solar energy facility include the solar array, a 34.5-kilovolt (kV) overhead and underground collector line, a two-acre operations and maintenance facility, three substations, internal access roads, a perimeter road, perimeter fencing, an integrated energy storage system (battery system), and water storage tanks for fire protection. A commercially available water source would be utilized during construction via temporary water pipelines or by trucking water onto the site.

Electricity generated by the Project would be interconnected to the NV Energy transmission system via overhead generation tie (gen-tie) lines extending from the Project substations to NV Energy's Crystal Substation, located less than four miles west of the Project site. The gen-tie lines would consist of a 230-kV circuit for delivery of 440 MW to NV Energy Balancing Authority and a 525-kV circuit for delivery of 250 MW to the Los Angeles Department of Water and Power (LADWP). The Project includes construction of the gen-tie lines including new access roads under the lines and improvements to existing NV Energy facilities at Crystal Substation to support interconnection.

All areas of the proposed solar facilities and gen-tie lines are on federal lands administered by the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) Las Vegas Field Office, under the 1998 Las Vegas Resource Management Plan (RMP) (BLM 1998).

To analyze the effects of granting a ROW for the Project, the BLM is preparing an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA). The EIS will also analyze a proposed amendment to the BLM's 1998 Las Vegas RMP to change the Visual Resource Management (VRM) classification of the Project site to a classification compatible with solar development. The EIS will identify, analyze, and disclose potential environmental effects of granting a ROW on federal lands and evaluate an RMP amendment.

1.2 PURPOSE OF PUBLIC SCOPING REPORT

The NEPA process is initiated with scoping. Scoping is an early and open process for determining the extent of issues to be addressed in the EIS and for identifying the significant issues related to the Proposed Action by seeking comments from interested and potentially affected parties including affected member of the public, agencies, tribes, and organizations.

This Public Scoping Report summarizes the public and agency scoping effort and documents the issues and concerns raised by agencies, non-governmental organizations, and individuals during the scoping comment period. The intent of scoping is to obtain feedback in order to focus the analysis in the EIS on significant issues and reasonable alternatives, to eliminate extraneous discussion, and to reduce the length of the EIS. Secretarial Order 3355 requires all EISs to be no more than 150 pages, excluding appendices.

2 SCOPING AND SOLICITATION OF COMMENTS UNDER NEPA

2.1 NOTICE OF INTENT

The formal scoping process begins with publishing a Notice of Intent (NOI) in the Federal Register. The Federal Register is the official federal daily publication for rules, proposed rules, and notices of federal agencies and organizations. The publication of the NOI serves as the official notice that the BLM is commencing preparation of an EIS. On July 13, 2018, in the Federal Register, Volume 83, Number 135, the BLM published the NOI to prepare an EIS for the Gemini Solar Project.

The NOI initiated the 45-day public scoping period for the EIS and described the Project, a proposed Las Vegas RMP amendment, a Notice of Segregation, and the environmental review process. It also identified contact information, the BLM website for the Project, and how comments could be submitted. The comment period began on July 13, 2018, with a request that all comments be received by August 27, 2018.

The NOI for the Project is included as Appendix A.

2.2 PUBLIC AND AGENCY NOTIFICATION

The BLM sent postcards notifying the public, state and local representatives, agencies, and non-governmental organizations of the initiation of the scoping period and the BLM's intent to prepare an EIS. The postcards identified the week that public scoping meetings would be held, the BLM's Project website for specific information on the dates and times of the meetings and Project information, and how to submit comments. A copy of the postcard is included in Appendix B-1.

2.3 NEWS RELEASE

The BLM issued a news release and posted it on the BLM website on July 13, 2018, announcing the Project, public scoping meetings, and requesting comments. The news release was also sent to the BLM Congressional email distribution list and distribution lists for the Expanded State Leadership Team and all Public Affairs Officers within the BLM. A copy of the news release is included in Appendix B-2.

2.4 BLM WEBSITE AND COMMENT METHODS

The BLM posted information on the Project website at https://go.usa.gov/xntTQ. The information posted included the Gemini Solar Project Plan of Development, an announcement of public scoping meetings and copies of the materials presented at the public scoping meetings, how to submit comments, point of contact information, and the official NOI. The BLM invited comments through a variety of methods, including:

- Comments submitted by email
- Comment forms collected at public scoping meetings
- Verbal comments recorded by a court reporter at public scoping meetings
- Comments by mail or fax

Comments were accepted through August 27, 2018.

2.5 PUBLIC SCOPING MEETINGS

The BLM held two open house style public scoping meetings on consecutive nights. The first meeting was held on August 1, 2018, from 5:00 PM to 8:00 PM at the Suncoast Hotel and Casino in Las Vegas (9090 Alta Drive, Las Vegas, NV 89145). The second meeting was held on August 2, 2018, from 5:00 PM to 8:00 PM at the Moapa Recreation and Community Center in Moapa (1340 East State Highway 168, Moapa, NV 89025). The scoping meetings on August 1st was attended by 22 people and the scoping meeting on August 2nd was attended by 2 people. Attendees included representatives from state agencies, organizations, and individuals.

At each meeting, attendees were requested to sign-in (Appendix C-1), were provided a comment form (Appendix C-2), a Speaker Card if they wished to make oral comments at the meeting (Appendix C-3), and a Project information sheet/handout (Appendix C-4). Both meetings followed the same format, with introductions and presentations (Appendix C-5) given at 5:15 PM and 6:15 PM, followed by an open house period where BLM management and staff, the Project Applicant, and the EIS contractor were available to answer questions. Project information, including maps, were provided on poster boards for discussion (Appendix C-6). At 7:00 PM, the public comment period began where each commenter was provided three minutes to provide their comments. A court reporter was available to record comments during the entirety of the public scoping meetings.

2.6 TRIBAL CONSULTATION

BLM invited Native American Tribes to participate in the scoping process for the Project. During the meetings with the Tribes, the BLM requested assistance in identifying any issues or concerns about the Project, including the identification of sacred sites and places of traditional religious and cultural significance that might be affected. BLM conducted government-to-government consultation with 7 tribes in California and Nevada. The BLM traveled to and consulted with the following tribes: Moapa Band of Paiutes, Las Vegas Paiute Tribe, Chemehuevi Indian Tribe, Fort Mojave Tribe, Bishop Paiutes, Timbisha Shoshone Tribe, and Twenty-nine Palms Band of Mission Indians. Most tribes deferred to the Moapa Band of Paiutes for identifying issues and concerns about Gemini Solar Project. The tribe’s concerns have been focused on coordination with the tribe, and on BLM hiring a tribal liaison from the Moapa Tribe. The Twenty-nine Palm Band of Mission Indians stated that the Gemini Solar Project was located on the edge of their historic use area.

2.7 AGENCY COORDINATION

The BLM invited a total of 9 federal, 13 state, and 9 local agencies to serve as cooperating agencies on the Project (Appendix D):

Federal

1. Advisory Council on Historic Preservation
2. Bureau of Indian Affairs – Western Regional Office
3. U.S. Department of Defense, Nellis Air Force Base
4. Environmental Protection Agency
5. Federal Aviation Administration
6. National Parks Service- Pacific West Region
7. National Parks Service- National Trails Intermountain Region
8. U.S. Army Corps of Engineers- Sacramento District
9. U. S. Fish and Wildlife Service-Southern Nevada District Office

State of Nevada

1. Nevada Department of Public Safety – Nevada State Fire Marshal Division
2. Nevada Department of Transportation
3. Nevada Department of Wildlife – Southern Region
4. Nevada Division of Forestry
5. Nevada Division of Environmental Protection
6. Nevada Division of Minerals
7. Nevada Division of Water Resources
8. Nevada Governor's Office
9. Nevada Governor's Office of Economic Development
10. Nevada Governor's Office of Energy
11. Nevada State Clearinghouse
12. Nevada State Historic Preservation Office
13. Public Utilities Commission of Nevada

Clark County

1. Board of Commissioners
2. Comprehensive Planning
3. Department of Air Quality
4. Desert Conservation Program
5. Fire Department
6. Health District Air Pollution Control Division
7. Public Works Department

8. Regional Flood Control District
9. Department of Aviation

As of August 27, 2018, 14 eligible agencies have accepted cooperating agency status on the Project, as shown below. Others may be added to the list at the time of the Draft EIS.

1. U.S. Department of Defense, Nellis Air Force Base
2. Environmental Protection Agency
3. National Parks Service- Pacific West Region
4. National Parks Service- National Trails Intermountain Region
5. U.S. Army Corps of Engineers- Sacramento District
6. U. S. Fish and Wildlife Service-Southern Nevada District Office
7. Nevada Department of Wildlife – Southern Region
8. Nevada Division of Forestry
9. Nevada State Clearinghouse
10. Nevada State Historic Preservation Office
11. Board of Supervisors
12. Clark County Comprehensive Planning
13. Clark County Department of Air Quality
14. Clark County Department of Aviation

3 SUMMARY OF COMMENTERS

3.1 INTRODUCTION

This section summarizes and characterizes the list of commenters that submitted comments during the scoping period and the number of comments received. Comments were received from federal and state agencies, non-governmental organizations, and individuals. Comments were received by email, on comment forms, and as verbal comments at the public scoping meetings. The transcripts from the public scoping meetings are provided in Appendix E-1, comments from government agencies are presented in Appendix E-2, comments from non-governmental organizations are presented in Appendix E-3, and comments from individuals are presented in Appendix E-4. The comments were reviewed to identify significant issues to be addressed in the EIS and possible Las Vegas RMP amendment. The key issues are discussed in Section 4 of this report.

3.2 IDENTIFICATION OF COMMENTERS AND NUMBER OF COMMENTS RECEIVED

3.2.1 List of Commenters

A total of 34 emails and letters, written scoping meeting comments, and verbal comments were received. Table 1 identifies all comments received. Table 2 summarizes the format of comments received, while Table 3 summarizes the number of comments by affiliation.

Table 1 Comments Received During Public Scoping Period

Commenter	Date
Government Agencies	
Environmental Protection Agency (EPA), Region 9 (Ann McPherson)	August 27, 2018
Nevada Division of Forestry (Gary Reese)	August 1, 2018[1] August 1, 2018
Nevada Department of Wildlife, Southern Region (Brad Hardenbrook)	August 21, 2018
Nevada Division of Environmental Protection, Bureau of Water Pollution Control	August 1, 2018
Southern Nevada Water Authority	August 13, 2018

3 SUMMARY OF COMMENTERS

Commenter	Date
Non-Governmental Organizations	
Robert Adams (American Motorcycle Association, Motorcycle Racing Association of Nevada)	August 1, 2018 August 2, 2018
Laura Cunningham (Western Watersheds Project)[2]	August 27, 2018
Alex Daue (The Wilderness Society)	August 27, 2018
Patrick Donnelly (Center for Biological Diversity)	August 26, 2018
Kevin Emmerich (Basin and Range Watch)	August 1, 2018[3] August 1, 2018 August 26, 2018
Pasha Feinberg (Defenders of Wildlife)	August 27, 2018
Daryl Folks (Trac-On Off Road Rides and Tours, Best in the Desert Racing Association, Mohave Southern Great Basin Resource Advisory Counsel, Motorcycle Racing Association of Nevada)	August 27, 2018
John Hiatt (Red Rock Audubon Society)	August 1, 2018 August 27, 2018
Edward LaRue (Desert Tortoise Council, Ecosystems Advisory Committee)	August 25, 2018
Individuals	
Donna Andress	July 16, 2018
Scott Brooks	July 27, 2018
Andrew Church	August 21, 2018
Ken Freeman	July 23, 2018
Jared Fuller	August 22, 2018
Robert Glover	August 1, 2018
Josh Hawkins	July 14, 2018
Hermi Hiatt	August 1, 2018
Alex Hughes	August 21, 2018
Mark Lichtenfeld	July 22, 2018
Jean Publiee	July 12, 2018
Escalante Slim	July 26, 2018
Richard Spotts	July 30, 2018
Tim V.	August 24, 2018
Lynn Wilson	July 23, 2018

Notes:
1,3 Both a verbal and written comment were provided at the August 1 Scoping Meeting
2 This is a joint comment letter with Kevin Emmerich (Basin and Range Watch), which is also listed

Table 2 Format of Scoping Comments

Format	# Received	Percent
Letter/Email	27	79%
Comment Form	2	6%
Verbal Comment	5	15%
TOTAL	**34**	**100%**

Table 3 Comments by Commenter Affiliation

Affiliation	# Received	Percent
Government	6	18%
Federal	*1*	*3%*
State	*5*	*15%*
Non-Governmental Organizations	13	38%
Individuals	15	44%
TOTAL	**34**	**100%**

3.2.2 Federal and State Agencies

Comments from federal and state agencies included the Environmental Protection Agency (EPA); Nevada Division of Forestry; Nevada Department of Wildlife; and Nevada Division of Environmental Protection, Bureau of Water Pollution Control (BWPC), and Southern Nevada Water Authority. The agencies raised issues concerning impacts to threecorner milkvetch and the desert tortoise population and habitat. Commenters requested information and analysis of cultural resources within the Project area, and for other resources such as hazards and hazardous materials, air quality, water resources and water sources, and visual resources. The need for a reasonable range of alternatives and detailed purpose and need were also included in the comments. Additional information on issues raised during the scoping period are provided in Section 4.

3.2.3 Non-Governmental Organizations

Non-governmental organizations that provided comments included:

- American Motorcycle Association, Motorcycle Racing Association of Nevada
- Western Watersheds Project
- The Wilderness Society
- Center for Biological Diversity
- Basin and Range Watch
- Defenders of Wildlife

- Trac-On Off Road Rides and Tours, Best in the Desert Racing Association, Mohave Southern Great Basin Resource Advisory Counsel, Motorcycle Racing Association of Nevada (submitted together as one commenter)
- Red Rock Audubon Society
- Desert Tortoise Council, Ecosystems Advisory Committee

These non-governmental organizations raised issues concerning the protection of biological resources, specifically desert tortoise and threecorner milkvetch. They also raised issues concerning the viewshed of the Project site, particularly as viewed from the Muddy Mountains. Concerns over the proposed amendment for the VRM class were also received. The non-governmental organizations expressed the need for a range of alternatives to be analyzed. Other comments requested protection of recreational uses, such as off-highway vehicle (OHV) use, in the Project area. Additional information on issues raised during the scoping period are provided in Section 4.

3.2.4 Individuals

Comments from individuals included landowners, businesses, and other interested individuals. Their comments focused on the loss of desert plants and animals, including threecorner milkvetch and desert tortoise. They raised concerns over the Project's visibility; cumulative impacts from the numerous solar projects in the area; and closure of trails for hikers, mountain bikers, OHV uses, and users of the Old Spanish Trail. Several commenters stressed the importance of considering alternatives, including rooftop solar and distributed generation. Additional information on issues raised during the scoping period are provided in Section 4.

4 ISSUES RAISED DURING SCOPING

4.1 OVERIVEW OF ISSUES RAISED

This section of the Public Scoping Report summarizes the various issues raised in the comments submitted by agencies, non-governmental organizations, and individuals during the scoping process. The comments focused on the Project's potential effects to environmental resource topics covered in EISs. The comments could be categorized into the following topics:

1. Project Description
2. Human environment issues
3. Natural environment issues
4. Indirect and cumulative impacts
5. Project alternatives
6. EIS administrative and permitting issues

Table 4 identifies the number of comment letters that mentioned each of the key environmental topics. Non-substantive comments are those that expressed an opinion with no supporting information. One commenter was in favor of the Project, stating the Project should be approved. Four commenters clearly stated that the Project should not be approved. The remaining 29 documents expressed a range of concerns over environmental impacts from the Project. The highest number of comments received raised concerns regarding biological resources with 19 documents addressing these issues. Comments addressing alternatives were next highest with 15 documents, followed by 10 documents addressing visual resource impacts, eight documents addressing the Old Spanish National Historic Trail, and eight documents addressing recreational uses.

Table 4 Number of Comment Letters/Forms/Verbal Comments Addressing Key Topics

Topic	# of Letters/Forms/Verbal Comments Including the Topic[1]	Percent of Total Letters that Mentioned the Topic[2]
Project Description and Purpose and Need	7	21%
Human Environment		
Visual Resources	10	29%
Cultural Resources	4	12%
Old Spanish National Historic Trail	8	24%

Topic	# of Letters/Forms/Verbal Comments Including the Topic[1]	Percent of Total Letters that Mentioned the Topic[2]
Land Use	4	12%
Hazard and Hazardous Materials	2	6%
Recreation	8	24%
Socioeconomics and Environmental Justice	3	9%
Natural Environment		
Biological Resources	19	56%
Water Resources	5	15%
Air Resources	4	12%
Cumulative Impacts	5	15%
Alternatives	15	44%
Mitigation	5	15%
EIS Administrative and Permitting Issues	5	15%
Issues Outside the Scope of the EIS	4	12%

[1] Note that most commenters addressed multiple topics in one letter/email or verbal comment, resulting in a count well over the 34 total comment documents received (or recorded in the case of verbal comments).

[2] Percent is the number of letters mentioning the topic out of 34 letters received.

4.2 PROJECT DESCRIPTION AND PURPOSE AND NEED

Several commenters expressed concerns regarding the proposed location of the Project, particularly that it is located on relatively undisturbed land within the Mojave Desert. Many of these commenters noted that the Project could have significant impacts on biological, visual, cultural, and recreational resources due to the location of the site. One individual/organization asked for an explanation as to why the Project is in a variance area rather than a designated solar energy zone, as identified in the Solar Energy Development Programmatic Environmental Impact Statement (Solar PEIS).

Various individuals submitted comments regarding the purpose and need. Comments stated that the purpose and need for the Project should include the broader public purpose of advancing solar energy generation and that the purpose and need should include the protection of natural resources. The EPA indicated that the EIS should clearly identify the underlying purpose and need for the Project in the context of the larger energy market that the Project would serve.

4.3 HUMAN ENVIRONMENT ISSUES

4.3.1 Visual Resources

Several commenters expressed concerns about the visual impact that would occur as a result of the Project. Several comments specifically expressed concerns over the impacts the Project would have to the viewshed from the Muddy Mountains Wilderness Area.

Several individual/organization comments expressed concerns about the proposed amendment to the 1998 RMP to revise the VRM designation for the Project area, including Basin and Range Watch and Western Watersheds Project. These organizations suggested that the BLM should wait to review the Project until the updated RMP is completed. The EPA indicated that the EIS should discuss the status of the proposed RMP amendment and provide illustrations showing the current VRM and proposed changes. The EPA also indicated that careful attention should be given to how solar arrays are positioned against the landscape, to minimize visual impacts.

Concerns over site lighting were expressed by one individual and use of off-site monitoring of infra-red cameras or motion sensors was suggested.

4.3.2 Cultural Resources

Two commenters expressed concerns about the historic (former alignment) of the Arrowhead Highway. The commenters stated that the cultural resource must be identified through cultural surveys and shown on project drawings. The commenters also stated that the resource should also be included in a preservation plan. EPA noted that the EIS should address impacts to cultural and Native American resources.

4.3.3 Old Spanish National Historic Trail

Various individual/organization comments expressed concerns related to impacts to the Old Spanish National Historic Trail. Various comments called for protection by the BLM and preservation plans for the trail. EPA included a similar comment and indicated that the EIS should evaluate impacts to the Old Spanish National Historic Trail. Several commenters requested that the EIS address the changes to the user experience of the Old Spanish Trail once the Project is built.

4.3.4 Land Use

The Wilderness Society indicated that the BLM should focus on designation of new Designated Leasing Areas (DLAs) and should not develop outside these DLAs. They also commented that the Project area may contain wilderness characteristics that must be inventoried and analyzed as part of the NEPA process.

The Desert Tortoise Council commented that the EIS should include an analysis for compliance with the 1998 RMP and analysis for compliance with Federal Land Policy and Management Act, with regards to desert tortoise.

4.3.5 Hazards and Hazardous Materials

The EPA indicated that the EIS should discuss impacts related to waste generation, including hazardous waste, and the proposed battery storage facilities. Details on waste types, volumes, disposal, and management should be included, as well as discussion of pesticide use. The Desert Tortoise Council indicated that the EIS should include a fire prevention plan and should address fire hazards related to battery storage.

4.3.6 Recreation

Several commenters expressed concerns about the closure of OHV trails and reduced public access at the Project site. Commenters requested that existing trails in the area should remain open and OHV recreation should be protected. One individual commenter asked about a mitigation plan for the loss of OHV recreational use. Another individual/organization proposed specific changes to the Project's development areas to minimize impacts to OHV recreational use.

4.3.7 Socioeconomics and Environmental Justice

The EPA indicated in their comment letter that the EIS should assess impacts to local communities and should address the potential for disproportionate adverse impacts to minority and low-income populations. Two comments discussed concerns over impacts to tourism due to restricted public access at the Project site once built, which could impact the economics of the region.

4.4 NATURAL ENVIRONMENT ISSUES

4.4.1 Biological Resources

Many commenters expressed concerns over the destruction of Mojave Desert plant and animal habitat and specifically, desert tortoise habitat. One comment indicated that translocation of desert tortoise cannot substitute for avoidance or preservation of habitat. Several commenters also expressed concerns over impacts to threecorner milkvetch and their habitat, including the Nevada Division of Forestry. Impacts to other species, including burrowing owl, bighorn sheep, gila monster, bats, kit fox, and microphyll woodlands were expressed in several comments. Comments were also received requesting that Land with Wilderness Characteristics be identified and protected and that the area should be evaluated as an Area of Critical Environmental Concern.

Various comments were submitted regarding impacts to birds that may crash into the solar panels due to "lake effect."

In their comment letter, the EPA expressed concern over the following biological topics that should be discussed in the EIS: cryptobiotic soil crusts; impacts to rare plants and vegetation management, including pesticide use and fencing; invasive species; desert tortoise habitat; impacts to birds related to lake effect; and impacts to protected species and habitat.

The Nevada Department of Wildlife, Southern Region, expressed concerns regarding the desert tortoise population and indicated they expect the EIS to address the anticipated impacts to desert tortoise and other species of conservation priority.

The Nevada Division of Forestry as well as other individuals and non-government organizations also commented on concerns over impacts to the habitat and known occurrences of the rare and state endangered threecorner milkvetch. The Nevada Division of Forestry stated that the population on Site F may be the second largest population in the state and that the Project applicant should consult with Nevada Division of Forestry for a state endangered species permit.

4.4.2 Water Resources

The BWPC provided a comment indicating that the project may be subject to BWPC permitting.

In their comment letter, the EPA indicated that the following water resource issues should be discussed in the EIS: information on Clean Water Act Section 303 (d) impaired waters, impacts of changing precipitation patterns as it relates to stormwater management, phased approach to grading and removal of vegetation, placement of solar panels to minimize erosion, quantity and source of water for construction and operation, and impacts to waters of the U.S. and desert washes. Another individual/organization's comment discussed impacts to ephemeral steams and washes and water use during construction and operation of the Project.

Southern Nevada Water Authority and several other commenters noted that the EIS should address sources of water for construction and operation, particularly if groundwater is used.

An individual/organization indicated that the EIS should include analysis of impacts from increased runoff from solar panels.

4.4.3 Air Resources

An individual commenter expressed concerns about use, containment, and removal of dust control chemicals over the life of the Project.

The EPA indicated that the EIS should provide a discussion of ambient air conditions and impacts to air quality and should provide mitigation measures to minimize effects related to greenhouse gas, fugitive dust, and other emissions. The EPA and an individual commenter both indicated the EIS should address potential impacts related to exposure to Valley Fever.

4.5 CUMULATIVE IMPACTS

An individual comment requested that the EIS address cumulative impacts with the other solar projects in the vicinity of the Gemini Solar Project. In their comment letter, EPA recommended the EIS consider the cumulative methodology developed by EPA, Federal Highway Administration, and California Department of Transportation. Several commenters expressed the need for the EIS, in general, to assess cumulative impacts.

4.6 PROJECT ALTERNATIVES

Several individuals/organizations submitted comments regarding Project alternatives. The comments generally requested that the EIS include a range of alternatives to ensure that the full spectrum of alternatives to the proposed Project are fully considered and evaluated.

Various commenters specified rooftops (residential and hotels), other developed areas, previous disturbed/damaged land, and various smaller sites as alternative locations for building the Project. Another commenter indicated that County land, state land, or private land should be used to build the Project, rather than federal land.

The Center for Biological Diversity commented that the EIS should consider alternatives that avoid high density desert tortoise populations and areas important for desert tortoise connectivity. A reduced Project footprint and off-site alternatives in developed/disturbed areas should also be considered. The EPA indicated that the EIS should include a reasonable range of alternatives that meet the stated purpose and need, including options for avoiding environmental impacts.

4.7 MITIGATION

The Wilderness Society commented that the BLM must seek ways to avoid, minimize and offset impacts and include requirements for doing so in the EIS, including compensatory mitigation. They commented that development should follow mitigation hierarchy of avoiding, minimizing, and mitigating impacts. Defenders of Wildlife commented that any compensatory mitigation offered by Project proponents should be accepted by BLM to maintain tortoise populations in the region. They also indicated that development should follow mitigation hierarchy of avoiding, minimizing, and mitigating impacts.

4.8 EIS ADMINISTRATIVE AND PERMITTING ISSUES

Western Watersheds Project and Basin and Range Watch both expressed concerns that the scoping meetings did not provide adequate information about the Project site to allow for meaningful comments. They also indicated that the comment period should have been 90 days, instead of 45, as was done for other large proejcts in the area. The Wilderness Society indicated that the scoping period should be extended by 45 days due to the potential change of the Project area, indicated by the developer, which was not identified during the scoping meetings.

The Desert Tortoise Council commented that the NOI should be reissued to clarify why there is a need to segregate 44,000 acres for a 7,200-acre project.

4.9 ISSUES OUTSIDE THE SCOPE OF THE EIS

One comment was received that noted support for the development of the Project. One commenter suggested revising the City's building standards to include options for energy saving windows and construction practices.

One individual commented that the EIS should include an explanation of the economic analysis/cost-benefit analysis of the alternatives to justify why solar farms are built on remote locations on BLM lands. A comment was submitted expressing concerns about the impact to wild horses.

5 NEXT STEPS IN THE NEPA PROCESS

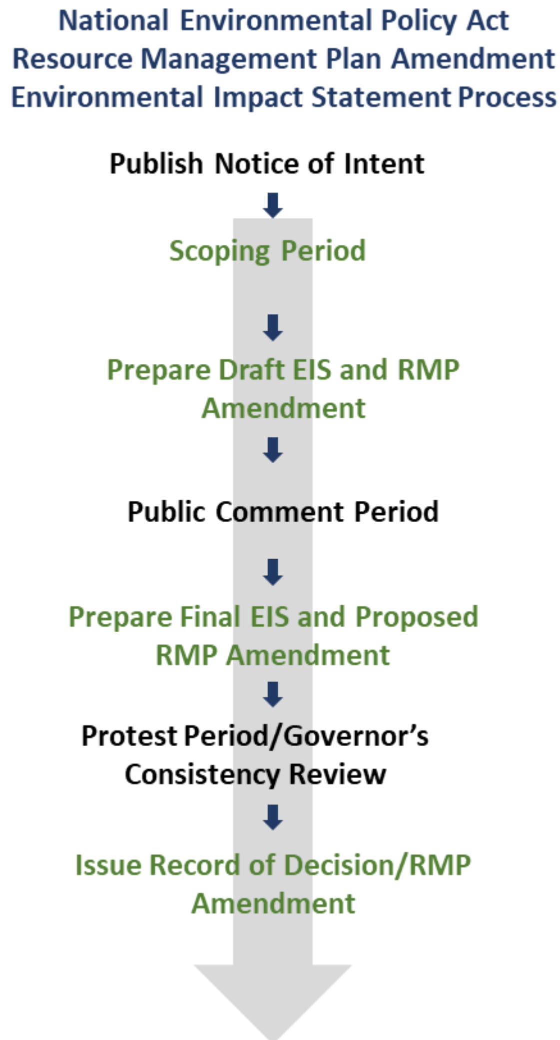
Substantive comments received during the scoping period will be considered during the preparation of the Draft EIS; however, not all comments will be considered.

An important part of the environmental planning process is engaging the public and relevant agencies from the earliest stages of and throughout the planning process to address issues, comments, and concerns. Figure 1 provides a summary of the EIS (NEPA) processes. Although the BLM welcomes public input at any time during the environmental analysis process, the next official public comment period will begin when the Draft EIS is published. The Draft EIS will be made available to all members of the public, agencies, and tribes. The availability of the Draft EIS will be announced via a Notice of Availability in the Federal Register and a 90-day public comment period will follow. Public meetings will be held during the comment period at the same locations as the public scoping meetings.

At the conclusion of the public comment period, the Draft EIS will be revised, followed by publication of the Final EIS. The availability of the Final EIS will be announced in the Federal Register. The date the notice appears in the Federal Register initiates the required 30-day availability period and 60-day Governor's Review. Although the 30-day availability period is not a formal public comment period, the BLM may receive comments. If there are comments on the Final EIS, the BLM will determine if they have merit (for example, if the comments identify significant new circumstances or information relevant to environmental concerns and bear upon the Proposed Action or if the comments note a correction to be addressed). Any comments received may be addressed in the Record of Decision (ROD).

The BLM will prepare the ROD to document the selected alternative and any accompanying mitigation measures. The ROD will be signed by the authorizing officer. No action concerning the proposal may be taken until the ROD has been issued, except under conditions specified in Council of Environmental Quality regulations (40 CFR § 1506.1).

Figure 1 NEPA Process Flowchart



APPENDIX A

Notice of Intent

contained on electronic media are degaussed or erased in accordance with 384 Departmental Manual 1 and NARA guidelines.

ADMINISTRATIVE, TECHNICAL, AND PHYSICAL SAFEGUARDS:

The records contained in this system are safeguarded in accordance with 43 CFR 2.226 and other applicable security and privacy rules and policies. During normal hours of operation, paper records are maintained in locked file cabinets under the control of authorized personnel. Electronic records are safeguarded by permissions set to ''Authenticated Users'' which require password login. Computer servers on which electronic records are stored are located in secured DOI controlled facilities with physical, technical and administrative levels of security to prevent unauthorized access to the DOI network and information assets. The computer servers in which electronic records are stored are located in DOI facilities that are secured by security guards, alarm systems and off-master key access. Access to servers containing records in this system is limited to DOI personnel and other authorized parties who have a need to know the information for the performance of their official duties. Data exchanged between the servers and the system is encrypted. Backup tapes are encrypted and stored in a locked and controlled room in a secure, off-site location.

Computerized records systems follow the National Institute of Standards and Technology privacy and security standards as developed to comply with the Privacy Act of 1974, 5 U.S.C. 552a; Paperwork Reduction Act of 1995, 44 U.S.C. 3501–3521; Federal Information Security Modernization Act of 2014, 44 U.S.C. 3551–3558; and the Federal Information Processing Standards 199: Standards for Security Categorization of Federal Information and Information Systems. Security controls include user identification, passwords, database permissions, encryption, firewalls, audit logs, and network system security monitoring, and software controls. Access to records in the system is limited to authorized personnel who have a need to access the records in the performance of their official duties, and each user's access is restricted to only the functions and data necessary to perform that person's job responsibilities. System administrators and authorized users are trained and required to follow established internal security protocols and must complete all security, privacy, and records management training and sign the DOI Rules of Behavior.

RECORD ACCESS PROCEDURES:

An individual requesting records on himself or herself should send a signed, written inquiry to the applicable System Manager identified above. The request must include the specific bureau or office that maintains the record to facilitate location of the applicable records. The request envelope and letter should both be clearly marked ''PRIVACY ACT REQUEST FOR ACCESS.'' A request for access must meet the requirements of 43 CFR 2.238.

CONTESTING RECORD PROCEDURES:

An individual requesting corrections or the removal of material from his or her records should send a signed, written request to the applicable System Manager as identified above. The request must include the specific bureau or office that maintains the record to facilitate location of the applicable records. A request for corrections or removal must meet the requirements of 43 CFR 2.246.

NOTIFICATION PROCEDURES:

An individual requesting notification of the existence of records on himself or herself should send a signed, written inquiry to the applicable System Manager as identified above. The request must include the specific bureau or office that maintains the record to facilitate location of the applicable records. The request envelope and letter should both be clearly marked ''PRIVACY ACT INQUIRY.'' A request for notification must meet the requirements of 43 CFR 2.235.

EXEMPTIONS PROMULGATED FOR THE SYSTEM:

None.

HISTORY:

77 FR 66628 (November 6, 2012).

[FR Doc. 2018–15010 Filed 7–12–18; 8:45 am]

BILLING CODE 4334–63–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[18XL1109AF LLUTG02000 L13100000.DO0000]

Notice of Termination of the San Rafael Swell Master Leasing Plan, Utah

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of termination.

SUMMARY: The preparation of an Environmental Assessment associated with the San Rafael Swell Master Leasing Plan Amendment is no longer required, and the process is hereby terminated. Pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969, as implemented by the Council on Environmental Quality regulations, the Bureau of Land Management (BLM) announced its intent to prepare an EA. The Notice of Intent (NOI) was published in the **Federal Register** on May 18, 2016. The Plan Amendment would have considered modifying oil and gas leasing decisions on approximately 525,000 acres in portion of the Price and Richfield Field Offices in Emery and Wayne Counties, Utah.

DATES: Termination of the planning process for Rafael Swell Master Leasing Plan Amendment takes effect immediately.

FOR FURTHER INFORMATION CONTACT: Chris Conrad, Price Field Manager, 125 South 600 West, Price, Utah 84501, telephone (435) 636–3600, email *cconrad@blm.gov.* Persons who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service (FRS) at 1–800–877–8339 to contact the above individual during normal business hours. FRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: Since the publication of the NOI, the BLM issued Washington Office Instruction Memo 2018–034, which terminates the Master Leasing Process.

Authority: 40 CFR 1506.6, 40 CFR 1506.10.

Edwin L. Roberson,

State Director.

[FR Doc. 2018–15016 Filed 7–12–18; 8:45 am]

BILLING CODE 4310–DQ–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLNVS01000. L51010000.PQ0000. LVRWF09F8730; N–85631; MO#4500119561]

Notice of Intent To Prepare an Environmental Impact Statement and Land Use Plan Amendment, and a Notice of Segregation for the Proposed Gemini Solar Project in Clark County, Nevada

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of intent.

SUMMARY: As requested by Solar Partners XI, LLC, and in compliance with the National Environmental Policy Act of 1969, as amended (NEPA), the Bureau of Land Management (BLM) Las Vegas Field Office intends to prepare an

Environmental Impact Statement (EIS) and land use plan amendment to the 1998 Resource Management Plan (RMP) for the proposed Gemini Solar Project in Clark County, Nevada. Publication of this Notice initiates the scoping process and opens a 45-day public comment period. Publication of this Notice also segregates the public lands from appropriation under the public land laws, including location under the Mining Law, but not the mineral leasing laws or the Materials Act, subject to valid existing rights.

DATES: Written comments must be received by the BLM no later than August 27, 2018. The date(s) and location(s) of any scoping meetings will be announced at least 15 days in advance through local news media and the BLM website at: *https://go.usa.gov/xntTQ.*

Comments must be received prior to the close of the scoping period or 15 days after the last public meeting, whichever is later, to be included in the Draft EIS. The BLM will provide additional opportunities for public participation upon publication of the Draft EIS.

ADDRESSES: You may submit comments by any of the following methods:

- *Email: blm_nv_sndo_geminisolar@blm.gov.*
- *E-planning: https://go.usa.gov/xntTQ.*
- *Fax:* 702–515–5023, Attention: Herman Pinales.
- *Mail:* BLM, Las Vegas Field Office, Attn: Herman Pinales, 4701 North Torrey Pines Drive, Las Vegas, Nevada 89130–2301.

FOR FURTHER INFORMATION CONTACT: For further information, and/or to have your name added to the mailing list, send requests to: Herman Pinales, Energy & Infrastructure Project Manager, at telephone 702–515–5284; address 4701 North Torrey Pines Drive, Las Vegas, Nevada 89130–2301; or email *blm_nv_sndo_geminisolar@blm.gov.* Persons who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service (FRS) at 1–800–877–8339 to contact the above individual during normal business hours. The FRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: In 2017, Solar Partners XI, LLC filed an application with the BLM requesting authorization to construct, operate, maintain, and decommission a 690-megawatt-per-year photovoltaic (PV) solar electric generating facility and associated generation tie-line and access road facilities. The expected life of the project is 30 years. The Solar Partners XI, LLC acquired the original 44,000-acre APEX Solar Thermal Power Generation Facility right-of-way application filed in 2008 by BrightSource Energy, LLC.

The proposed Gemini Solar Project would be located approximately 25 miles northeast of Las Vegas and south of the Moapa River Indian Reservation in Clark County, Nevada.

The proposed Gemini Solar Project includes 7,115 acres of federal lands administered by the BLM. The Visual Resource Management (VRM) class in the Application Area is mostly III and some II (due to proximity to Muddy Mountain Wilderness Area and Bitter Springs Back Country Byway), which will require a land use plan amendment to a class IV in order for the project to be consistent with the land use plan. A VRM class 2 allows for activities with a low level of landscape change; a class III allows a moderate level of change that would not dominate the landscape; and a class IV allows a high level of change that would dominate the landscape.

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including alternatives, and to guide the process for developing the EIS. At present, the BLM has identified the following preliminary issues: Threatened and endangered species, biological resources, visual resources, cultural resources, tribal interests, recreation, and cumulative impacts. The Congressionally-designated Old Spanish National Historic Trail crosses the area. Habitat for the federally listed desert tortoise is also in this proposed area.

The BLM will consult with Native American tribes on a government-to-government basis in accordance with applicable laws, regulations, Executive Order 13175, and other policies. Tribal concerns will be given due consideration, including impacts on Indian Trust assets. Federal, State, and local agencies, along with other stakeholders that may be interested or affected by the BLM's decision on this project, are invited to participate in the scoping process and, if eligible, may request or be requested by the BLM to participate as a cooperating agency.

Segregation of the Public Lands

In 2013, the BLM published a Final Rule, Segregation of Lands—Renewable Energy (78 FR 25204), that amended the regulations found in 43 CFR 2090 and 2800. The provisions of the Final Rule allow the BLM to temporarily segregate public lands within a solar or wind application area from the operation of the public land laws, including the Mining Law, by publication of a **Federal Register** notice. The BLM uses this temporary segregation authority to preserve its ability to approve, approve with modifications, or deny proposed ROWs, and to facilitate the orderly administration of the public lands. This temporary segregation is subject to valid existing mining claims located before this segregation notice. Licenses, permits, cooperative agreements, or discretionary land use authorizations of a temporary nature which would not impact lands identified in this notice may be allowed with the approval of an authorized officer of the BLM during the segregation period. The lands segregated under this notice are legally described as follows:

Mount Diablo Meridian, Clark County, Nevada

T. 17 S., R. 64 E.,
Sec. 10, S½;
Sec. 11, S½;
Secs. 12 and 13;
Sec. 14, N½ and SE¼;
Sec. 15, N½;
Sec. 22, E½;
Secs. 23 thru 26;
Sec. 27, E½;
Sec. 34, E½;
Secs. 35 and 36.
T. 17 S., R. 65 E.
Secs. 7 thru 24;
Secs. 26 thru 35.
T. 17 S., R. 66 E.,
Secs. 7, 18 and 19.
T. 18 S., R. 64 E.,
Secs. 1 and 2;
Sec. 3, lots 5 and 6, S½NE¼, and SE¼;
Sec. 10, E½;
Secs. 11 thru 14;
Sec. 15, E½;
Sec. 22, E½;
Secs. 23 thru 26;
Sec. 27, E½;
Sec. 34, E½;
Secs. 35 and 36.
T. 18 S., R. 65 E.,
Secs. 2 thru 9;
Secs. 16 thru 20;
Sec. 21, N½ and SW¼;
Sec. 30.

The areas described contain 45,165.48 acres, according to the official plats of the surveys and protraction diagrams of the lands on file with the BLM.

As provided in the Final Rule, the segregation of lands in this Notice will not exceed 2 years from the date of publication unless extended for up to 2 additional years through publication of a new notice in the **Federal Register**. Termination of the segregation occurs on the earliest of the following dates: Upon issuance of a decision by the authorized officer granting, granting with modifications, or denying the application for a ROW; automatically at the end of the segregation; or upon publication of a **Federal Register** notice of termination of the segregation.

Upon termination of segregation of these lands, all lands subject to this segregation would automatically reopen to appropriation under the public land laws.

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Authority: 40 CFR 1501.7, 43 CFR 1610.2, 43 CFR 1610.5, 43 CFR 2091.3–1(e), and 43 CFR 2804.25(f)

Gayle Marrs-Smith,

Las Vegas Field Manager.

[FR Doc. 2018–15020 Filed 7–12–18; 8:45 am]

BILLING CODE 4310–HC–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[18XL1109AF LLUTC04000 L13200000.EL0000 UTU 081895]

Notice of Availability for the Alton Coal Tract Coal Lease by Application Final Environmental Impact Statement, Utah

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of availability.

SUMMARY: In accordance with the National Environmental Policy Act of 1969 (NEPA), the Federal Land Policy and Management Act of 1976, and the Mineral Leasing Act of 1920 as amended (MLA), the Bureau of Land Management (BLM) prepared a Final Environmental Impact Statement (EIS) for the Alton Coal Tract Lease by Application (LBA), case number UTU–081895.

DATES: The BLM will not issue a final decision on the proposal for a minimum of 30 days after the date that the Environmental Protection Agency publishes its Notice of Availability in the **Federal Register**.

ADDRESSES: The public may review the Final EIS at the Kanab Field Office, 669 South Highway 89 A, Kanab, Utah 84741, and the BLM Utah State Office Public Room, 440 West 200 South, Suite 500, Salt Lake City, Utah 84101; during business hours, 8 a.m. to 4:30 p.m. (unless otherwise posted), Monday through Friday, except Federal holidays. The Final EIS is available online at: *https://go.usa.gov/xNmE2.*

FOR FURTHER INFORMATION CONTACT: Keith Rigtrup, Planner, telephone: 1–435–865–3000; email: *krigtrup@blm.gov.*

Persons who use a telecommunications device for the deaf may call the Federal Relay Service (FRS) at 1–800–877–8339 to contact the above individual during normal business hours. The FRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: In accordance with 43 CFR 3425, Alton Coal Development, LLC (ACD) submitted an application on November 12, 2004, with the BLM to lease Federal coal near the town of Alton, Utah. The tract identified in the application lies immediately adjacent to an active coal mine operated by ACD on private land.

The BLM provided a 90-day public scoping period at the beginning of the EIS process to identify potential issues and concerns associated with the Proposed Action. The BLM evaluated the scoping comments and used them to develop alternatives to the Proposed Action, to guide the analysis of potential effects from leasing and mining the tract, and to identify potential mitigations for inclusion in the Draft EIS. On November 4, 2011, the BLM published in the **Federal Register** (76 FR 68501–502, November 4, 2011) a Notice of Availability (NOA) of the Draft EIS for public comment. Based on comments received on the Draft EIS, the BLM decided to prepare a Supplemental Draft EIS for public review before preparing and distributing the Final EIS. On June 18, 2015, the BLM published an NOA for the Supplemental Draft EIS in the **Federal Register** (80 FR 34931–932, June 18, 2015). The BLM evaluated and used the comments received on the Draft EIS and the Supplemental Draft EIS to produce this Final EIS.

The Final EIS analyzes and discloses to the public the direct, indirect, and cumulative environmental impacts of issuing a Federal coal lease on the Alton Coal Tract, including mining and transportation of coal to a railhead near Cedar City, Utah, and to the Intermountain Power Plant near Delta, Utah. It includes the BLM's responses to comments received during the extended 90-day public comment period, from June to September 2015, for the Supplemental Draft EIS. It also includes all alternatives considered in the Supplemental Draft EIS, including Alternative K1, the BLM's preferred alternative for this LBA, based on the analysis of the potential impacts of issuing a lease for the Alton Coal Tract.

The Final EIS analyzes three action alternatives: (1) Alternative B: 3,581 acres, 44.9 million short tons (the Proposed Action), (2) Alternative C: 3,178 acres, 39.2 million short tons (wetlands reduction), and (3) Alternative K1: 2,114 acres, 30.8 million short tons. Alternative K1 was developed in response to the pending wetland and sage-grouse issues raised during the public comment period for the Draft EIS. A No Action Alternative is also included in the Final EIS which, if selected, would preclude offering of the lease tract. All action alternatives included a detailed Greater Sage-Grouse Mitigation Plan. The Final EIS also analyzed the No-Action Alternative (Alternative A) that would reject the application to lease Federal coal. Preparation of the Final EIS included Office of Surface Mining Reclamation and Enforcement, National Park Service and Environmental Protection Agency as cooperating agencies.

The Alton Coal Tract includes approximately 44.9 million recoverable tons of in-place bituminous coal underlying the following lands in Kane County, Utah:

Salt Lake Meridian, Utah
T. 39 S., R. 5 W.,
Sec. 7, SE¼SW¼ and S½SE¼;
Sec. 18, lots 3 and 4, E½, E½NW¼, and E½SW¼
Sec. 19, lots 1 thru 4, NE¼, E½NW¼, E½SW¼, N½SE¼, and SE¼SE¼;
Sec. 20, lots 4 and 5, and N½SW¼;
Sec. 30, lots 2 thru 4, SW¼NE¼, SE¼NW¼, E½SW¼, and W½SE¼;
Sec. 31, lots 1 thru 3, NE¼, E½NW¼, NE¼SW¼, and N½SE¼;
T. 39 S., R. 6 W.,
Sec. 12, SW¼ and W½SE¼;
Sec. 13, NW¼NE¼, N½NW¼, SE¼NW¼, and SE¼;
Sec. 24, NE¼, N½NW¼, SE¼NW¼, E½SW¼, N½SE¼, and SE¼SE¼;
Sec. 25, E½NE¼, SW¼NE¼, and SE¼.

The area described, including both public and non-public surface lands, aggregate 3,581.27 Federal mineral acres according to the official plats of the surveys on file with the BLM.

Consistent with NEPA and its implementing regulations and the MLA and its implementing regulations, the BLM must prepare an environmental analysis prior to holding a competitive Federal coal lease sale. An EIS has been prepared for this particular sale. All alternatives have been analyzed and could be offered for sale. If an action alternative is selected in the subsequent ROD, that tract would be offered in a competitive lease sale, and a lease for Federal coal would be issued if the bid

APPENDIX B

Public Scoping Notification Package

APPENDIX B-1

Public Scoping Notification Package

Notification Postcard

The Bureau of Land Management Las Vegas Field Office is seeking public comments on the proposed Gemini Solar Project, which would be located on approximately 7,100 acres of public land 25 miles northeast of Las Vegas, Nevada along Interstate-15, in close proximity to Apex Industrial Park and south of the Moapa River Indian Reservation. The public comment period opened July 13 and will close August 27, 2018. Public scoping meetings will be held the week of July 30, 2018 with a presentation given at 5:15 p.m. followed by an open house where BLM staffers and project proponents will be available to answer questions until 6:15 p.m. At 6:15 p.m., a second presentation (duplicate of first) will be given followed by an open house where BLM staffers and project proponents will again be available to answer questions until 7:00 p.m. The final hour will be a public hearing where individuals will have the opportunity to offer public comment. A court reporter will be available to record comments during the entirety of the public scoping meetings.

For more information on date and location of meetings, please visit the Gemini Project website at: https://go.usa.gov/xntTQ or call Herman Pinales at 702-515-5284.
Input may be submitted by any of the following methods:

- E-mail: blm_nv_sndo_geminisolar@blm.gov
- Fax: (702) 515-5010
- Mail: BLM, Las Vegas Field Office, Attn: Herman Pinales, 4701 North Torrey Pines Drive, Las Vegas, Nevada 89130-2301

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from the public review, we cannot guarantee that we will be able to do so.

Bureau of Land Management
Southern Nevada District Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130

APPENDIX B-2

Public Scoping Notification Package

BLM Press Release

BLM Nevada News

Southern Nevada District Office
FOR IMMEDIATE RELEASE
Contact: Kirsten Cannon, (702) 515-5057, k1cannon@blm.gov

BLM seeks comments on Gemini Solar Project near Las Vegas

LAS VEGAS—The Bureau of Land Management Las Vegas Field Office is seeking public comments on the proposed Gemini Solar Project in Clark County, Nevada. The proposal aligns with the Trump administration's America First Energy Plan, an all-of-the-above approach that includes renewable sources such as wind, geothermal, and solar, as well as sources such as coal, oil, and gas – all of which can be developed on public lands.

"The BLM strives to be a good neighbor in the communities we serve, and we look forward to receiving input from the public on this proposal," said Tim Smith, BLM Southern Nevada District Manager.

The Gemini Solar Project would consist of the construction, operation, and eventual decommissioning of solar modules and associated facilities necessary to generate up to 690 megawatts of electricity. The proposed project area includes 7,115 acres of public land 25 miles northeast of Las Vegas, Nevada, and extends approximately six miles north to south and four miles east to west, located adjacent and south/southeast of Interstate 15.

It is estimated that the project would generate up to 2,000 direct jobs at peak construction, with a permanent staff of seven operating the facility after construction.

A Notice of Intent to Prepare an Environmental Impact Statement and Land Use Plan Amendment, and a Notice of Segregation for the Proposed Gemini Solar Project in Clark County, Nevada was published in the July 13, 2018 Federal Register, opening a 45-day public comment period which closes on August 27, 2018.

The BLM will announce scoping meetings at least 15 days in advance in a news release that will be posted on the Bureau's website at https://go.usa.gov/xntTQ.

The BLM will consult with Native American tribes on a government-to-government basis in accordance with the applicable laws, regulations, Executive order 13175, and other policies. Tribal concerns will be given due consideration, including impacts in Indian Trust assets.

Written comments may be mailed to the BLM, Southern Nevada District, Energy & Infrastructure Project Manager, 4701 N. Torrey Pines Drive, Las Vegas, NV, 89130, or emailed to blm_nv_sndo_geminisolar@blm.gov or faxed to 702-515-5023. For more information, please call Herman Pinales at telephone 702-515-5284.

Before including addresses, phone numbers, email addresses, or other personal identifying information in comments, be aware that entire comments-including personal identifying information-may be made publicly available at any time. While commenters can request that personal identifying information be withheld from public review, the BLM cannot guarantee that we will be able to do so.

-BLM-

APPENDIX C

Scoping Meeting Materials

APPENDIX C-1

Scoping Meeting Materials

Sign-In Sheets

U.S. Department of the Interior
Bureau of Land Management

SCOPING MEETING SIGN-IN SHEET

Gemini Solar Project EIS & Resource Management Plan Amendment

Suncoast Hotel and Casino,
Madrid Room
9090 Alta Drive
Las Vegas, NV 89145
August 1, 2018, 5 pm - 8 pm

DOI-BLM-NV-S010-2018-0051-EIS

	Name (Please Print)	Representing (check appropriate box)	E-mail Address (if unavailable please provide Mailing Address including the City, State and Zip Code)
1.	Dwight Hempel	Self ☑ Organization ☐ Name of Organization:	djhempel@aol.com
2.	Pat Krum	Self ☑ Organization ☐ Name of Organization:	pkrum@bellsouth.com
3.	Judi Hempel	Self ☑ Organization ☐ Name of Organization:	
4.	KEVIN EMMERICH	Self ☐ Organization ☐ Name of Organization:	
5.	LAURA CUNNINGHAM	Self ☐ Organization ☑ Name of Organization: BASIN & RANGE WATCH	bluerockiguana@gmail.com
6.	Roger Hallbeck	Self ☑ Organization ☐ Name of Organization:	halyonfat@gmail.com
7.	Alure Larson	Self ☐ Organization ☑ Name of Organization: SNEI	SNEI.COM
8.	Cayenne Engel	Self ☐ Organization ☑ Name of Organization: NDF	cengel@forestry.nv.gov
9.	CAREY CARLOS	Self ☐ Organization ☑ Name of Organization: SNEI	CAREYCARLOS@SNEI.COM
10.	Gary A. Reese	Self ☐ Organization ☑ Name of Organization: NDF	greese@forestry.nv.gov
11.	ZINA Dean	Self ☐ Organization ☑ Name of Organization: PureLiveSeed, LLC	zina@seedqueen.com
12.		Self ☐ Organization ☐ Name of Organization:	
13.		Self ☐ Organization ☐ Name of Organization:	
14.		Self ☐ Organization ☐ Name of Organization:	
15.		Self ☐ Organization ☐ Name of Organization:	

Privacy notice: Before including your address, phone number, email address, or any other personal identifying information in your comments, be advised that your entire comment(s), including personal identifying information, may be made publicly available at any time. While individuals may request that the BLM withhold personal identifying information from public view, the BLM cannot guarantee it will be able to do so. If you wish to withhold your personal information, you must state this prominently at the beginning of your comment(s).

SCOPING MEETING SIGN-IN SHEET

Gemini Solar Project EIS & Resource Management Plan Amendment

U.S. Department of the Interior
Bureau of Land Management

Suncoast Hotel and Casino,
Madrid Room
9090 Alta Drive
Las Vegas, NV 89145
August 1, 2018, 5 pm - 8 pm

DOI-BLM-NV-S010-2018-0051-EIS

	Name (Please Print)	Representing (check appropriate box)	E-mail Address (if unavailable please provide Mailing Address including the City, State and Zip Code)
61.	Chris Brooks	Self ☐ Organization ☒ Name of Organization: Arevia Power	chris@chrisbrooksconsulting.com
62.	Judy Bundorf	Self ☒ Organization ☐ Name of Organization:	jbundorf@cox.net
63.	Wayne Bundorf	Self ☒ Organization ☐ Name of Organization:	
64.	HENRIK CHRISTENSEN	Self ☐ Organization ☒ Name of Organization: SWCA	hchristensen@swca.com
65.	Robert Adams	Self ☐ Organization ☒ Name of Organization: AMAD-35/MRAN	radams@racemran.com
66.	Daryl Folks	Self ☐ Organization ☐ Name of Organization: MOSORAC BTTD Tree-On	
67.	JENNIFER MARGISON	Self ☒ Organization ☐ Name of Organization:	JKMARGISON@COX.NET
68.	Debbie Burgos	Self ☐ Organization ☒ Name of Organization:	raceto~~[illegible]~~22@yahoo.com
69.	Glenn Shaw	Self ☐ Organization ☒ Name of Organization:	Spanish Trail
70.	JOHN HIATT	Self ☐ Organization ☒ Name of Organization: RRAS	kjhiatt@gmail.com
71.	Henri Hiatt	Self ☒ Organization ☐ Name of Organization:	HHIATT@yahoo.com
72.		Self ☐ Organization ☐ Name of Organization:	
73.		Self ☐ Organization ☐ Name of Organization:	
74.		Self ☐ Organization ☐ Name of Organization:	
75.		Self ☐ Organization ☐ Name of Organization:	

Privacy notice: Before including your address, phone number, email address, or any other personal identifying information in your comments, be advised that your entire comment(s), including personal identifying information, may be made publicly available at any time. While individuals may request that the BLM withhold personal identifying information from public view, the BLM cannot guarantee it will be able to do so. If you wish to withhold your personal information, you must state this prominently at the beginning of your comment(s).

SCOPING MEETING SIGN-IN SHEET

Gemini Solar Project EIS & Resource Management Plan Amendment

U.S. Department of the Interior
Bureau of Land Management

DOI-BLM-NV-S010-2018-0051-EIS

Moapa Recreation and Community Center
1340 East State Highway 168
Moapa, NV 89025
August 2, 2018, 5 pm - 8 pm

	Name (Please Print)	Representing (check appropriate box)	E-mail Address (if unavailable please provide Mailing Address including the City, State and Zip Code)
1.	Elise McAllister	Self ☐ Organization ☑ Name of Organization: Partners In Conservation	pic org + mvdsl.com PO Box 381 Moapa NV 89025
2.	Vernon Robison	Self ☐ Organization ☑ Name of Organization: Moapa Valley Progress	progress@mvdsl.com PO Box 430 Overton NV 89040
3.		Self ☐ Organization ☐ Name of Organization:	
4.		Self ☐ Organization ☐ Name of Organization:	
5.		Self ☐ Organization ☐ Name of Organization:	
6.		Self ☐ Organization ☐ Name of Organization:	
7.		Self ☐ Organization ☐ Name of Organization:	
8.		Self ☐ Organization ☐ Name of Organization:	
9.		Self ☐ Organization ☐ Name of Organization:	
10.		Self ☐ Organization ☐ Name of Organization:	
11.		Self ☐ Organization ☐ Name of Organization:	
12.		Self ☐ Organization ☐ Name of Organization:	
13.		Self ☐ Organization ☐ Name of Organization:	
14.		Self ☐ Organization ☐ Name of Organization:	
15.		Self ☐ Organization ☐ Name of Organization:	

***Privacy notice:** Before including your address, phone number, email address, or any other personal identifying information in your comments, be advised that your entire comment(s), including personal identifying information, may be made publicly available at any time. While individuals may request that the BLM withhold personal identifying information from public view, the BLM cannot guarantee it will be able to do so. If you wish to withhold your personal information, you must state this prominently at the beginning of your comment(s).*

APPENDIX C-2

Scoping Meeting Materials

Comment Form

Gemini Solar Project EIS and Resource Management Plan Amendment

BLM SCOPING COMMENT SHEET

The Bureau of Land Management (BLM) would like to obtain your input regarding the Gemini Solar Project EIS and associated Resource Management Plan Amendment.

Where to provide comments: You can hand this form in at a public scoping meeting, mail it in using the address on the reverse, or fax it in to 702-515-5023. **Comments can also be submitted via email to the following email address: blm_nv_sndo_geminisolar@blm.gov**

Name: ______________________________

Title: ______________ Organization: ______________

Mailing Address: ______________________________

City: __________ State: __________ Zip: __________

Email: ______________________________

Date: ______________________________

☐ Please check box if you want to be on the mailing list for future updates and notification for this project. The Draft EIS will be posted on the BLM Southern Nevada District Office website. You will be notified when it is available.

COMMENT *(use back side if you need additional space or attach additional sheets)*

Fold in thirds so address (on reverse) is showing, add postage, tape bottom of fold, and mail, ***postmarked by Aug 27, 2018.***

☐ Please check box if you do **not** want your name released when comments are made public.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Bureau of Land Management
Southern Nevada District – Las Vegas Field Office
Las Vegas Field Office Manager
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

From:

Place Stamp Here

Thank you for your comment!

To return via mail:
Fold in thirds so address (above) is showing, add postage,
tape bottom of fold (no staples), and mail.
Postmark by: August 27, 2018

Comment continued:

APPENDIX C-3

Scoping Meeting Materials

Speaker Card

GEMINI SOLAR PROJECT EIS SCOPING MEETING

SPEAKER SIGN-UP CARD

If you would like to make a verbal statement, please print your name and address clearly so that the court reporter enters your information correctly.

Name ______________________________

Address ______________________________

City, State, Zip ______________________________

SELECT ONE I am here ☐ Representing Myself ☐ Representing and Organization

Name of Organization ______________________________

GEMINI SOLAR PROJECT EIS SCOPING MEETING

SPEAKER SIGN-UP CARD

If you would like to make a verbal statement, please print your name and address clearly so that the court reporter enters your information correctly.

Name ______________________________

Address ______________________________

City. State, Zip ______________________________

SELECT ONE I am here ☐ Representing Myself ☐ Representing and Organization

Name of Organization ______________________________

GEMINI SOLAR PROJECT EIS SCOPING MEETING

SPEAKER SIGN-UP CARD

If you would like to make a verbal statement, please print your name and address clearly so that the court reporter enters your information correctly.

Name ______________________________

Address ______________________________

City, State, Zip ______________________________

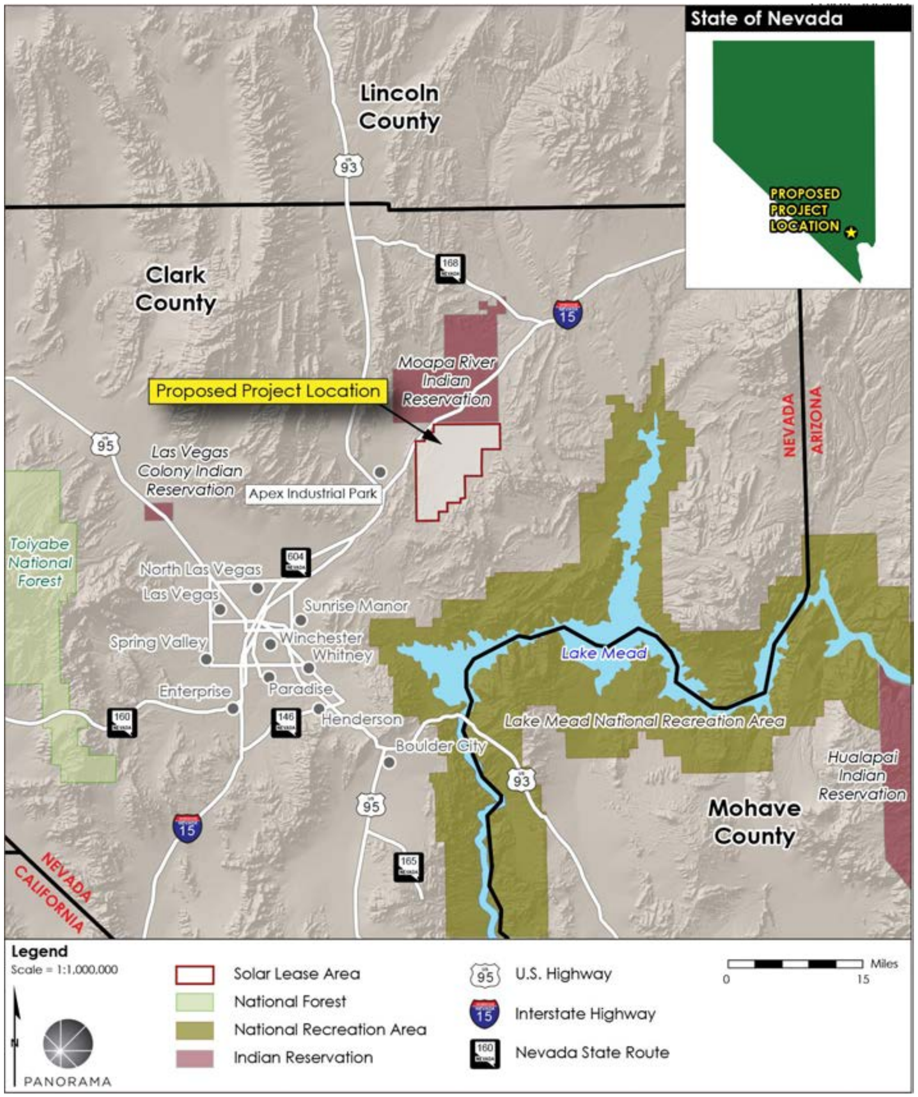
SELECT ONE I am here ☐ Representing Myself ☐ Representing and Organization

Name of Organization ______________________________

APPENDIX C-4

Scoping Meeting Materials

Project Information Handout



GEMINI SOLAR PROJECT EIS SCOPING MEETING

What is the Gemini Solar Project?

In 2017, Solar Partners XI, LLC amended an existing application with the BLM requesting authorization to construct, operate, maintain, and decommission an approximately 690-megawatt photovoltaic (PV) solar electric generating facility and associated generation tie-line and access road facilities, on approximately 7,100 acres of land administered by the BLM. The project is located approximately 25 miles northeast of Las Vegas, along Interstate-15, in close proximity to Apex Industrial Park and south of the Moapa Reservation, in Clark County, Nevada

The Project would include:

- ◊ The PV Solar Array—including solar panels, internal energy collection systems, and integrated battery storage
- ◊ Infrastructure—including internal roadways, fire breaks, an Operations and Maintenance Facility, drainage systems
- ◊ Transmission Systems—up to three internal substations, gen-tie lines to Crystal Substation, upgrades to Crystal Substation

Environmental Documentation

To authorize this project, the BLM would need to approve the application for a right-of-way grant and amend the 1998 Resource Management Plan for the Las Vegas Field Office to change the designation of the Project site to allow solar development.

The BLM will produce an Environmental Impact Statement (EIS) prepared under the National Environmental Policy Act (NEPA) to evaluate the potential environmental, social, and economic impacts at the proposal site.

Gemini Solar Project Scoping Meeting

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

How to Submit Input

The purpose of today's scoping meeting is to provide the public and regulatory agencies an opportunity to comment on the scope of the EIS and to identify issues that should be addressed in the environmental document.

Input may be submitted by any of the following methods:

Email	Fax	Mail
blm_nv_sndo_geminisolar@blm.gov	702-515-5010 Attn: Herman	BLM Southern Nevada District Office Gemini Solar Project EIS 4701 N. Torrey Pines Drive Las Vegas, NV 89130

How to Provide Effective Input

Do:

- Provide new information or data
- Be specific and clearly identify:
  - ◊ How is your input relevant?
  - ◊ How should your input be incorporated into the EIS?
  - ◊ Physical location associated with your input
  - ◊ What the issue is
  - ◊ Why you believe this
- Provide constructive solutions with documentation or resources to support your recommendations
- If applicable, include your experience as it related to your observations and input

Don't:

- Use vague statements or concerns. Vague statements do not give the BLM direction to act
- Understand that your input is a vote for or against one of the alternatives. The BLM must rely on supporting information, not on the quantity of information received
- Use form letters to convey your point. Your unique way of writing or phrasing your input is important for understanding your point of view

Helpful:

Please be sure to identify the water needs for the project, quantify how much water would be used, and potential sources of that water. Given limited availability of water and particularly, groundwater, I would like to see use minimized as much as possible.

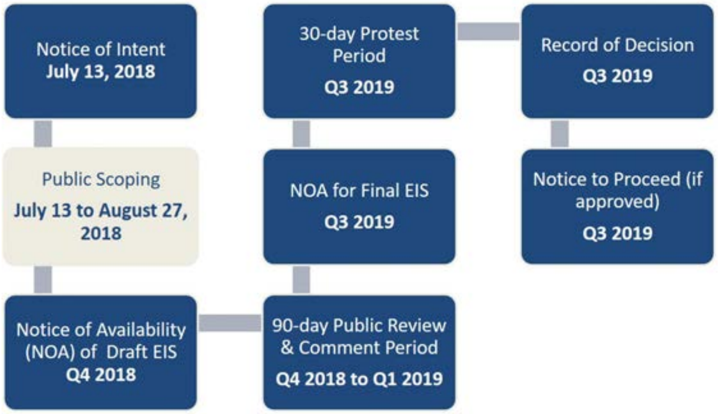
Not So Helpful:

There should be more alternatives in different areas.

This input doesn't contain supporting information or rationale, such as where, how many, how large, why, or provide information to support the statement.

Input must be submitted by August 27, 2018

Schedule



Gemini Solar Project Scoping Meeting

Project Website: https://go.usa.gov/xntTQ

APPENDIX C-5

Scoping Meeting Materials

Presentation

Open House Schedule

- 5:00 – 5:15 pm Open House Format*
- 5:15 – 5:30 pm Presentation
- 5:30 – 6:15 pm Open House Format*
- 6:15 – 6:30 pm Repeat Presentation
- 6:30 – 7:00 pm Open House Format
- 7:00 – 8:00 pm Verbal Comments

*Ask questions to BLM staff, visit various posters, provide individual input to court recorder

U.S. Department of the Interior
Bureau of Land Management

Gemini Solar Project

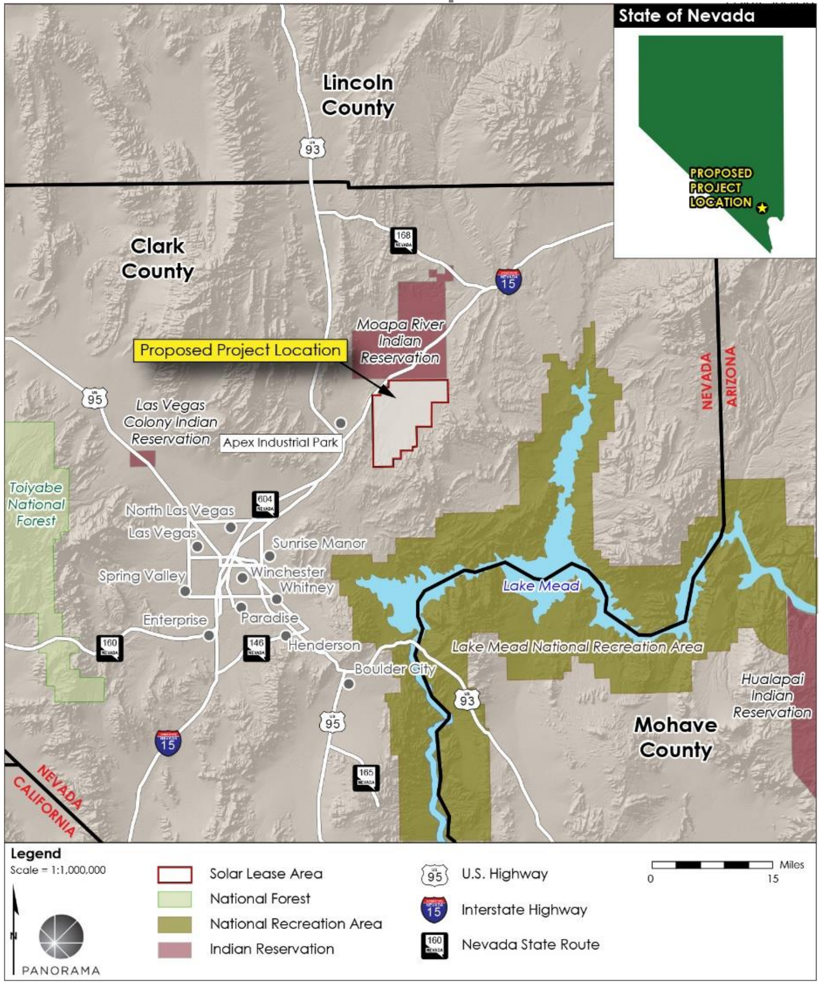
Solar Partners XI, LLC

Timeline Overview

- 2008 initial application filed – for a solar thermal project
- Amended application in December 2017 – for a photovoltaic project
- June 27, 2018 accepted for processing as Fast41 project
- Notice of Intent issued on July 13, 2018 for a 45-day scoping period
- EIS to be completed in 12 months from NOI to Record of Decision
- Construction to start in Q3 2019

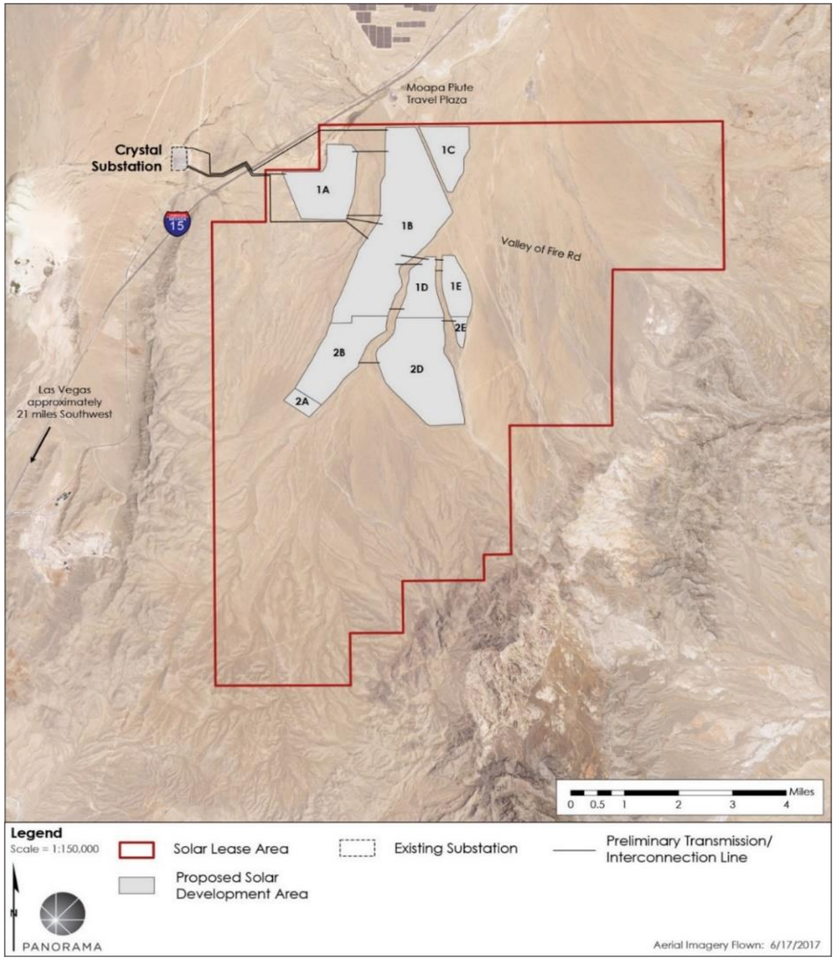
Project Location

25 miles northeast of Las Vegas along I-15, in close proximity to Apex Industrial Park and south of the Moapa Reservation



- Nearest community is Moapa – approx. 17 miles north along I-15

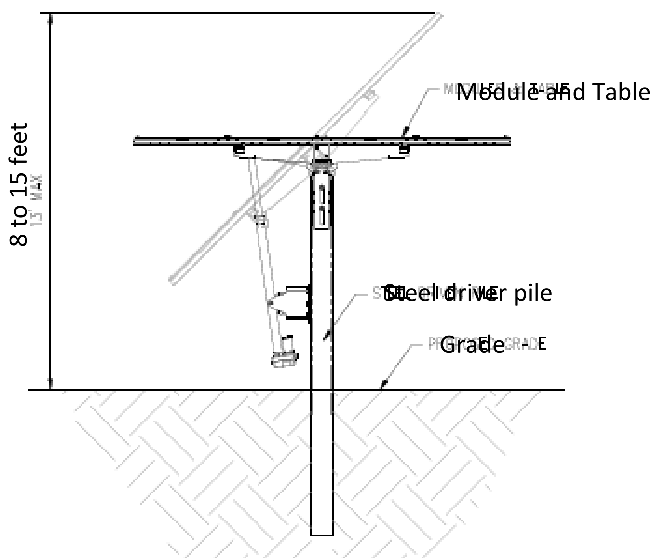
Project Overview

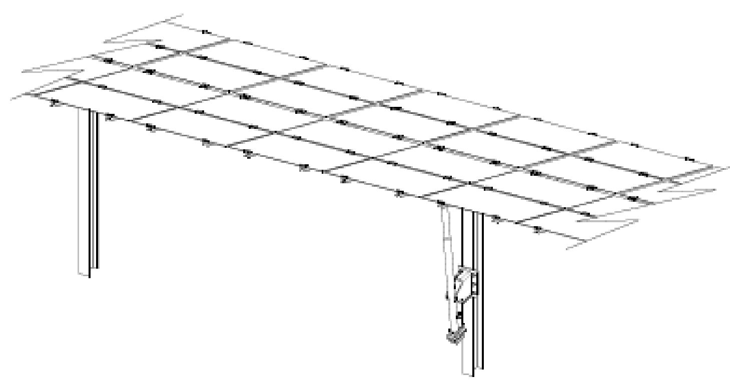


- Approximately 44,000-acre application area
- Develop a photovoltaic solar facility on approximately 7,100 acres of land within a 44,000 acre application area
  - Preliminary plan is 690 MW
  - Could generate more depending on buildable area and technology improvements
  - Siting of development areas to minimize environmental impacts
- One 230 kV and one 525 kV gen-tie to Crystal Substation
- 5.5 miles of new 230 kV line on existing towers to connect Crystal Substation to Harry Allen Substation
- Integrated battery storage included

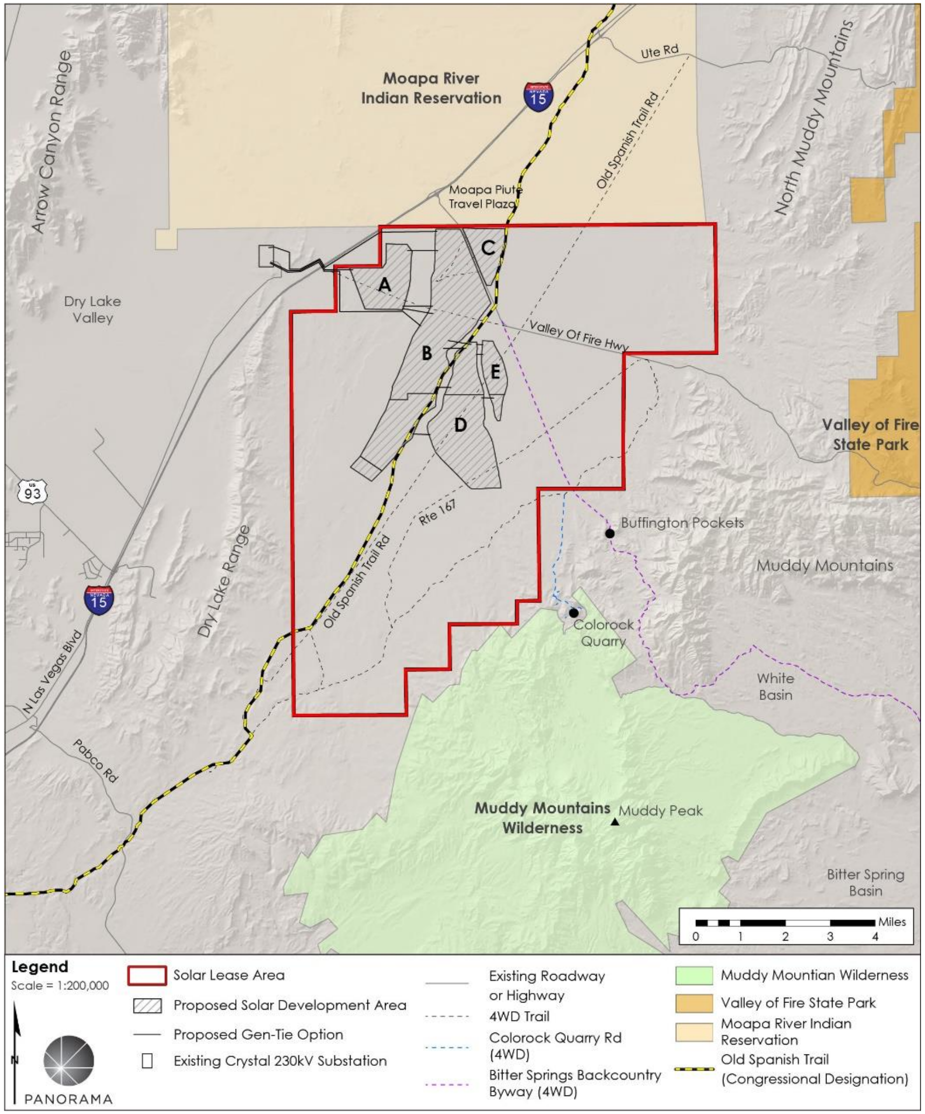
- Single-axis horizontal trackers, other technology possible

Photo by SunPower Corporation





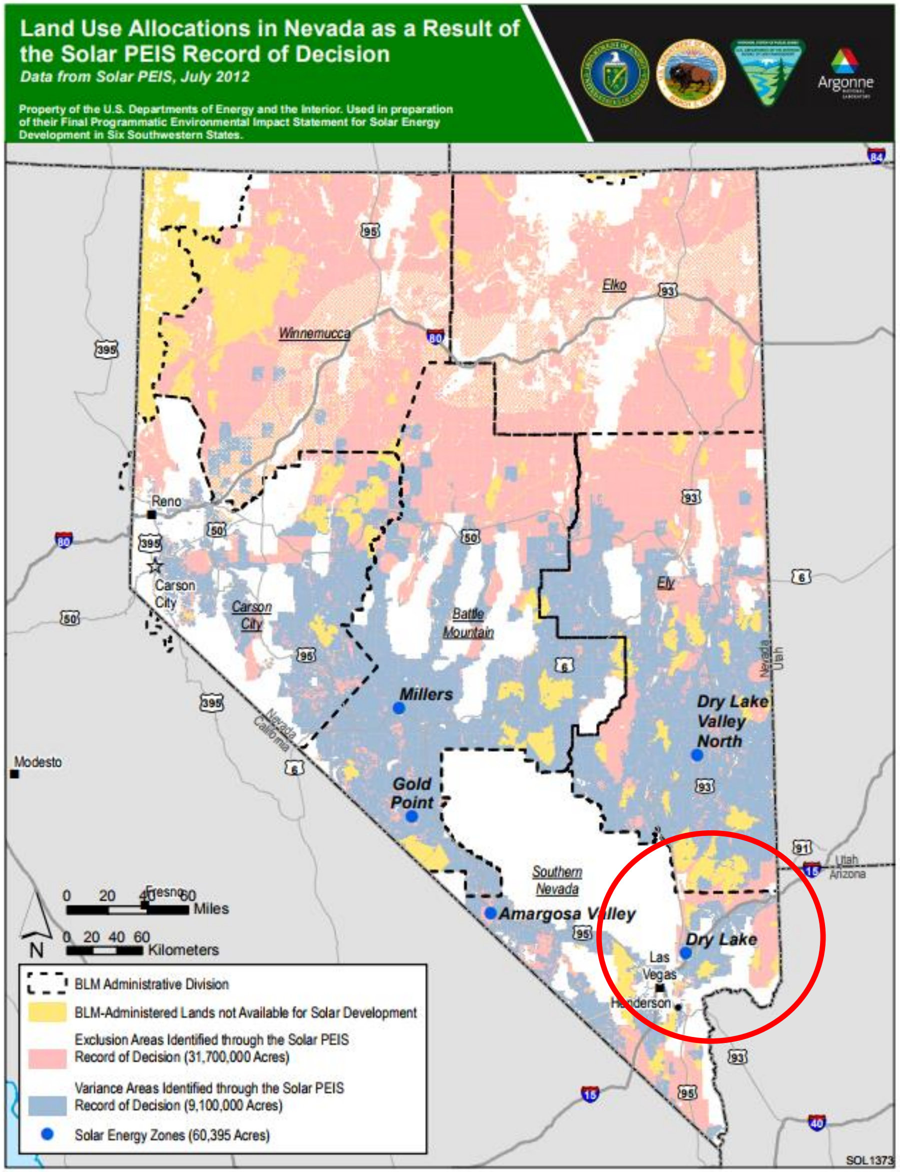
Surrounding Land Uses



- Nearby Uses:
  - Bitter Springs Back Country Byway
  - Muddy Mountains Wilderness
  - Valley of Fire State Park
  - Moapa River Indian Reservation
  - Congressionally Designated route of the Old Spanish Trail

NEPA Requirements

- Right-of-way application filed in 2008 -- not subject to the BLM's Record of Decision (ROD) for Solar Energy Development in Six Southwestern States (BLM 2012.)
- An Environmental Impact Statement is needed
  - Not subject to PEIS; however, useful information in PEIS



NEPA Process

Notice of Intent
July 13, 2018

Public Scoping
July 13 to August 27, 2018

Notice of Availability (NOA) of Draft EIS
Q4 2018

90-day Public Review & Comment Period
Q4 2018 to Q1 2019

NOA for Final EIS
Q3 2019

30-day Protest Period
Q3 2019

Record of Decision (signed by DOI Secretary)
Q3 2019

Notice to Proceed (if approved)
Q3 2019

Preliminary Issues Identified by BLM

- Biological and Hydrologic Resources
- Visual Resources
- Recreation
- Cultural and Tribal Resources
- Lands Realty/Energy Corridors
- Cumulative

Technical Studies

Study
Geotechnical
Drainage Study
Jurisdictional Delineation
Desert Tortoise Surveys
Avian Point Counts
Eagle Nesting Survey
Botanical Surveys
Archaeological/Cultural Surveys
Paleontological Surveys
Visual Assessment
Air Quality Assessment
Noise Assessment
Traffic Assessment
Phase I ESA (Hazards)
Socioeconomic Assessment

- Biological surveys for the project site commenced in Fall 2017 and completed July 2018, reporting in process
- Archaeological and paleontological studies finished July 2018, reporting in process
- Drainage study commenced in May 2018 and is in process
- Phase I ESA finished in March 2018
- Geotechnical study commenced in July 2018 and reporting is in process
- All other studies underway

Biological Resources

- Identified issues
  - Special status wildlife
    - Desert tortoise, burrowing owl, American badger, desert kit fox, bighorn sheep, bats
    - Eagle nesting and avian species
  - Jurisdictional waters
  - Botanical species

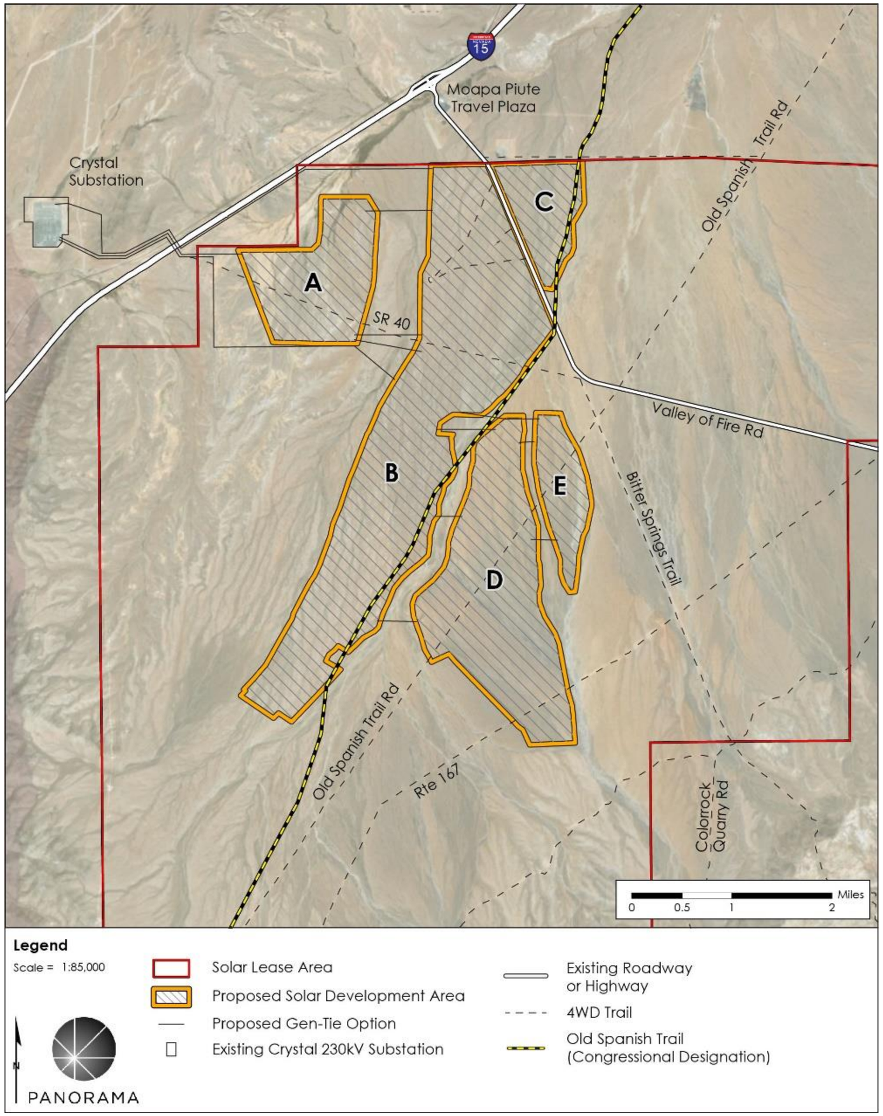
- Consultations
  - USFWS, Section 7
    - Will need Biological Opinion
    - Tortoise Translocation Plan
  - Working with NDOW
  - Army Corps of Engineers for Section 404 of Clean Water Act Permit

Visual Resources

- Identified issues
    - Visual impacts from solar field and gen-tie on valley and views of the valley
    - Bitter Springs Backcountry Byway exiting Muddy Mountains
    - Visual impacts on Congressionally – designated Old Spanish Trail Corridor
    - Solar application area is within Visual Resource Management (VRM) Class III area – 1998 RMP will need to be amended to make Class IV for compatibility with solar development

Recreational Resources

- Identified issues
  - Existing trails
  - Off-Highway Vehicle (OHV) areas
    - Currently allowed on existing trails and washes only
  - Congressionally-Designated route of Old Spanish Trail
- Consultations
  - NPS on Old Spanish Trail
  - Interest groups

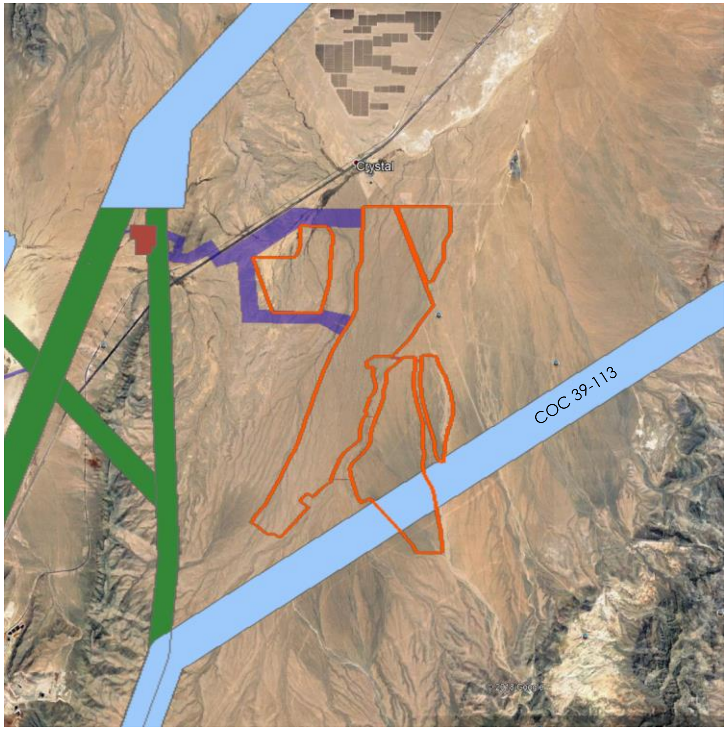


Cultural and Tribal Resources

- Identified issues
  - Archaeological resources identified
  - Native American
    - Prehistoric resources and properties
- Consultations
  - State Historic Preservation Office
    - Section 106 of National Historic Preservation Act compliance needed
  - Moapa Tribe
  - Tribal Consultations

Lands and Realty/Transmission Corridor

- Identified issues
  - Section 368 Energy Corridor through Proposed Action Area (COC 39-113)



Cumulative Impacts

- Will address composite impacts of multiple solar facilities, other energy facilities, transmission corridors in the region

Alternatives

- NEPA requires the development of alternatives that can meet the purpose and need of the Project, but considers the alternative uses of resources.
- Alternative areas or configurations for development within the 44,000 acre application area are under consideration to reduce some of the impacts of the Project.
- Suggestions for alternatives are welcome during scoping.

Ways to Provide Input

- **Submit** input by mail, email, fax, or in person with the provided input forms
- **Input is due by August 27, 2018**
- More information can be found at: https:go.usa.gov/xntTQ
- Submit via:
  - **Email**: blm_nv_sndo_geminisolar@blm.gov
  - **Fax**: 702-515-5010, Attn: Herman Pinales
  - **Mail**: BLM Southern Nevada District Office

    Attn Herman Pinales

    4701 N. Torrey Pines Drive

    Las Vegas, NV 89130

How to make a comment: At the Scoping meeting using the comment forms or provide verbal comments. Email comments or mail in comments to the addresses above

APPENDIX C-6

Scoping Meeting Materials

Poster Boards

Gemini Solar Project EIS and Land Management Plan Amendment

NEPA and the EIS Process

The National Environmental Policy Act of 1969 (NEPA) requires the lead federal agency (BLM) to evaluate effects of the proposed action on the natural and human environment.

The Environmental Impact Statement (EIS) will include a detailed analysis of potential environmental impacts from which decision-makers can make an informed decision.

Key Milestones during the EIS process include:

Scoping (July 13 to August 27, 2018)

» 45-day scoping period from Issuance of NOI

Draft EIS/Draft RMP Amendment

» 90-day public comment period

Final EIS/Proposed RMP Amendment

» 30-day protest period

Issue Record of Decision

National Environmental Policy Act Resource Management Plan Amendment Environmental Assessment Process

Publish Notice of Intent

↓

Scoping Period — We Are Here

↓

Prepare Draft EIS and RMP Amendment

↓

Public Comment Period

↓

Prepare Final EIS and Proposed RMP Amendment

↓

Protest Period

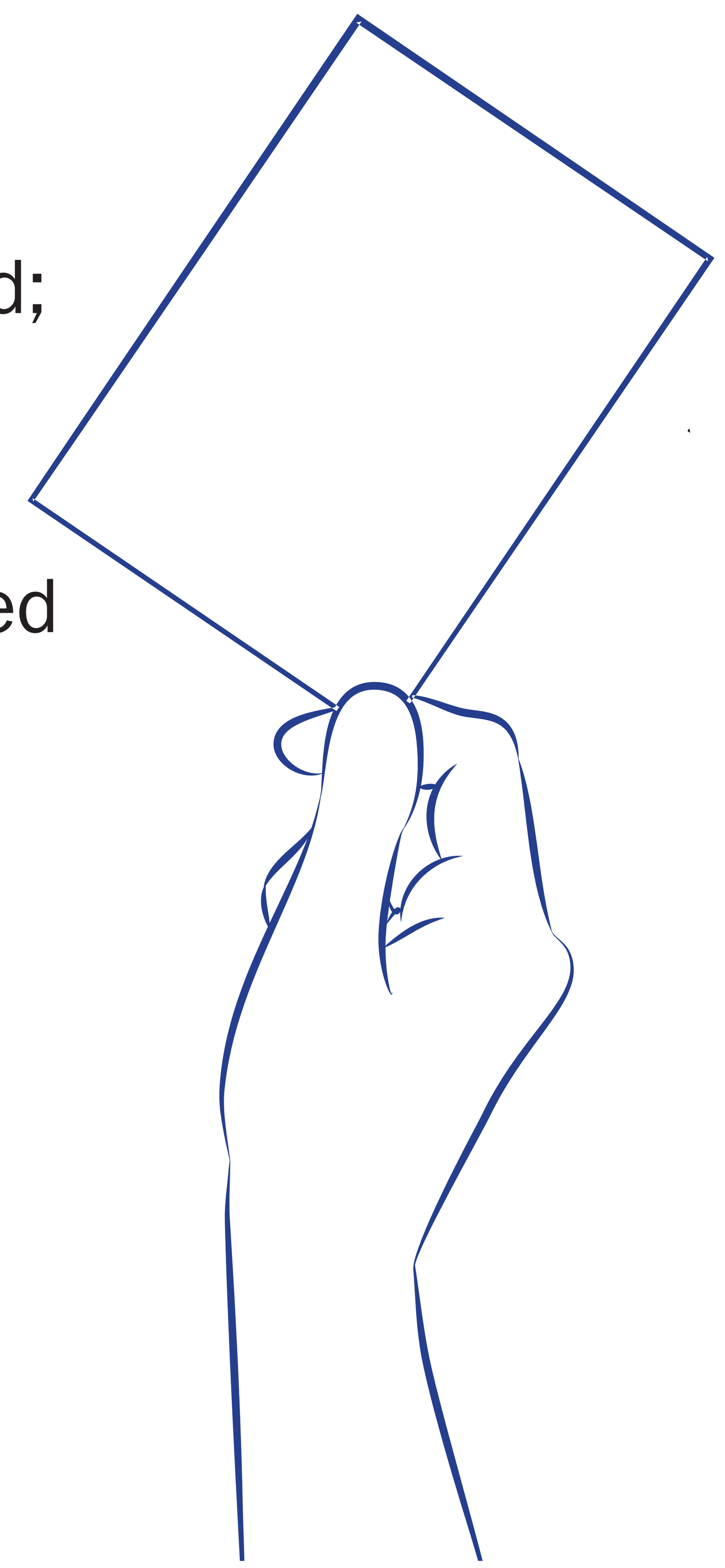
↓

Issue Record of Decision/ RMP Amendment

Tips for Providing an Effective Comment

Effective comments address one or more of the following:

- Resources likely to be affected by the project;
- Potential resource issues that should be analyzed;
- Data sources that the agency may not be aware of;
- Reasonable alternatives other than those suggested; and/or
- Changes or revisions in one or more of the suggested alternatives.



Ways to Provide a Comment:

At the meeting:

Fill out a comment form and submit it in the comment box or provide comments directly to the court reporter.

After the meeting:

E-mail: blm_nv_sndo_geminisolar@blm.gov

Mail: Gemini Solar Project

Attn: Herman Pinales
BLM Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Fax: 702-515-5010

For more information or if you have further questions contact:

Herman Pinales
702-515-5284

For Project Updates:

Project website: https://go.usa.gov/xntTQ

Gemini Solar Project EIS and Land Management Plan Amendment

NEPA Schedule

Notice of Intent
July 13, 2018

Public Scoping
July 13 to August 27, 2018

Notice of Availability (NOA) of Draft EIS
Q4 2018

90-day Public Review & Comment Period
Q4 2018 to Q1 2019

NOA for Final EIS
Q3 2019

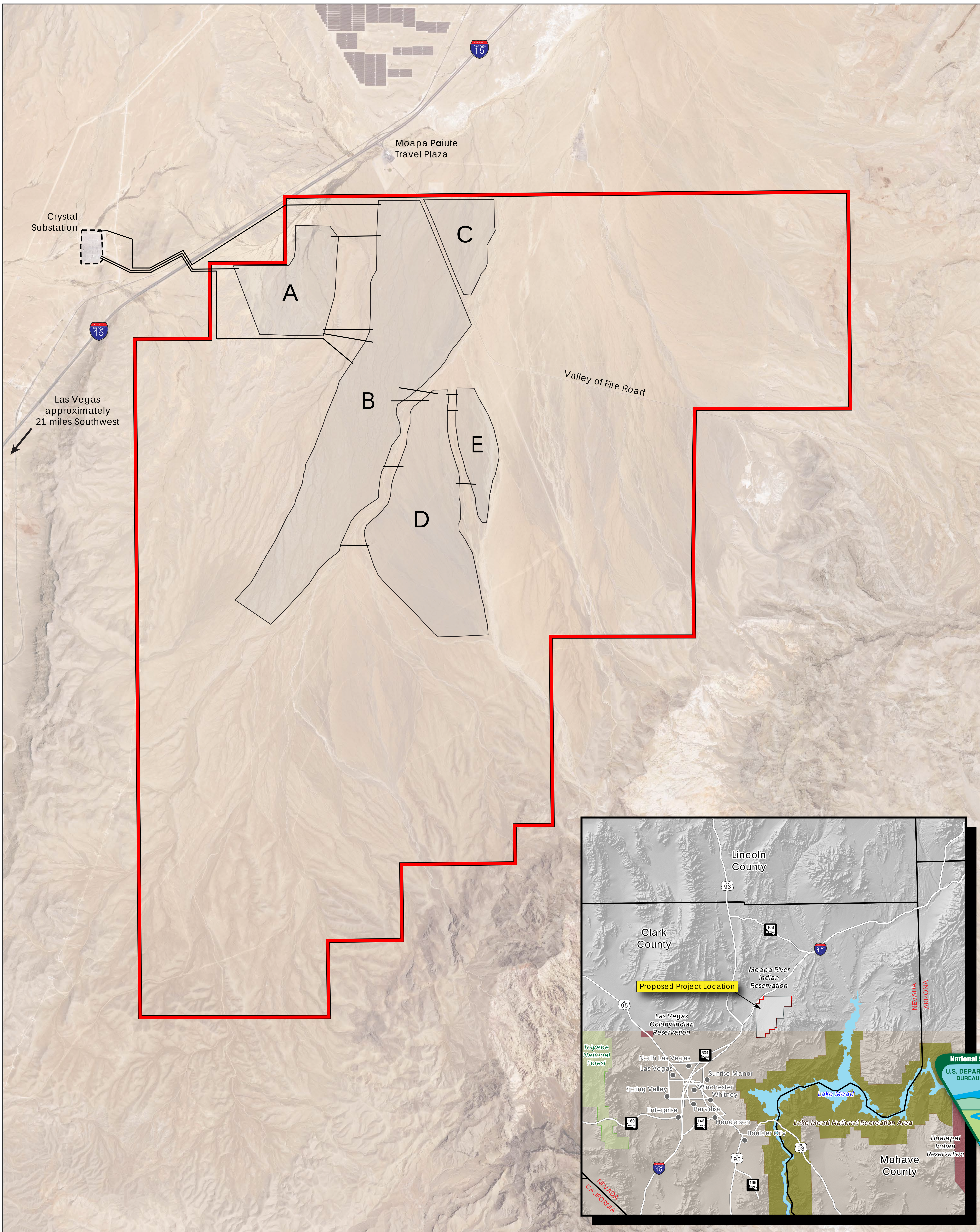
30-day Protest Period
Q3 2019

Record of Decision
Q3 2019

Notice to Proceed (if approved)
Q3 2019

Gemini Solar Project EIS and Land Management Plan Amendment

Proposed Action Area Map



National System of Public Lands
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Legend

- Solar Lease Area
- Existing Substation
- Preliminary Transmission/ Interconnection Line
- Proposed Solar Development Area

0 0.5 1 1.5 2 Miles

N

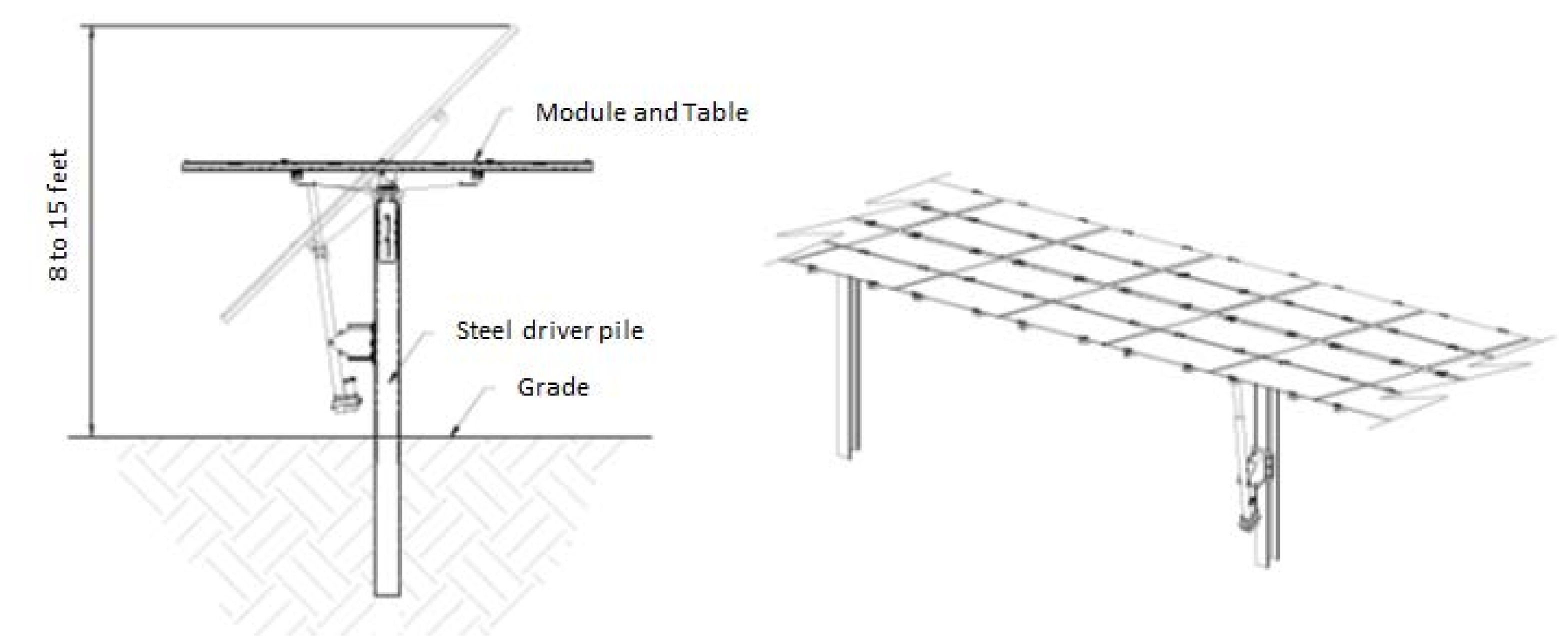
Scale: 1:40,000
Aerial Imagery Flown: 6/17/2017

PANORAMA

Gemini Solar Project EIS and Land Management Plan Amendment

Project Components

Component	Subcomponent Description
Solar Field	Solar array blocks of solar photovoltaic modules on single-axis horizontal trackers
	DC collection system and power conservation system (PCS) to collect power from the array blocks
	Overhead 34.5 kV AC collection system to get power from PCS to switchyard
	Battery storage system
Infrastructure	Internal roadway system, fire breaks, transmission access roads
	2-acre operations and maintenance building area, including office, parking, water storage
	30-foot steel-lattice meteorological towers
	Desert tortoise exclusion fencing
	Drainage control systems
Transmission	Up to three substations
	Gen-tie lines from switchyards to Crystal Substation (one 230 kV circuit and one 500 kV circuit)
	Redundant telecom with gen-tie
	Upgrades to Crystal Substation and Harry Allen Substation
	5.5 miles of new 230 kV line on existing towers to connect Crystal Substation to Harry Allen Substation



Gemini Solar Project EIS and Land Management Plan Amendment

Key Environmental Resources

Biological Resources
- Desert tortoise
- Sensitive plants
- Avian and bat species
- Waters of the US

Hydrologic Issues
- Drainage

Visual Resources
- Bitter Springs Backcountry Byway
- Congressionally-Designated Old Spanish Trail

Recreational Resources
- BLM-designated trails
- Off-highway vehicle (OHV) areas

Cultural and Tribal Resources
- Archaeological and Historic Resources

Lands and Realty/Transmission Corridor
- Section 368 Energy Corridor (39-113)

Cumulative Impacts

National System of Public Lands
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Gemini Solar Project EIS and Land Management Plan Amendment

Technical Studies Completed or Underway

Study	Timeframe
Preliminary Geotechnical Study	July to August 2018
Drainage Study	May to August 2018
Jurisdictional Delineation	March to June 2018
Desert Tortoise Surveys of Project Site	September 2017 to May 2018
Avian Point Counts	December 2017 to August 2018
Eagle Nesting Survey	December 2017 to July 2018
Botanical Surveys	March to April 2018
Archaeological/Cultural Surveys	March to July 2018
Paleontological Surveys	March to July 2018
Visual Assessment	May to Aug 2018
Air Quality Assessment	August to September 2018
Noise Assessment	July to August 2018
Traffic Assessment	August to September 2018
Phase I ESA (Hazards)	March 2018
Socioeconomic Assessment	October 2017

APPENDIX D

Cooperating Agency Invitation Letters

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, D.C. 20001-2637

Dear Sir or Ma'am:

The Bureau of Land Management (BLM) will be preparing an Environmental Impact Statement (EIS) for the proposed Gemini Solar Project (Project). This letter invites you to be a cooperating agency for the EIS.

The Project is located entirely on BLM-managed land approximately 25 miles northeast of Las Vegas in Clark County, Nevada. Depending on the buildable area and panel efficiency, the proposed Project would be an approximately 690-megawatt (MW) photovoltaic (PV) power plant, located on approximately 7,115 acres. The proposed Project would provide renewable energy to the electrical transmission grid via a new 230-kilovolt (kV) generation tie-in to the existing Crystal Substation. The proposed Project would include an energy storage (lithium-ion battery). A segment of congressionally designated Old Spanish National Historic Trail also passes through the project site. Access to the project site includes the Valley of Fire Highway and Bitter Springs Backcountry Byway.

The applicant's filing for a right-of-way on BLM-managed lands triggers a National Environmental Policy Act (NEPA) review process of the proposed Project by the BLM. The BLM will also be analyzing a proposed amendment to the 1998 Resource Management Plan to change the Visual Resource Management classification of the Project area.

BLM will serve as the lead Federal agency for consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, and for consultations with the Nevada State Historic Preservation Office under Section 106 of the National Historic Preservation Act. The Project was determined to be a "covered project" under the Fixing America's Surface Transportation ("FAST") Act of 2015, Pub.L. 114-94, Section 41001 on June 27, 2018. The Project is under a One Federal Decision, BLM will develop a single EIS and sign a single Record of Decision (ROD).

The BLM may request that any agency with jurisdiction by law or with special expertise with respect to an environmental issue to be addressed in the EIS be a cooperating agency. Designated cooperating agencies have certain responsibilities to support the NEPA process. The benefits of

becoming a cooperating agency include disclosure of relevant information early in the EIS process and establishment of a mechanism to address any intergovernmental issues. Should your agency decide not to become a formal cooperating agency for this EIS, you will continue to be kept informed of the Project's progress and developments and you will receive the Draft and Final EIS documents. Any concerns or comments your agency provides during the NEPA process will be fully considered in finalizing the EIS and the ROD.

We want to ensure that any important environmental concerns and natural resources and/or places of interest for your agency within the Project area are considered and addressed in the EIS. We welcome any information that you are willing to share with us. We would appreciate it if, within 30 days, you could submit any such information or let us know when such information could be expected.

A list of other invited cooperating agencies receiving this letter is enclosed. If you are aware of any other individuals or agencies that should be consulted regarding the Project, please let us know. Also, if you know of any additional agency representatives who should be added to the Project's mailing list and/or receive a copy of the Draft and Final EISs, please contact Herman Pinales, Energy & Infrastructure Project Manager, by phone at 702-515-5284 or email at blm_nv_sndo_geminisolar@blm.gov.

We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Chip Lewis
Bureau of Indian Affairs, Western Regional Office
2600 N Central Ave 4th Floor Mail Room
Phoenix AZ 85004-3008

Dear Chip Lewis:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Faye Streier
U.S. Bureau of Reclamation
P.O. Box 61470
Boulder City, NV 89006

Dear Faye Streier:

The Bureau of Land Management (BLM) will be preparing an Environmental Impact Statement (EIS) for the proposed Gemini Solar Project (Project). This letter invites you to be a cooperating agency for the EIS.

The Project is located entirely on BLM-managed land approximately 25 miles northeast of Las Vegas in Clark County, Nevada. Depending on the buildable area and panel efficiency, the proposed Project would be an approximately 690-megawatt (MW) photovoltaic (PV) power plant, located on approximately 7,115 acres. The proposed Project would provide renewable energy to the electrical transmission grid via a new 230-kilovolt (kV) generation tie-in to the existing Crystal Substation. The proposed Project would include an energy storage (lithium-ion battery). A segment of congressionally designated Old Spanish National Historic Trail also passes through the project site. Access to the project site includes the Valley of Fire Highway and Bitter Springs Backcountry Byway.

The applicant's filing for a right-of-way on BLM-managed lands triggers a National Environmental Policy Act (NEPA) review process of the proposed Project by the BLM. The BLM will also be analyzing a proposed amendment to the 1998 Resource Management Plan to change the Visual Resource Management classification of the Project area.

BLM will serve as the lead Federal agency for consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, and for consultations with the Nevada State Historic Preservation Office under Section 106 of the National Historic Preservation Act. The Project was determined to be a "covered project" under the Fixing America's Surface Transportation ("FAST") Act of 2015, Pub.L. 114-94, Section 41001 on June 27, 2018. The Project is under a One Federal Decision, BLM will develop a single EIS and sign a single Record of Decision (ROD).

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Brok Armantrout
City of Boulder City
P.O. Box 61350
Boulder City, NV 89006

Dear Brok Armantrout:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Marci Henson
Director of Air Quality Department
4701 W Russell Road, Suite 200
Las Vegas, NV 89118

Dear Marci Henson:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Ron Gregory
Director of Comprehensive Planning Clark County
500 S Grand Central Pkwy, Suite 1
Las Vegas, NV 89155

Dear Ron Gregory:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Clark County
Desert Conservation Program
4701 W Russell Road, Suite 200
Las Vegas, NV 89118

Dear Sir or Ma'am:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Clark County Fire Department
575 E Flamingo Road
Las Vegas, NV 89119

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Jennifer Sizemore
Clark County Health District, Air Pollution Control Division
625 Shadow Lane
Las Vegas, NV 89106

Dear Jennifer Sizemore:

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We look forward to hearing from you.

Sincerely,

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Denis Cederburg, Director of Public Works
Clark County Public Works Department
500 S Grand Central Pkwy, 2nd Floor
Las Vegas, NV 89155

Dear Denis Cederburg:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

John Tennet
Clark County Regional Flood Control District
600 S Grand Central Pkwy, Suite 300
Las Vegas, NV 89106-4511

Dear John Tennet:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Alijah Robinson
U.S. Department of Energy, U.S. Energy Information Administration
1000 Independence Ave, SW
Washington, D.C. 20585

Dear Alijah Robinson:

The Bureau of Land Management (BLM) will be preparing an Environmental Impact Statement (EIS) for the proposed Gemini Solar Project (Project). This letter invites you to be a cooperating agency for the EIS.

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We look forward to hearing from you.

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Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

DeEllen Brasher
U.S. Department of Defense
937 N. Harbor Drive, Box 81 Bldg 1
San Diego, CA 92132

Dear DeEllen Brasher:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Ann McPherson, Environmental Scientist
Environmental Protection Agency, Pacific Southwest Office
75 Hawthorne Street
San Francisco, CA 94105

Dear Ann McPherson:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Federal Aviation Administration
Flight Standards District Office
7181 Amigo Street, Suite 180
Las Vegas, NV 89119

Dear Sir or Ma'am:

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We look forward to hearing from you.

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
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4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Sean Robertson
City of Henderson
P.O. Box 95050 MSC-115
Henderson, NV 89009

Dear Sean Robertson:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Sherri McMahon
City of Las Vegas
495 S Main Street
Las Vegas, NV 89101

Dear Sherri McMahon:

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Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Steven Pennix, Branch Head
Naval Air Systems Command, Sustainability Office, Code 52F00MD
575 I Avenue, Building 53D, Room 103
Point Mugu, CA 93042

Dear Steve Pennix:

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Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Tod Oppenborn
Nellis Air Force Base
6020 Beale Avenue
Nellis AFB NV 89191

Dear Tod Oppenborn:

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Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Johanna Murphy
City of North Las Vegas
2250 Las Vegas Blvd North, Suite 300
North Las Vegas, NV 89030

Dear Johanna Murphy:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Michael Boyles, Lands, Planning, and Compliance Specialist
National Park Service, Lake Mead National Recreation Area
601 Nevada Way
Boulder City, NV 89005

Dear Michael Boyles:

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Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Jill Jensen, Cultural Resources Specialist
National Park Service, National Trails Intermountain Region
50 W Broadway, Suite 950
Salt Lake City, UT 84101

Dear Jill Jensen:

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We look forward to hearing from you.

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Lara Rozzell, External Energy & Minerals Program Manager
Pacific West Region, National Park Service
333 Bush Street, Suite 500
San Francisco, CA 94104-2828

Dear Lara Rozzell:

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Southern Nevada District

United States Department of the Interior

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Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Superintendent
National Park Service, Mojave National Preserve
2701 Barstow Road
Barstow, CA 92311

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Southern Nevada District

United States Department of the Interior

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4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Skip Canfield
Nevada State Clearinghouse
901 S. Stewart Street, Suite 5003
Carson City, NV 89701-5246

Dear Skip Canfield:

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Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Nevada Division of Environmental Protection
2030 E Flamingo Road, Suite 230
Las Vegas, NV 89119

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Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Cayenne Engel, Resource Management Officer
Nevada Division of Forestry
4747 Vegas Drive
Las Vegas, NV 89108

Dear Cayenne Engel:

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Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Susan Klekar, Division Administrator
Nevada Department of Transportation
705 North Plaza Street, Suite 220
Carson City, NV 89701-0602

Dear Susan Klekar:

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Garrett Wake, Chief, Southern Nevada Operations
Nevada Division of Minerals
2030 E Flamingo Road, Suite 220
Las Vegas, NV 89119

Dear Garrett Wake:

The Bureau of Land Management (BLM) will be preparing an Environmental Impact Statement (EIS) for the proposed Gemini Solar Project (Project). This letter invites you to be a cooperating agency for the EIS.

The Project is located entirely on BLM-managed land approximately 25 miles northeast of Las Vegas in Clark County, Nevada. Depending on the buildable area and panel efficiency, the proposed Project would be an approximately 690-megawatt (MW) photovoltaic (PV) power plant, located on approximately 7,115 acres. The proposed Project would provide renewable energy to the electrical transmission grid via a new 230-kilovolt (kV) generation tie-in to the existing Crystal Substation. The proposed Project would include an energy storage (lithium-ion battery). A segment of congressionally designated Old Spanish National Historic Trail also passes through the project site. Access to the project site includes the Valley of Fire Highway and Bitter Springs Backcountry Byway.

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BLM will serve as the lead Federal agency for consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, and for consultations with the Nevada State Historic Preservation Office under Section 106 of the National Historic Preservation Act. The Project was determined to be a "covered project" under the Fixing America's Surface Transportation ("FAST") Act of 2015, Pub.L. 114-94, Section 41001 on June 27, 2018. The Project is under a One Federal Decision, BLM will develop a single EIS and sign a single Record of Decision (ROD).

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Nevada Division of Water Resources
400 Shadow Lane, Suite 220
Las Vegas, NV 89106

Dear Sir or Ma'am:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Brad Hardenbrook, Supervisory Habitat Biologist
Nevada Department of Wildlife, Southern Region
4747 Vegas Dr.
Las Vegas, NV 89108

Dear Brad Hardenbrook:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Nevada Department of Public Safety
Nevada State Fire Marshal Division
107 Jacobsen Way
Carson City, NV 89701

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Paul Anderson, Executive Director
Nevada Governor's Office of Economic Development
555 E. Washington Ave, Suite 5400
Las Vegas, NV 89101

Dear Paul Anderson:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Angie Dykema
Nevada Governor's Office of Energy
755 N. Roop Street, Suite 202
Carson City, NV 89701

Dear Angie Dykema:

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Gayle Marrs-Smith
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Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Nevada Governor's Office
Grant Sawyer State Office Building
555 E. Washington Ave, Suite 5100
Las Vegas, NV 89101

Dear Governor Sandavol:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

John Koenig, Chairman
Nye County
2100 E. Walt Williams Drive
Pahrump, NV 89048

Dear John Koenig:

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Public Utilities Commission of Nevada
9075 W. Diablo Drive, Suite 250
Las Vegas, NV 89148

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Rebecca L. Palmer
Nevada State Historic Preservation Office
901 S Stewart Street, Suite 5004
Carson City, NV 89701

Dear Rebecca L. Palmer:

The Bureau of Land Management (BLM) will be preparing an Environmental Impact Statement (EIS) for the proposed Gemini Solar Project (Project). This letter invites you to be a cooperating agency for the EIS.

The Project is located entirely on BLM-managed land approximately 25 miles northeast of Las Vegas in Clark County, Nevada. Depending on the buildable area and panel efficiency, the proposed Project would be an approximately 690-megawatt (MW) photovoltaic (PV) power plant, located on approximately 7,115 acres. The proposed Project would provide renewable energy to the electrical transmission grid via a new 230-kilovolt (kV) generation tie-in to the existing Crystal Substation. The proposed Project would include an energy storage (lithium-ion battery). A segment of congressionally designated Old Spanish National Historic Trail also passes through the project site. Access to the project site includes the Valley of Fire Highway and Bitter Springs Backcountry Byway.

The applicant's filing for a right-of-way on BLM-managed lands triggers a National Environmental Policy Act (NEPA) review process of the proposed Project by the BLM. The BLM will also be analyzing a proposed amendment to the 1998 Resource Management Plan to change the Visual Resource Management classification of the Project area.

BLM will serve as the lead Federal agency for consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, and for consultations with the Nevada State Historic Preservation Office under Section 106 of the National Historic Preservation Act. The Project was determined to be a "covered project" under the Fixing America's Surface Transportation ("FAST") Act of 2015, Pub.L. 114-94, Section 41001 on June 27, 2018. The Project is under a One Federal Decision, BLM will develop a single EIS and sign a single Record of Decision (ROD).

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
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2800 (NVS01000)

Nevada State Historic Preservation Office
901 S Stewart Street, Suite 5004
Carson City, NV 89701

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Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

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Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Robert Nellis
State of Nevada
901 S. Stewart Street, Suite 5003
Carson City, NV 89148

Dear Robert Nellis:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Jason Gipson
Chief, Nevada-Utah Regulatory Section
533 West 2600 South, Suite 150
Bountiful, Utah 84010

Dear Jason Gipson:

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Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
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4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
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In Reply Refer To:
N-84631
2800 (NVS01000)

Glen Knowles, Field Supervisor
U.S. Fish and Wildlife Service, Southern Nevada District Office
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Dear Glen Knowles:

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Southern Nevada District Office
Las Vegas Field Office
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
http://www.blm.gov/nv/st/en.html

In Reply Refer To:
N-84631
2800 (NVS01000)

Kevin DesRoberts
U.S. Fish and Wildlife Service, Southern Nevada District Office
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Dear Kevin DesRoberts:

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Las Vegas Field Office
Southern Nevada District

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4701 N. Torrey Pines Drive
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In Reply Refer To:
N-84631
2800 (NVS01000)

Western Area Power Administration
P.O. Box 6457
Phoenix, AZ 85005-6457

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We look forward to hearing from you.

Sincerely,

Gayle Marrs-Smith
Field Manager
Las Vegas Field Office
Southern Nevada District

APPENDIX E

Scoping Comments

APPENDIX E-1

Scoping Comments

Transcripts from Public Scoping Meetings

GEMINI SOLAR PROJECT

EIS SCOPING MEETING

REPORTER'S TRANSCRIPT OF PROCEEDINGS

On Wednesday, August 1, 2018

At 5:00 p.m.

Held at the Suncoast Hotel and Casino

9090 Alta Drive

Las Vegas, Nevada

Reported by: Deborah Ann Hines, CCR #473, RPR

TANIA TREIS: My name is Tania Treis. I'm with Panorama Environmental. We're the NEPA consultants. And I just want to give you a quick overview of the schedule for tonight and then I'm going to pass it over to Gayle with BLM to give an introduction, and then we're going to do our presentation.

So the open house started with, again, open house format. We've got some posters in the back. And we're going to do the presentation next, it's about 15 minutes, then we'll open the floor again, and again you can look at the posters, you can ask questions and talk to folks with name cards in the back. At 6:15 we're going to repeat the presentation, the whole process will repeat again with the open house. And then between 7:00 and 8:00 o'clock we will do speakers.

So if you're interested in giving verbal comments, please fill out a speaker card, and you can give it to Whitney, who's out front manning the table. If you don't want to speak in front of everyone, you can go up to our court recorder and give her your comments individually, or out in the front we have a comment sheet so you can fill that out. If you want to take that with you, mail it in later or if you want to mail comments, you can do that as well. And the presentation will talk about other ways you can comment.

GAYLE MARRS-SMITH: Well, good afternoon, everyone. My name is Gayle Marrs-Smith. I'm the field manager for the Las Vegas office of the Bureau of Land Management in the Southern Nevada District. So welcome to the first of two public scoping meetings for the Gemini Solar Project.

I would like to introduce our distinct manager tonight to everyone. This is Tim Smith, District Manager for the Southern Nevada District.

And so I would like to welcome everyone and thank you so much for your time and energy to come here and learn more about the Gemini Solar Project. So this is, like I said, the first of two public scoping meetings. Tomorrow we will be at the Moapa Community Center, and we will have an identical schedule and a format as tonight's. So tell your friends, if there's anybody else who's interested, if they can't make it tonight, we will be doing the same thing tomorrow night.

So public scoping is so important to the BLM, and the reason for that is that we need to make sure that you understand the project, and that if you have issues and concerns about the project, that we take those issues and concerns and accurately record them so that we can make sure that we capture that in the environmental impact statement that we will be developing. We might think we know what those issues are, but we really rely on the people who live closest to the project to make sure that we get everything covered from soup to nuts regarding issues so that we can build a better analysis and a better document.

So tonight we have some Bureau of Land Management specialists here, because during the open house portion of tonight's open house you'll be able to go to the different posters and we'll have our BLM specialists and you can ask questions too. So will my BLM people here please raise their hands so everybody can see who's here?

We've got quite a few of them. We have a couple of archeologists, we have someone who specializes in utility corridors, that's Michelle. We have some realty people, Eric and Shannon are here, and we have Kerri Ann in the back. We have a botanist here, if you have questions about vegetation and rare species, and we have wildlife biologists, and I believe we have someone in fire even. So if you have questions about fire ecology to the site and how that impacts, we have someone there to answer that.

So please ask questions to these specialists and they would be happy to try to answer them. We also have some people here from Arevia Solar and they can help answer technical questions about the project itself.

So again without further ado we'll get the presentation started, and once again thank you so much for taking your time in coming to this public scoping meeting.

RICARDO GRAF: Good evening, everyone. My name is Ricardo Graf. I'm the managing partner and chief development officer of Arevia Power. We are the project proponent of the Gemini Solar Project. And between myself and my partner, we make up Arevia Power through investment. We have a combined 20 years of utility scale development experience, have financed and built about a gigawatt of utility scale solar projects.

So I'm just going to go through some of the timelines here of the project. So in 2008 there was an initial application that was filed for a solar thermal project. So this was originally, and the purpose of this project was going to be a CSP project, solar power towers. And what happened in December of 2017 is we amended that application to implement a solar photovoltaic project instead of CSP.

Now, going over to June 27th of this past year, it was accepted for processing in the Fast41 system. The notice of intent was issued July 13th, so that was published in the Federal Register and we're embarking on a 45-day scoping period. The EIS is anticipated to last about 12 months, so that starts from July 13th. So July of next year we're expecting a full record of decision. And the project is anticipated to start construction in Q3 of 2019.

So just to give you some orientation of where the project is located, it's about 25 miles northeast of Las Vegas along the I-15 corridor in close proximity to the Apex Industrial Park, which is to the south, and the Moapa Reservation, which is just north of us. The nearest community is the Moapa community, which is 17 miles north of the project site.

So a little bit about the overview of the project. The application area is about 44,000 acres. And within the 44,000 acres we're looking at about

7100 acres of areas that we plan to build within. It's preliminarily planned to do 690 megawatts of project, the project that we're going to build within those areas, but it could generate more depending on the buildable area that we end up with and the technology improvements. We see a lot of advancements in solar photovoltaic spaces and the batteries.

We're also very thoughtful about how we initially approached the siting of the project in order to minimize environmental impacts. The project consists of two interconnections. It's a 250-megawatt interconnection that we have at the 525 south Crystal Substation, and the second interconnection is for 440 megawatts at the 230KV substation, the Crystal Substation. The project is going to require 5.5 mile gen-tie between Crystal Substation and Harry Allen to be built. It's already been environmentally surveyed, and there's permits in place to build that, so the poles are already erected and there's going to be a line, a 230KV line that's built between Harry Allen and Crystal.

And more importantly what we're seeing is a lot of advancements in battery technology and how it improves the energy product to the customer, and so batteries will be a big element of the project.

The technical nuances of this project is, as I stated again, it's photovoltaic cells, just as you see here in these graphics. And we're planning to have a single-axis tracking system installed in the array, which is it tracks the sun over the course of the day.

TANIA TREIS: So as Ricardo had mentioned, we're about 25 miles outside of Las Vegas, and then nearest residential communities are pretty far away, about 17 miles. But there are several other surrounding land uses, so some of those include the Bitter Springs Back Country Byway, probably what you're most familiar with the Valley of Fire State Park, goes down Valley of Fire Highway through the project and then up into the mountains. The Moapa River Indian Reservation, again, is on the northern border of the project area. And then there is a route of the congressionally designated Old Spanish Trail. You can see that in the yellow and the black. That does go through, between development cells in the project area.

So as Ricardo had mentioned, there was a right-of-way application filed originally in 2008. So this is basically an older application, so that means that this project is not subject to the record of decision for the solar energy development PEIS or the solar PEIS, and that means it will have its own independent environmental impact statement; however, a lot of the information in that PEIS is useful towards our process. This project is near the Dry Lake Solar Energy Zone. That's down south of the project on the 15, so it's pretty close to that area.

So this is a slide that shows the NEPA process. The notice of intent was released in July, about two and a half weeks ago. And we're right now in the gray square, the public scoping. This open scoping period will go to August 27th. After scoping is over, we'll look at the comments and we'll continue our technical analysis and works towards preparing the Draft EIS. And according to our schedule, what we're looking at is the Draft EIS will likely go out for public comment towards the end of this year. So fourth quarter of this year we'll look for that.

Once that's out on the street, it will have a 90-day public comment period. So it will be available for the public to look at, to review, to provide comments for 90 days. And that's going to be, again, the end of this year through quarter one of next year.

After that period is over, the comments will be responded to, and a Final EIS will be prepared. The notice of availability of that will be Q3 2019, and then, again, we're looking towards a record of decision signed by the interior secretary around July of 2019 with a notice to proceed, if it's approved, right after that in the third quarter of next year.

So the NOI identified some very preliminary issues that are going to be addressed in the EIS, and those include biological and hydrologic resources, visual, recreation, cultural and tribal, realty/energy corridors, and cumulative, and I'll talk a little bit more about each one. There may be others as well in the process as we develop the EIS.

So in order to address the issues, several technical studies have either been completed or underway. A lot of the fieldwork for this project has been completed and we're in the reporting stage. So to run through, the biological surveys were commenced in the fall of last year. That includes desert tortoise, avian point, eagle nesting, botanical surveys, as well as a jurisdictional delineation. And those fieldwork was pretty much completed in July. The studies are being finalized.

And of note, as the studies are finalized and approved by the BLM, they will go up on the E-planning website, and at the end of the presentation we have a link. It's also on some of the handouts that we have.

The archeological and paleontological studies finished in July. They're also in the reporting stage now. There's drainage studies again underway. A hazard assessment, geotechnical study, a preliminary geotechnical study has been completed in the field in order to understand the ground and the surface in order to design the plant. And again other studies such as air, noise, traffic are all -- socioeconomic are all underway.

In terms of biological resources, the identified issues include presence of special status species. So probably the most prominent is the desert tortoise that's known on the site, but also burrowing owl and kit fox, bighorn sheep, bats, eagles.

There are some jurisdictional waters, and there is a known plant species, it's a state species, endangered species. To address these issues, consultations will include and have already been underway with the U.S. Fish and Wildlife Service.

The project will need a biological opinion for impacts to tortoise. The teams are working with both the Nevada Department of Wildlife, the Fish and Wildlife Service, and Army Corps of Engineers for an independent permit for this project for impacts of waters.

The project obviously will have some visual effect because this is in currently an undeveloped area, so there will be visual effects of the solar field. This project is right off the I-15 as well as down Valley of Fire Highway. There may be some views of the project as you're coming out of the Bitter Springs Back Country Byway, exiting the Muddy Mountains.

Another part of the NEPA analysis will be looking at the visual effects to that corridor, the Old Spanish Trail. And of note to the solar application area is in a Class III area in the 1998 resource management plan. The project does involve an amendment to the resource management to make it a class that's compatible with the solar project.

There are some recreational uses right on the project site itself. There's some existing trails, some off highway vehicle use that's currently allowed and trails and washes. And again there's the congressionally designated route of the Old Spanish Trail, and so to address these issues, consultations with National Park Service have been underway, Old Spanish Trail Association, the OHV groups, that's all underway.

The entire site has been surveyed for cultural and archeological and historic resources. And so, again, any archeological or historic resources, there could be impacts on the project. The consultations that have occurred include coordination with the State Historic Preservation Office. The BLM has already started the consultations with the tribes, and the developer and BLM are working with the Moapa tribe.

There is also a Section 368 Energy Corridor that goes through the southern part of one of the development areas, and so the EIS process will look at compatibility issues. There's no current use of it, but that is a designated corridor that needs to be addressed.

As I mentioned earlier, the project is pretty close to the Dry Lake Solar Energy Zone, so there's a lot of development along that corridor. The EIS will need to address what's the composite impacts of all the solar development in this area in the cumulative impact section, so that's another area that will be addressed for all of our parameters.

And then the process also includes, a very important part of the process, is to look at alternatives. So NEPA requires a development of alternatives that can meet the purpose and need of the project but consider alternative uses of the resources. So this is in the development stages at this point. The alternatives can include alternative configurations of study areas within that 44,000 acre lease area, but also part of the scoping process is accepting comments from public agencies on alternatives.

And so this last slide here shows the ways that you can provide comments. So you can submit mail, email, fax, in person. Again, the comments are due on August 27th. And there's the website. The handout in the front also has all this information on it, but you can submit email, fax, mail to Herman Pinales. And you can also, as we said earlier, you can provide a comment directly to the court recorder here or you can write a comment on the card and put it in the envelope in the back.

And so I think that's all we have for the presentation, and we will open the floor to the posters and the BLM team to take individual comments and questions. And we'll do the presentation again in about an hour, at 6:15. Thank you.

(A recess was taken.)

TANIA TREIS: It's just a tiny bit after 7:00 so we're going to start the speaker portion. And so the way that this is going to work is that I will call up each person and spell your name out. You have three minutes to provide your comment and you're going to address it to our court recorder. She is going to verbatim, take a verbatim transcript of your comment.

Once the three minutes is up, you'll see a red stop sign, I'm going to move this over to the edge here, but you'll see your timer running on the screen as you're speaking. When the red stop sign pops up, your three minutes are up and then it will be time for the next person to come up.

So with that, the first comment card that I have is Gary Reese. So that's G-a-r-y, R-e-e-s-e.

GARY REESE: My comments are also on behalf of Cayenne Engle, C-a-y-e-n-n-e, Engle, E-n-g-l-e, and we're both resource management officers with the Nevada Division of Forestry. We're tasked with enforcing the state endangered plant laws, both the

NRS and the NACs with respect to state endangered species, and we do have one in this project area, the Three-corner Milkvetch. And the map that we're seeing here does not show Area F. It's my understanding that Area F has in excess of 1100 of Three-corner Milkvetch and that they were found this spring. And in the report that I only saw about an hour ago, the botanical resources report, it claimed that this was not a particularly good year for botanizing.

So we did sight a population at Sandy Cove. Cayenne Engle has surveyed that with a master's thesis research of Diane Bangle. I can't spell that name, but she did a master's thesis out of UNLV, and they have multiple year population data for Sandy Cove.

I wanted to point out that Sandy Cove, at 8,000 estimated plants in the year 2009, is a threatened habitat. It is substantially less of a sand dune than it was in the early days of Lake Mead. And in my reef photography along Lake Mojave, it's in Timothy Sullivan's ET71 photography, the sand dunes have greatly receded as a result of the building of the lakes. There's no longer sand that's coming across the valleys now. The sand is hitting the lake and dropping out before they make these dunes bigger.

Another threat besides loss of sand at Sandy Cove is the threat of Brassica tournefortii, it's Sahara mustard. And Cayenne Engle relayed to me that the same year I was surveying on the Overland Lake side did not see the species, she was surveying with Diane Bangle in that banner year, and they were having to hand pull Brassica. It's her opinion that without continued control of that, that that population would be overrun by Brassica, which has a finalogy that's going to compete against the Milkvetch and possibly reduce its number.

So there is a concern that Area F has perhaps the second largest population of the state endangered species, and perhaps as much as 12 percent of its known individuals. And I recommend that the company consult with NDF and seek a state endangered species permit as required under that NRS and NACs. Thank you.

TANIA TREIS: Our next speaker is Kevin Emmerich. That's K-e-v-i-n, E-m-m-e-r-i-c-h.

KEVIN EMMERICH: Thank you. My name is Kevin Emmerich, and our group, Basin and Range Watch, and we follow really big, large energy projects like this that have so many impacts.

Here we go again. 7,000 acres. That's ten square miles. That's big. You mow it, you clear it, you're going to have to alter ten square miles of really good desert tortoise habitat. As an agency, the BLM has to review a need for a project. Not far down the highway is Las Vegas experiencing one of the major growth booms in the history. It's growing at all seams.

Communities like Sky Canyon, thousands of acres are not utilizing a lot of the build environmental alternatives of this project, such as rooftop parking lot covers, that sort of thing. It's really unfortunate. And if you examine a need for this project, consider that the BLM is a multiple use agency that has a responsibility to protect endangered species.

And this is an excellent desert tortoise habitat. Your survey uncovered over 200. And I'm guessing that habitat probably has, on ten square miles, about 400 tortoises you're going to have to excavate and move. The species is not doing well. It's declining in a lot of its range and it's facing a lot of threats like the Northern Corridor Highway in Utah and several connectivity issues to the east -- or to the west of here, the Dry Lake Solar

Zone you're going to build, and you've just probably approved the Dry Lake East Designated Lease Area, and the desert tortoise linkage is just disappearing in that area.

This particular area that's identified is the least caught pathway by biologists, and that means that it's a very important area for desert tortoise linkage and connectivity. When you fence it off and build a bunch of solar panels, you're just going to take away that habitat. The cumulative impact is great when you consider the massive growth of the community of Las Vegas. I can go on and on about the habitat.

Again it's a great waste. The solar panels don't character the desert, or if you set up a good net metering program that allows people to sell the energy back to the grid on the rooftop. You can select a no action alternative, although you don't, and then here we have you're going to downgrade the visual class so you have to build giant solar farms along the road to the Valley of Fire. Yeah, you'll create some construction jobs, but you know as well as I do these solar farms create ten to twenty full-time jobs. It is not worth it. Stop doing this to our desert. We're losing it all. Thank you.

TANIA TREIS: Our next speaker will be John Hiatt. That's J-o-h-n, H-i-a-t-t.

JOHN HIATT: There are a lot of issues with this project. As we drive north from the intersection of Highway 93 and 15, we see Dry Lake Solar Zone, we see those, that photovoltaic array there. As we go north we find two projects on the Moapa Reservation just across the highway from where this is proposed, and now we see this, one of the biggest projects, certainly the biggest photovoltaic project in Nevada.

There are lots of things that need to be considered here. One is a pretty impressive habitat out there. One of the things Gary Reese didn't mention was that another threat to the Three-corner Milkvetch is the proliferation of African mustard, a different mustard than Sahara mustard is also there.

No one has really talked about the cumulative impact of all these things on bird populations as they fly over these things from a distance. As birds fly, they look like a lake, like a water surface because they reflect light, especially at night. The birds will come down and realize too late this isn't water, it's a solid, they crash into it, they die, it's over. So that needs to be taken into consideration.

The Old Spanish Trail has been federally designated, it's protected. The map shows it going right across the Spanish Trail, traversing right across one of the projects with no effort whatsoever it appears to take that into account. There needs to be a wide corridor on either side of the Old Spanish Trail so that people going out and looking and trying to experience what it's like to be on the Old Spanish Trail can understand what it looks like.

And if you see solar panels on either side of you, twenty feet or fifty feet or even a hundred feet away, this is not exactly what it was like when the pioneers, when the Spanish using that trail or the Mexicans using that trail came by. So there needs to be a buffer zone, and I would say at least a thousand feet on each side of the Old Spanish Trail to accommodate this, if it's even going to happen at all.

The visual impact of this thing will be significant from everyone. This is like 7,000 acres. That's hard for the average person to even conceive of what 7,000 acres is like. It's immense. And so when people go out to the Muddy Mountains, when they go to the Valley of Fire, for instance, it really is not reasonable for them to drive through an industrial project to get to the Valley of Fire, the most popular state park in Nevada.

So I would say that there needs to also be a buffer zone on either side of the Valley of Fire Road. I would say a thousand feet on either side of the road is not unreasonable, considering the size of the project area and the size of the project. There's space for doing that. There are a number of other things that I will be commenting on in my written comments, but that's all for the moment. Thank you.

TANIA TREIS: Our next speaker is Hermi Hiatt. That's H-e-r-m-i, H-i-a-t-t.

HERMI HIATT: Good evening. This is one of the meetings that I've come to, I usually don't comment, but I'm the second person talking about plants, and I'm specifically talking about the plant that Gary Reese is mentioning, the Three-corner Milkvetch.

It is a Nevada endangered, critically endangered species. I have been watching this population in the vicinity of this project since 2005, and I usually go when the time is right, when they should be germinated and they may have some seeds so I can confirm it's the real plant.

So anyway, I've been observing those populations. Unfortunately I haven't been able to get out the last two years, but I'm so glad to find out tonight that 2018, the spring of 2018 was a really good season and that they were thriving. So the rains came at the right time and the population was thriving.

That plant actually is quite finicky about habitat. It needs windblown sand. It will not be sand that's deposited by water, so it's eolian sand, and so, you know, when you have a population, like Gary was mentioning in F, and I found somewhere down here there's another good area that they found a lot of plants. So I just hope that that can be avoided and the habitat will not be disturbed so the blown up sand can stay there and we can have some more plants in the future. That's all I have to say. It's unusual to be able to talk about plants because they don't move.

TANIA TREIS: Our final speaker tonight is Bob Adams. That's B-o-b, A-d-a-m-s.

BOB ADAMS: Hi. Bob Adams representing the American Motorcycle Association, Southern Nevada chapter, and the Motorcycle Racing Association of

Nevada. And I want to talk about people and the quality of life of people.

I'm a California refugee from 1993, and Nevada was like going back 30 years when I came here. All the great things that we had in California in the 70's were still here. And from lessons learned there, let's do it right here. We are growing. But I think we use the example, say look at Phoenix that by preserving, identifying and preserving popular recreation areas and natural areas that we can preserve that small city quality of life for generations to come.

And some of this project is really going to roll right over some very, very popular areas that people have been out playing on for years, especially when it comes to the application grant, that we run over what's called programmatic biological opinion routes now where these routes or roads are surveyed that there's sample routes. And once we lose those routes in areas, that we've pretty much lost them forever. That's why we want to go ahead and keep these routes open.

And let's take some of this area and set it aside for recreation in some sort of a permanent use, permanent multiple use area that has the same permits as say a wilderness that people can come to. And by multiple use we have shared use, and by shared use we all have more. Thank you.

TANIA TREIS: That was the last speaker, so with that, thank you all for coming, and think our meeting is concluded.

(Thereupon the proceedings were concluded at 7:19 p.m.)

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CERTIFICATE OF REPORTER

STATE OF NEVADA)
SS:
COUNTY OF CLARK)

I, Deborah Ann Hines, certified court reporter, do hereby certify that I took down in shorthand (Stenotype) all of the proceedings had in the before-entitled matter at the time and place indicated; and that thereafter said shorthand notes were transcribed into typewriting at and under my direction and supervision and the foregoing transcript constitutes a full, true and accurate record of the proceedings had.

IN WITNESS WHEREOF, I have hereunto affixed my hand this 22nd day of August, 2018.

Deborah Ann Hines, CCR #473, RPR

GEMINI SOLAR PROJECT
EIS SCOPING MEETING

REPORTER'S TRANSCRIPT OF PROCEEDINGS

On Thursday, August 2, 2018
At 5:00 p.m.

Held at the Moapa Recreation Center
1340 Highway 168
Moapa, Nevada

Reported by: Deborah Ann Hines, CCR #473, RPR

RICARDO GRAF: How are you? My name is Ricardo Graf. I'm a managing partner and chief development officer for Arevia Power. Arevia Power is a utility scale solar developer, and between myself and my partner and other partners of Arevia we have about 20 years of developing utility scale solar projects.

So just to give you a quick overview on timelines, the project initially filed its application in 2008. It was for a solar thermal plant, a CSP, solar power towers is what we initially proposed. In December of 2017 we took that application and we amended it for photovoltaic use. It's basically PV panels that are going to be installed.

And on June 27th, so this was this past month, it was accepted for processing for a Fast41 project. A notice of intent was published in the Federal Register on July 13th, and that started the 45-day scoping period. We're anticipating that the EIS will find its record of decision in 12 months from the notice of intent publishing. So July of next year we'll have a record of decision in place. And we're anticipating it to start construction in Q3 of 2019.

So just to give you some orientation on the project, if you're not familiar with the area, the project location is 25 miles northeast of Las Vegas along the I-15 corridor in close proximity to the Apex Industrial Park and basically south of the Moapa Reservation. We share a line with the reservation. The nearest community is where we're at today, 17 miles north of the project.

So some specifications on the application area. It's about a 44,000 acre application area. We're planning to construct on approximately 7100 acres of the 44,000 acres that's the study area. And preliminarily we're looking at 690 megawatts. It could generate more depending on the buildable area and the improvements of technology. We're seeing some advancements in photovoltaic.

And the siting of where this development areas are placed was carefully selected to minimize environmental impacts. The project consists of two interconnections. We have a 440 megawatt interconnection for interconnecting at a 230KV substation that's owned by NV Energy. It's called Crystal Substation. We also have a 250 megawatt interconnection application, and it's interconnecting at the 525 substation. That one is called South

Crystal Substation, NV Energy substation. The project is 5.5 miles -- so this project will require a 5.5-mile line to go between the Crystal Substation and the Harry Allen Substation, both owned by NV Energy. And the poles have already been erected. They basically just need a line placed on that, on that route.

And a really important component of the project will be batteries. The covering of the batteries with solar will be the new wave of technology, so it's really bringing us out of all the people from relying on.

The technical aspects of the project, as I mentioned, is that this is a PV project, so this is an example of what you might see at the project. Like it's going to be installed on a single-axis tracking system, meaning it will track the sun through the course of the day.

TANIA TREIS: So I'm Tania Treis. I'm with Panorama Environmental, and I'm the environmental consultant that's preparing -- working with the BLM to prepare the environmental impact statement under the National Environmental Policy Act for this project.

So as Ricardo had mentioned, the project is

25 miles outside of Vegas, 17 miles away from this community, which is the closest community. But it has several other land uses surrounding it, mostly recreational type uses. So as was mentioned just to the north of the project sharing a boundary is the Moapa River Indian Reservation. The Valley of Fire State Park is probably the most familiar, but is along Valley of Fire Road outside of the project area up in the hills beyond the project. The Bitter Springs Back County Byway also is outside the project area but in the vicinity. And the Muddy Mountains wilderness. Also the congressionally designated route of the Old Spanish Trail does traverse through some of the development areas in the project area.

So as Ricardo had mentioned, there was a right-of-way application filed in 2008, so this is an older lease, which means that it is not subject to the record of decision for the solar energy development in six southwestern states, which is known as the solar PEIS, solar programatic environmental impact statement. You may have heard of that in this area. That's a big solar EIS development. This project is not specifically subject to it because it's an older lease, which means that it's going to have it's own environmental impact statement that's independent; however, there's a lot of useful information in that document that would be used for this project. This project is near one of the areas that's designated in the solar EIS, PEIS called Dry Lake.

So this slide shows the NEPA process. And right now we're in the gray box, which is the public scoping meeting. The notice of intent to prepare an EIS was published in the Federal Register on July 13th, so about two and a half weeks ago. The public scoping period starts from the publication and it goes 45 days to August 27th, so this is the timeframe where comments are accepted, written, mailed in comments. And later we'll talk about ways to submit comments. Once the comment period closes, the comments will all be addressed in a document called a scoping report, so it will identify the comments, categorize them, provide some answers, and that will be used to help prepare the Draft EIS, Environmental Impact Statement.

And so the Draft EIS, the next step of the public comment, would be the release of the Draft EIS. And right now it's targeted that that will go out for public review at the end of this year, probably Q4, December timeframe. And because the project requires what's known as a resource management plan amendment, it has a mandatory 90 day public review period. So the public will have about three months to look at that EIS and provide comments to the BLM.

Once that comment period closes, those comments will be looked at, they'll be addressed, maybe some edits made, and then the Final EIS will be published. And, again, we're looking at around the middle of next year. Once the final is published, there's a period of time before the record of decision is signed. And, again, that would be right about mid July of 2019 it's expected, and if approved the notice to proceed will come in later 2019.

So the notice of intent identified some preliminary technical issues. So these are again the topics that are addressed in the environmental impact statement include biological and hydrologic resources, visual resource, recreation resources, cultural and tribal, land, realty/energy corridors. These are just a couple but the EIS will address more but these are the ones we're looking at some issues.

So in order to prepare this EIS and to address these issues, several detailed technical studies have been prepared or in the process of being prepared. The list on the left are all the technical studies. Many of them in the field have already been completed. These studies, this process actually started last year. So in terms of biological studies, those surveys started in the fall of last year, and various studies continued through about July of last month, and right now they're in the reporting phase.

And as these reports are completed, they are going to be reviewed by the BLM. Once they're approved by the BLM, they'll be posted on the E-planning website and so the public can look at those documents and review them as they became available. Some of the first ones that should be available very soon include the desert tortoise and the botanical survey results.

Archeological and paleontological surveys were completed as well and again in the reporting phase for those. A drainage study, looking at how water flows through the site and what affects the project will be on the flow of water is underway and should be completed fairly soon. A hazard assessment was completed for the site. Geotechnical studies, preliminary geotechnical studies were conducted in order to understand the soils and the geology to engineer the project properly. And other studies for the EIS include air, noise, traffic, visual, and socioeconomic are also being prepared.

So to talk a little bit about some of the issues here. Biological resources. There have been some biological resource out here. Known species include the federally threatened desert tortoise, as well as some other species that have been identified in the surveys. There's avian and eagle surveys that were conducted, and there's some bird species out there.

There are -- this one is jurisdictional waters, so these are inside channels that have flow that are the jurisdiction of the Army Corps of Engineers. And there are botanical species including a state endangered plant species, the Three-corner Milkvetch.

And to address these issues part of the process involves consultations and permitting, and so that includes -- and these are underway -- conversations with the U.S. Fish and Wildlife Service and working with the Nevada Department of Wildlife, as well as the Army Corps of Engineers in order to understand the concerns and apply for the appropriate permits for the project.

Visual resources will also be addressed. Obviously this is an area that there isn't development right now, although it's along a corridor where there is quite a bit of development down the street, but this area has not been developed so we have to look at what is the visual change from building a solar facility, both the solar panels and the new transmission associated with it.

There may be some views of it coming out, for example the Bitter Springs Back Country Byway and exiting the Muddy Mountains of this site. There's some views coming down Valley of Fire Road, views from the congressionally designated Old Spanish Trail need to be considered in the EIS.

And the last point is a little technical. It will be explained in the EIS, but the area is currently a visual resource management Class III. And according to the resource management plan for the BLM, that would need to be -- the plan would need to amend it to make it a class that's appropriate for solar.

Recreational resources, as I mentioned earlier, the surrounding, a lot of surrounding land uses support some recreational use. So there's some existing trails on the site. There's some off highway vehicle use of this area, including existing trails and washes. There's the congressionally designated route of the Old Spanish Trial that goes through the area that can be used recreationally. And to address these issues, the BLM is in consultation with the National Park Service, and Arevia is going to be in contact with the Old Spanish Trail Association to understand their concerns and be able to address their concerns, as well as they've already reached out and spoken with some of the OHV community.

Cultural and tribal issues must be addressed in the EIS as well. As I mentioned, the entire area has been surveyed for archeological sources. And any resources found will have to be addressed for impacts. Part of that process involves consultation with the State Historic Preservation Office. And the BLM has already initiated some of the mandatory consultations with the Native American tribes in Moapa.

And, finally, the project has what's known as an energy corridor. It's a designated area for energy for utilities. So it's that blue line that crosses through the very southern part of the proposed development area. And so there's no transmission or other utilities in that line now, but part of the process will be looking at compatibility with that.

And then as we mentioned, this project is near Apex and the Dry Lake area, so there's been a lot of development, transmission, solar in this area. So part of this process also includes looking at what are the cumulative affects from building another solar facility. So that would be a process we'll look at, what are the effects from all the projects together on the various environmental parameters that we talked about.

And then finally a very important process, part of NEPA is defining alternatives. So NEPA requires the development of alternatives that can meet the purpose and need of a project but consider alternative uses of resources. So this is the alternative development process is currently in process. What that could look like is looking at different configurations within that overall 44,000 acre lease are. Again they're looking at developing about 7,000 of the 44, so there's some opportunity to move things around in there. But it's also the scoping period is a time for receipt of comments from the public on things that alternatives that ultimately can be used.

So finally how to provide input. You can provide your comments and your questions via mail. Again the due date is August 27th, and so if you want more information about the project, again, like, we mentioned before, any documents associated with the project are going to be found on this website here. You can email your comments to Herman Pinales at the BLM. And you can make comments tonight, as we mentioned earlier, you can give comments directly to our court recorder, you can write comments and put them in an envelope and give them to Whitney. There will also be a, from 7:00 to 8:00 there will be an open comment period. And that's all we have.

(Thereupon the proceedings
were concluded at 5:35 p.m.,
after all attendees exited
the meeting)

* * * * *

CERTIFICATE OF REPORTER

STATE OF NEVADA)
SS:
COUNTY OF CLARK)

I, Deborah Ann Hines, certified court reporter, do hereby certify that I took down in shorthand (Stenotype) all of the proceedings had in the before-entitled matter at the time and place indicated; and that thereafter said shorthand notes were transcribed into typewriting at and under my direction and supervision and the foregoing transcript constitutes a full, true and accurate record of the proceedings had.

IN WITNESS WHEREOF, I have hereunto affixed my hand this 22nd day of August, 2018.

Deborah Ann Hines, CCR #473, RPR

APPENDIX E-2

Scoping Comments

Comment Letters and Forms from Government Agencies

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

AUG 27 2018

Herman Pinales
Energy and Infrastructure Project Manager
Bureau of Land Management
Las Vegas Field Office
4701 North Torrey Pines Drive
Las Vegas, NV 89130-2301

Subject: Scoping comments for the proposed Gemini Solar Project, Clark County, Nevada

Dear Mr. Pinales:

The U.S. Environmental Protection Agency (EPA) has reviewed the Federal Register Notice published on July 13, 2018 requesting comments on the Bureau of Land Management's (BLM) decision to prepare an Environmental Impact Statement (EIS) and Land Use Plan Amendment, as well as a Notice of Segregation, for the proposed Gemini Solar Project. Our comments are provided pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508) and our NEPA review authority under Section 309 of the Clean Air Act.

The proposed Gemini Solar Project would consist of a 690-megawatt (MW) solar photovoltaic (PV) project, located on 7,115 acres of BLM-administered lands approximately 25 miles northeast of Las Vegas, south of the Moapa Indian Reservation. The proposed project would be situated on multiple sites within an approximately 44,000-acre area and constructed in two phases: Phase 1 (440 MWs) and Phase 2 (250 MWs).

EPA is a cooperating agency under NEPA and has also accepted an invitation to be a FAST-41 cooperating agency on this project. To assist in the scoping process, we have identified the following recommendations for your attention in the preparation of the EIS:

Purpose and Need
The Draft Environmental Impact Statement (DEIS) should clearly identify the underlying *purpose* and *need* for the proposed project (40 CFR 1502.13). When formulating the need, identify and describe the underlying problem, deficiency, or opportunity that the action is meant to address. The DEIS should discuss the proposed project in the context of the larger energy market that this project would serve; identify potential purchasers of the power produced; and discuss how the project will assist the State, as well as other potential purchasers of the energy, in meeting their renewable energy portfolio standards and goals. Describe the criteria used to determine the minimum project size that would be considered feasible.

Alternatives Analysis
The DEIS should include a reasonable range of alternatives that meet the stated purpose and need for the project and that are responsive to the issues identified during the scoping process. A reasonable range of alternatives will include options for avoiding environmental impacts. The alternatives analysis should

describe the approach used to identify environmentally sensitive areas and the process used to designate them in terms of sensitivity. Reasonable alternatives could include, but are not necessarily limited to, alternative photovoltaic (PV) configurations, mountings, and capacities, alternative gen-tie transmission interconnection options, as well as alternative energy storage technologies. The CEQ Regulations for implementing NEPA state that alternatives should include appropriate mitigation measures not already included in the proposed action or alternatives (40 CFR 1502.14(f)). The DEIS should provide a discussion of the reasons for the elimination of alternatives that are not evaluated in detail.

Water Resources

Water Supply and Water Quality

The DEIS should estimate the quantity of water the project will require during the construction phase and during operations (e.g. cleaning the PV panels during routine maintenance, administration and sanitation uses in offices). Describe the source of this water and potential effects on other water users. If groundwater will be used, identify the potentially-affected groundwater basin(s) and evaluate potential impacts to groundwater recharge, springs or other surface water bodies, biologic resources, as well as the potential for subsidence. If water will be supplied from an off-site source, analyze environmental impacts associated with the transport and storage of the alternative water supply. Identify available technologies to minimize or recycle water, including using xeric native plants in any landscaping around buildings. Describe water reliability for the proposed project and clarify how existing and/or proposed sources may be affected by changing precipitation patterns.

Clean Water Act Section 404

The DEIS should describe all waters of the U.S. that could be affected by the project alternatives, and include maps that clearly identify all waters within the project area. Avoidance of any wetlands/waters of the U.S is strongly recommended. If avoidance is not possible, we recommend early consultation with the U.S. Army Corps of Engineers (Corps) to determine if the proposed project requires a Section 404 permit under the Clean Water Act (CWA). If so, it is advisable to ensure that the NEPA alternatives are consistent with the alternatives analysis required under the CWA Section 404 (b)(1) Guidelines. In comparing alternatives, we recommend the discussion include the acreages and channel lengths, habitat types, values, and functions of the waters that would be affected. We recommend including a verified jurisdictional determination from the Corps in the DEIS if waters cannot be avoided.

Avoidance of Desert Washes

In addition to avoiding wetlands and waters of the U.S., we recommend careful micro-siting of project components to avoid ephemeral drainages to the greatest extent possible. These waters are being cumulatively impacted by the numerous large-scale solar projects proposed in the desert. Desert washes perform a variety of hydrologic, biochemical, and geochemical functions that directly affect the integrity and functional condition of higher-order waters downstream. Healthy ephemeral waters with characteristic plant communities control rates of sediment deposition and dissipate the energy associated with flood flows. Ephemeral washes also provide habitat for shelter, breeding and foraging, and movement of wildlife. Many plant populations are dependent on these ecosystems and have adapted to their unique conditions. These values are present regardless of whether the washes are deemed jurisdictional waters of the U.S. under Section 404 of the CWA.

Placement of Panels to Minimize Erosion

Placement of PV panels within washes could result in erosion, migration of channels, and local scour. To minimize potential impacts associated with erosion, we recommend: 1) avoiding placement of support structures in washes; 2) committing to the use of natural washes in their present location and natural form; 3) utilizing existing natural drainage channels on site in lieu of concrete-lined channels; 4) avoiding microphyll woodlands; 5) including adequate natural buffers for flood control; 6) minimizing the number of road crossings over washes; 7) designing necessary crossings to provide adequate flow-through during storm events; 8) limiting grading; 9) maintaining micro-level topography to the greatest extent possible; and 10) mounting PV panels at sufficient height above ground to maintain natural vegetation.

Phased Approach to Grading and Removal of Vegetation
Prematurely grading the entire site and removing vegetation can result in excessive dust problems and unnecessary impacts to habitat, vegetation, soils and other resources – particularly if the project is not constructed in its entirety. As PV technology improves, less land is needed per megawatt generated. During past solar site visits, we have seen large acreages graded that ultimately were not needed to meet the megawatt goals for a project. This land now sits idle, fenced in and may take decades to be restored. To avoid a similar outcome, we recommend a mitigation measure or permit condition that would require a phased approach to construction that ensures only the necessary acreage is built upon.

Sizing Stormwater Infrastructure
We recommend that the BLM/Clark County assess the impacts of changing precipitation patterns on the proposed project. Important design considerations may be needed to accommodate future anticipated effects associated with, for example, increased intensity and severity of storms, which would require an appropriately-sized stormwater management system.

Clean Water Act Section 303(d)
The CWA requires States to develop a list of impaired waters that do not meet water quality standards, establish priority rankings, and develop action plans called Total Maximum Daily Loads (TMDLs) to improve water quality. The DEIS should provide information on CWA Section 303(d) impaired waters in the project area. Portions of the Muddy River are impaired for nutrients, metals, and pathogens. The DEIS should describe whether the project could contribute to this impairment and include any mitigation measures that will be implemented to avoid further degradation of impaired waters.

Air Quality
The DEIS should provide a detailed discussion of ambient air conditions (baseline or existing conditions), National Ambient Air Quality Standards, nonattainment areas, general conformity requirements, and potential air quality impacts of the project, including cumulative and indirect impacts, for each fully evaluated alternative. Emissions of all air pollutants, including greenhouse gases, should be estimated for construction and operations. The DEIS should analyze reasonable practicable mitigation measures to reduce project-related greenhouse gas, fugitive dust, and other emissions. Typical mitigation measures include design changes to reduce construction and operations emissions, fugitive dust control measures, mobile and stationary source controls and administrative controls. Any commitments to mitigation measures should be specified in the DEIS, Final EIS, and Record of Decision (ROD).

Valley Fever
The project site is located in an area that the Centers for Disease Control has classified as "suspected endemic" for *Coccidioides immitis*, a fungus causing Valley Fever in humans.[1] Ground disturbing activities associated with the proposed action may result in dispersal of *Coccidioides* spores. A

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[1] See: http://www.cdc.gov/fungal/diseases/coccidioidomycosis/causes.html

discussion of this potential health and safety impact should be included in the DEIS. Measures should be identified to prevent or reduce the risk of exposure to workers and local residents.

Biological Resources and Habitat Protection

EPA recommends coordination with the U.S. Fish and Wildlife Service (USFWS) on matters pertaining to species and habitat protection. We offer the following general recommendations based on our experience with multiple solar projects:

Protected Species and Habitat

The DEIS should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area. The document should identify and quantify which species or critical habitat might be directly or indirectly affected by each alternative. EPA recommends that BLM coordinate with the USFWS to determine whether consultation under Section 7 of the Endangered Species Act (ESA) is required. We recommend that the DEIS include a biological assessment in an appendix, as well as a description of the progress or outcome of ESA consultation with the USFWS. We recommend that BLM coordinate with the USFWS and Nevada Department of Wildlife to ensure that current and consistent surveying, monitoring, and reporting protocols are applied in all species protection and mitigation efforts. Disclose in the DEIS the status of such coordination efforts, as well as any potential impacts of construction and operations activities on habitat and species, and any measures that would be implemented to protect important wildlife habitat areas from potential adverse effects of proposed activities. The DEIS should disclose potential impacts to desert tortoise, burrowing owl, American badger, desert kit fox, and golden eagle – as well as any other sensitive species which may be impacted by the proposed Project.

Analysis of impacts and mitigation for listed species should include: 1) baseline conditions of habitats and populations of the covered species: 2) a clear description of how avoidance, mitigation, and conservation measures will protect and encourage the recovery of the covered species and their habitats in the project area; and 3) monitoring, reporting and adaptive management efforts to ensure species and habitat conservation effectiveness.

Desert tortoise Habitat

The project location contains habitat for the threatened Mojave Desert tortoise, a species that is experiencing negative impacts from multiple sources, including renewable energy projects. The DEIS should fully present the direct and cumulative impacts that this project, along with other solar projects proposed in the Mojave Desert, is expected to have on this species. The potential long-term effects of utility-scale energy development in fragmenting or isolating desert tortoise conservation areas and restricting gene flow should be considered.

Impacts to Birds

The DEIS should discuss whether there is increased fatality risk to birds, particularly water fowl, associated with solar PV arrays. Birds may mistake the PV panels for water – the so-called lake effect – resulting in unexpected deaths of birds from collisions with the solar panels. The DEIS should discuss the issue of avian mortality and describe measures to minimize potential impacts. We recommend that the Bird and Bat Conservation Strategies include avian mortality monitoring and adaptive management measures.

The DEIS should include assurances that the design of the transmission line would comply with current standards and practices that reduce the potential for raptor fatalities and injuries. The commonly referenced source of such design practices is found within the Avian Power Line Interaction Committee documents: *Suggested Practices for Avian Protection on Power Lines: State of the Art in 2006* manual and *Reducing Avian Collisions with Power Lines: The State of the Art in 2012.*

Avoiding Cryptobiotic Soil Crusts

Desert tortoise survey reports indicate that cryptobiotic crust is found throughout the project site, with concentrations near drainage banks. We recommend avoiding disturbance of existing desert pavement/cryptobiotic soil crusts, if possible, and adopting methods and installation techniques that minimize impacts to the maximum extent possible.

Vegetation Management

The DEIS should discuss general locations of rare plants and describe how potential impacts will be minimized. The DEIS should also consider impacts associated with an increase of shade on vegetation and species in the desert environment, and impacts associated with constructing fences around the project site. If any pesticides and herbicides would be used for vegetation treatment, the DEIS should address any potential toxic hazards related to the application of the chemicals, and describe what actions would be taken to ensure that impacts will be minimized. Soils under PV arrays are frequently sterilized with pesticides to prevent weed growth, which prevents the natural revegetation of native plants that could minimize erosion and provide wildlife habitat. We recommend maintaining the presence of native plants under PV panels, to the greatest extent possible. We encourage the use of wildlife-friendly fencing that could also allow for unimpeded flows during precipitation events.

Invasive Species

Executive Order (E.O.) 13112, *Invasive Species* (February 3, 1999) mandates that federal agencies whose actions may affect the status of invasive species use their relevant authorities to prevent the introduction of such species, provide for their control, and minimize the economic, ecological, and human health impacts that invasive species cause. The DEIS should describe how the project will meet the requirements of E.O. 13112. We recommend including an invasive plant management plan for the monitoring and control noxious weeds.

Hazardous Materials/Waste Management

The DEIS should discuss the potential direct, indirect and cumulative impacts of waste generation, including hazardous waste, from construction and operation activities, as well as the proposed battery storage facility. The document should identify projected waste types and volumes and describe their expected storage, disposal, and management. The DEIS should explain how the generation of hazardous waste would be minimized, and identify applicable federal hazardous waste requirements. If PV panel trackers will utilize hazardous materials such as refrigerants, discuss and evaluate potential impacts from accidental or unexpected releases. The DEIS should discuss whether any pesticides, including herbicides or rodenticides, would be used at the project site.

Environmental Justice

The DEIS should assess impacts to local communities consistent with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994). The DEIS should address the potential for disproportionate adverse impacts to minority and low-income populations, and the approaches used to foster public participation by these populations. Assessment of the project's impact on minority and low-income populations should reflect coordination with those affected populations.

Cultural Resources and Tribal Consultation
The DEIS should evaluate how both construction and operation activities may impact cultural resources, including Native American cultural resources. We recommend that the DEIS document any tribal consultation that has been conducted and the outcome of that consultation, as well as any activities or mitigation measures proposed to address concerns identified by tribal governments.

National Historic Trails
The DEIS should evaluate how both construction and operation activities may impact the Old Spanish National Historic Trail, which transects the proposed project site, and describe whether trail protective corridors exist, or are recommended, for trail corridor protection. The DEIS should describe the status of coordination and consultation activities with the National Park Service and BLM, accordingly. If mitigation measures are required, discuss the measures in the DEIS, Final EIS, and ROD.

Visual Impacts
According to the Federal Register Notice, the project sites are located on lands managed as Visual Resource Management (VRM) Class II and Class III. A BLM Resource Management Plan (RMP) amendment would be required to change the VRM Class II areas. The DEIS should discuss the status of the proposed RMP amendment and provide illustrations which clearly show current VRM Class II and Class III areas, as well proposed changes.

Careful attention should be given to how solar arrays are set against the landscape. Steps should be taken to minimize the visual impacts and make the arrays and related facilities less obtrusive. Visual impacts should be evaluated from positions nearby, including the Muddy Mountain Wilderness, Bitter Springs Back Country Byway, Valley of Fire State Park, Moapa River Indian Reservation, and the Old Spanish National Historic Trail.

Cumulative Impacts
Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The DEIS should describe the methodology used to assess cumulative impacts. We recommend that the BLM consider the methodology[2] developed jointly by EPA, the Federal Highway Administration, and the California Department of Transportation. While this methodology was developed for transportation projects, the principles and steps in this guidance offer a systematic way to analyze cumulative impacts for any project.

We appreciate the opportunity to provide comments on the preparation of the DEIS. If you have any questions, please contact me at (415) 972-3545 or mcpherson.ann@epa.gov.

Sincerely,

Ann McPherson

Ann McPherson
Environmental Review Section

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[2] Available at: http://www.dot.ca.gov/ser/cumulative_guidance/approach.htm.

Gemini Solar Project EIS and Resource Management Plan Amendment

BLM SCOPING COMMENT SHEET

The Bureau of Land Management (BLM) would like to obtain your input regarding the Gemini Solar Project EIS and associated Resource Management Plan Amendment.

Where to provide comments: You can hand this form in at a public scoping meeting, mail it in using the address on the reverse, or fax it in to 702-515-5023. **Comments can also be submitted via email to the following email address: blm_nv_sndo_geminisolar@blm.gov**

Name: Gary Reese

Title: Organization:

Mailing Address: 366 7th St, #3

City: Elko State: NV Zip: 89801

Email: pcacala@earthlink.net

Date: Aug. 1, 2018

☐ Please check box if you want to be on the mailing list for future updates and notification for this project. The Draft EIS will be posted on the BLM Southern Nevada District Office website. You will be notified when it is available.

COMMENT *(use back side if you need additional space or attach additional sheets)*

① If the cultural resources report misses mapping former alignment of the Arrowhead Highway, please obtain that information from a survey done on proposed met towers. That survey was done by Logan Simpson Design in 2014 covering the south half of the proposed Action area. ② My verbal comment failed to mention 1930 aerial photography of Sandy Cove supporting my conclusion the dune is losing area

Fold in thirds so address (on reverse) is showing, add postage, tape bottom of fold, and mail, ***postmarked by Aug 27, 2018.***

☐ Please check box if you do **not** want your name released when comments are made public.

DATE: 8/01/2018

TO: Nevada State Clearinghouse, DCNR

FROM: Nevada Division of Environmental Protection, Bureau of Water Pollution Control

SUBJECT: State Clearinghouse Comments for E2019-011 (EIS – Gemini Solar – Clark County)

Disclaimer: The Nevada Division of Environmental Protection (NDEP), Bureau of Water Pollution Control (BWPC) does not have authority for projects occurring on Tribal Lands.

The NDEP, BWPC has received the aforementioned State Clearinghouse item and offers the following comments:

The project may be subject to BWPC permitting. Permits are required for discharges to surface waters and groundwaters of the State (Nevada Administrative Code NAC 445A.228). BWPC permits include, but are not limited to, the following:

- Stormwater Industrial General Permit
- De Minimis Discharge General Permit
- Pesticide General Permit
- Drainage Well General Permit
- Temporary Permit for Discharges to Groundwater's of the State
- Working in Waters Permit
- Wastewater Discharge Permits
- Underground Injection Control Permits
- Onsite Sewage Disposal System Permits
- Holding Tank Permits

Please note that discharge permits must be issued from this Division before construction of any treatment works (Nevada Revised Statute 445A.585).

For more information on BWPC Permitting, please visit our website at: https://ndep.nv.gov/water/water-pollution-control/permitting .

Additionally, the applicant is responsible for all other permits that may be required, which may include, but may not be limited to:

- Dam Safety Permits - Division of Water Resources
- Well Permits - Division of Water Resources
- 401 Water Quality Certification - NDEP
- 404 Permits - U.S. Army Corps of Engineers
- Air Permits - NDEP
- Health Permits - Local Health or State Health Division
- Local Permits - Local Government

Thank you for the information and the opportunity to comment.

SOUTHERN NEVADA WATER AUTHORITY
100 City Parkway, Suite 700 • Las Vegas, NV 89106
MAILING ADDRESS: P.O. Box 99956 • Las Vegas, NV 89193-9956
(702) 862-3400 • snwa.com

Via FedEx

August 13, 2018

Herman Pinales
Bureau of Land Management
Las Vegas Field Office
4701 North Torrey Pines Drive
Las Vegas, Nevada 89130–2301

Dear Mr. Pinales:

SUBJECT: SOUTHERN NEVADA WATER AUTHORITY SCOPING COMMENTS ON THE PROPOSED GENIMI SOLAR PROJECT (N-84631)

Southern Nevada Water Authority (SNWA) appreciates the opportunity to provide scoping comments on the proposed Gemini Solar Project (N-84631) (Proposed Project). SNWA is a political subdivision of the State of Nevada formed by a cooperative agreement between seven water and wastewater agencies in southern Nevada, including Big Bend Water District, City of Boulder City, City of Henderson, City of Las Vegas, City of North Las Vegas, Clark County Water Reclamation District, and Las Vegas Valley Water District. SNWA is responsible for managing the regional water resources of southern Nevada and developing solutions that will ensure adequate future water supplies for Las Vegas through the development and implementation of regional water resource management and conservation programs and initiatives.

Section 1.3.8.1 of the Plan of Development states the anticipated total amount of water needed during the Proposed Project construction would be approximately 2,000 acre-feet, and approximately 20 acre-feet during its operation. However, the source of the water is not described in the document. Please provide a description of the water source in the Environmental Impact Statement (EIS).

Table 4-1 Routine Maintenance Protocol, lists Water Wells that will be maintained annually via a visual inspection and pressure test. Also, the project proponent will prepare a Groundwater Monitoring and Reporting Plan (Section 5.3). These statements imply groundwater will be used for the construction and operation of the Proposed Project. Again, please provide more detail (e.g., the groundwater hydrographic basin(s) source, the analysis of water rights, water rights ownership, and potential water availability, the groundwater monitoring/reporting process and their products, location/number of water wells, etc.) in the EIS. These items should be identified in the initial planning process since they have the potential to dramatically change a proponent's remaining actions regarding water resources. Further, since SNWA is responsible for the management and development of water resources for southern Nevada, we respectfully request to be notified when the Groundwater Monitoring and Reporting Plan is final and available to the public.

SNWA appreciates the opportunity to comment on the Proposed Project. Please continue to keep us informed of the status of this proposal by placing SNWA on your project mailing list. Also, please notify SNWA when the Groundwater Monitoring and Reporting Plan is final. If you have any questions regarding these comments or need additional information, please contact me at kimberly.reinhart@snwa.com or (702) 862-3457.

Sincerely,

Kimberly Reinhart

Kimberly Reinhart
Senior Environmental Planner

KR:CL:sn

APPENDIX E-3

Scoping Comments

Comment Letters and Forms from Non-Governmental Organizations

7770 QUARTER HORSE AVE
PAHRUMP, NV 89061
rapahrump@gmail.com
775 727 1592
August 2, 2018

COMMENTS: DOI-BLM-NV-S010-2018-0051-EIS (Gemini Solar)

blm_nv_sndo_geminisolar@blm.gov

Dear Planning Team:

Las Vegas metro-area is surrounded by federal public land. Quality of Life of area citizens should be the key component in resource management planning. Past planning public land planners have mitigated for everything but recreation. The results are a continual net loss of recreation opportunities.

Phoenix metro is proof by smart planning small city Quality of Life can be preserved as cities grow together into large metros. To preserve our small city Quality of Life we must identify heritage OHV sport/recreation areas and protect those areas by permanent boundaries. Public recreation (including riding OHVs) should be on equal standing with preservation and development in resource planning decisions.

The Gemini lease area applied for contains miles of popular OHV routes including PBO (Programmatic Biological Opinion) routes approved for speed competition events. Can the proposed Gemini project be built without net loss of OHV sport/recreation opportunities?

My concerns are as an OHV rider, a Conservationist, and a Planner. I serve or have served as a member and officer of several OHV organizations and government bodies regulating use of OHVs, including the MOSO RAC and Nevada OHV Commission. I serve on Southern Nye County's Conservation District and am a former Regional Planning Commissioner. Sport and recreation is a legitimate sustainable use of public land. Please keep public land public. Keep public land open to the public.

Thank you for your consideration. And my best regards.

Sincerely,

Robert Adams

Basin and Range Watch

PO Box 70
Beatty NV 89003

775-553-2806, emailbasinandrange@gmail.com, www.basinandrangewatch.org

Western Watersheds Project
Cedar Canyon Road, Cima, CA 92323
tel: (775) 513-1280
fax: (208) 475-4702
email: lcunningham@westernwatersheds.org
web site: www.westernwatersheds.org
Working to protect and restore Western Watersheds and Wildlife

To: Bureau of Land Management, Southern Nevada District, Energy & Infrastructure Project Manager, 4701 N. Torrey Pines Drive, Las Vegas, NV, 89130, Emailed to blm_nv_sndo_geminisolar@blm.gov

August 22nd, 2018

Re: Scoping comments for the Gemini Solar Project – DOI-BLM-NV-S010-2018-0051-EIS-Gemini Solar

Basin and Range Watch is a 501(c)(3) non-profit working to conserve the deserts of Nevada and California and to educate the public about the diversity of life, culture, and history of the ecosystems and wild lands of the desert. Federal and many state agencies are seeking to open up millions of acres of unspoiled habitat and public land in our region to energy development. Our goal is to identify the problems of energy sprawl and find solutions that will preserve our natural ecosystems, open spaces, and quality of life for local communities. We support energy efficiency, better rooftop solar policy, and distributed generation/storage alternatives, as well as local, state and national planning for wise energy and land use following the principles of conservation biology. We have visited the site of the proposed Gemini Solar Project. We have taken photos of the region, hikes on the site and have observed unique flora and fauna on the site.

Western Watersheds Project is a non-profit organization with more than 1,500 members and supporters. Our mission is to protect and restore western watersheds and wildlife through education, public policy initiatives and legal advocacy. Western Watersheds Project and its staff and members use and enjoy the public lands and their wildlife, cultural and natural resources for health, recreational, scientific, spiritual, educational, aesthetic, and other purposes. Western Watersheds Project also has a direct interest in energy development that occurs in areas with sensitive wildlife populations and important wildlife habitat. We support solar energy and renewable energy in order to offset the dangerous trends of increasing greenhouse gas emissions. But we have comments on how to better site these utility-scale projects in the places that minimizes impacts to natural and cultural resources of the deserts, analyze alternatives that would avoid impacts to natural communities and sensitive species.

Introduction:

The Gemini Solar Project would be developed on a large site comprised of public lands that are important for threatened and rare species of plants and animals including the Threecorner milkvetch and the desert tortoise. The close distance to Lake Mead and the Muddy River will give the project the potential lake effect that could attract birds and possibly cause mortality. The project would be developed on the entrance road to Valley of Fire State Park, and be highly visible from the Muddy Mountains Wilderness Area. The project would be developed on a section of the historic Old Spanish Trail.

Short Comment Period, Lack of Information at Scoping Meetings and During the Scoping Process Precludes Meaningful Public Participation in the NEPA Process:

In July, 2018, Bureau of Land Management (BLM) held two scoping meeting for this project. At the time of the meetings, very little information was provided on the specifics of the biological, visual and archeological resources on the Project site. The BLM's website for the Project only has the project Plan of Development posted at the time which provided only minimal information. Very little information about battery storage was provided, compared to other current solar projects under review.

This spring and summer, the Southern Nevada BLM held scoping periods for two other large-scale renewable energy projects: Crescent Peak Wind and Yellow Pone Solar. These projects are also very large and would have equally disruptive impacts on the resources of the regions they would be built in. But has BLM provided 90 full days in the scoping periods for these two projects and only 45 days for the scoping for the Gemini Solar Project.

The project site for the Gemini Solar Project contains very important biological, cultural, and visual resources. BLM's rush to scope this Project without providing the public with relevant information on which to comment is a classic violation of NEPA's dual goals of disclosure of relevant information to the public and fostering of informed public participation in the "democratic decision-making" process. BLM should extend the scoping period until 60 days after it has posted all relevant information on biological and cultural studies of the project site on its website for the Project so that the public can provide meaningful comments.

Two Land Use Plans (LUP's) are Being Reviewed at the Same Time:

At this time, the BLM must amend the 1998 Southern Nevada Resource Management Plan (SNRMP) in order to approve this project. This comes at a very awkward time because the BLM is also reviewing the revision of this plan which they have a goal of completing in early 2019.

The Visual Impacts would be so disruptive that the BLM must down-grade the entire Visual Resource Management (VRM) Class for the region. The region is currently managed as VRM II and III, but must be downgraded to VRM IV, the least protected VRM Class, so the project can comply with the LUP amendment. The high visual class is due to the fact that the project would be built next to the Muddy Mountains Wilderness Area and along the Bitter Springs Backcountry Byway. Downgrading the VRM Class to accommodate one company will make the BLM quite unpopular on a public level. The beautiful desert scenery remains the same.

The new Southern Nevada Resource Management Plan has been on the table since 2014. Since that time, the population of Southern Nevada has grown considerably and it would only be a quick fix to amend the 1998 plan for this one project. Doing this only for the project proponent skirts the public NEPA process that has been used to amend the old plan. The project site is popular with recreationists who will resent having their access cut off. This decision should be decided on the RMP level and we hope BLM will not compromise the higher standards of this site in the RMP just to please the applicant.

The revised Resource Management Plan is a new land use plan which gives the public an opportunity to request revisions to each plan.

Below are justifiable reasons for the BLM to wait on this review until the RMP can be updated. According to the National Environmental Policy Act, NEPA Handbook, *"RMPs are periodically evaluated to determine if management decisions contained within them are still current and adequate. Where changing conditions (such as the Federal listing of a wildlife or plant species as threatened or endangered) and/or demands on the public lands have resulted in the need to update management decisions in the RMP, the BLM may either revise or amend the RMP to bring it into conformance with these changing conditions."*

We believe that if the BLM would evaluate current information and updates on the declining status of species like the desert tortoise and burrowing owl, they would find new and important information. Furthermore, the BLM will need to conduct more surveys for the Threecorner milkvetch. For best results, the surveys need to be conducted after a wet winter during the spring. Failure to survey the current conditions of the plant's status may result in inaccurate information used to write a Draft EIS. This justifies waiting for a completed RMP.

Secretarial Order 3355:

The new Secretarial Order – 3355 requires the BLM to have the entire review be conducted in one year from the beginning of scoping and all EIS documents should be 150 pages or 300 under special requests to the DOI. The 150 pages is supposed to exclude appendices but the BLM told us at the Gemini scoping meeting that there would be no appendices. We think that the BLM got this wrong as the order states:

“To implement the longstanding directives in 43 C.F.R. 46.405, and in 2 40 C.F.R. 1500.4 and 1502.7, all EISs 1) for which a bureau is the lead agency and 2) that have not reached the drafting stage shall not be more than 150 pages or 300 pages for unusually complex projects***, excluding appendices***.” (emphasis ours).[1]

If the BLM is bound to just a 150-page document, we would like to request that all of the other information be included in the appendices – no matter how long they may be.

Compensatory Mitigation:

The Trump administration is ending a policy of off-site compensatory mitigation that requires developers to pay the government for damages their work can have on wildlife and habitats on public land. These funds are used to mitigate similar habitats for species in other parts of the desert.

By eliminating the requirement for off-site mitigation, the BLM will have to mitigate all of the impacts to these resources on site. Since the project will remove a major part of the core habitat for the Threecorner milkvetch, mitigating these impacts on site may be impossible. Equally, developing a ten square mile project in good quality desert tortoise really cannot be mitigated on site. Project proponents will often reduce their project size in their own ROW so they can mitigate on site, but you have chosen a site that very well may be occupied by close to 300 threatened desert tortoises. That is quite a number to move “on site”. Even if you cut the project in half, you would still need to move this many tortoises and crowd them together on site. This is an unviable option.

We would like to closely review all of these on-site mitigation proposals.

Purpose and Need/Alternatives:

The Gemini Solar Project would develop, disturb and destroy 7,100 acres (10 square miles) of Mojave Desert habitat. The project will have impacts on biological resources, (desert tortoise, kit fox, burrowing owl, Threecorner milkvetch, sand transport, microphyll woodlands), cultural landscapes, archeological sites, air quality, public health, public access, and visual resources.

The Purpose and Need Statement should include a need to protect cultural, biological, hydrological, and visual resources, as well as air quality and recreational uses. The Purpose and Need Statement should also include a need to protect the resources on this site and in the general region by examining Distributed Generation and Brownfield alternatives. Any Bureau of Land Management Purpose and Need Statement should not narrowly interpret the following orders to justify the project. These orders do not have to narrowly apply to the region:

Executive Order 13212 mandates transmission of energy in a “*safe and environmentally sound manner”.* But as we have seen from past approved BLM projects, large environmental issues have created problems for wildlife, visual resources, cultural resources and many of the projects such as the Ivanpah Solar Electric Generating System Project have not delivered the

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[1] https://www.doi.gov/sites/doi.gov/files/uploads/3355_-_streamlining_national_environmental_policy_reviews_and_implementatio.pdf

promised capacity from the developer. Some photovoltaic projects are now curtailed to alleviate an over-generation problem from the build-out of large-scale solar energy. The environmental impacts need to be considered more strongly, and conservation made a priority.

Secretarial Order 3285A1 is from 2010 and establishes the development of renewable energy as a priority for the Department of Interior (DOI), but it never says how much of that goal has been fulfilled since 2010. Thousands of megawatts of renewable energy have already been built on public lands, and grid congestion is now the result. Better regional planning needs to occur before more intermittent generation is added. This order also does not specifically say that a particularly high-resource-value location of the Gemini Solar Project is required to meet this goal.

The project is home to **BLM Sensitive Species**: the BLM is required to protect Sensitive Species as defined in BLM Manual 6840 (Special Status Species Management). The objectives of the BLM sensitive species policy are twofold, as follows:

1. To conserve or recover species listed under the Endangered Species Act of 1973 (ESA; 16 USC, Section 1531 et seq.), as amended, and the ecosystems on which they depend so that ESA protections are no longer needed for these species;

2. To initiate proactive conservation measures that reduce or eliminate threats to BLM sensitive species to minimize the likelihood of and need for listing of these species under the ESA.

State Endangered Species --the Gemini Solar Project will impact the Threecorner milkvetch by removing a large percentage of its core habitat. It is fully protect as a Nevada State Endangered Species.

The Gemini Solar Project site also will potentially impact species protected under the federal **Endangered Species Act**. These species include the Desert tortoise, Yuma clapper rail, Western yellow-billed Cuckoo and Southwestern Willow Flycatcher.

The site also contains **Fish and Wildlife Service Species of Special Concern**: Burrowing owls and Threecorner milkvetch.

The BLM has a commitment to follow guideline of the Endangered Species Act. Signed into law in 1973, *the original goal of the Endangered Species Act (ESA) was to preserve and recover key domestic species from the brink of extinction.*

Resources on the site are also protected by the **Archeological Resources Protection Act of 1979**. This statute (16 U.S.C. 470aa-470mm; Public Law 96-95 and amendments to it) was enacted: *...to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.*

The **Migratory Bird Treaty Act of 1918** was an *Establishment of a Federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory* *bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird." (16 U.S.C. 703)*

Need for this Project?

The Over-generation Problem in California Due to Large-scale Solar Projects

The Need for this project is questionable, as it adds a large cumulative impact to grid congestion in California. The state is currently experiencing a worsening glut of solar power at peak times on the transmission system, as measured by the California Independent System Operator. This has been shown as the Duck Curve, where renewable energy generation exceeds demand in the middle of the day, then causes the need to ramp up generation at the end of the day after the sun sets with inefficient natural gas peaker plants. At times, as much as 13,000 MW is needed in 3 hours in the evening hours, as solar projects go offline at night.

The National Renewable Energy Laboratory (NREL) examined the problem (Denholm et al. 2015, p. 8): "NREL has also examined higher renewable penetration scenarios in California using PLEXOS with a Western Interconnection database derived from the Western Electricity Coordinating Council (WECC) Transmission Expansion Policy Planning Committee (TEPPC), with additional modification based on the LTPP database (Brinkman et al. 2015). The NREL study examined cases where California achieves greater than 50% reduction in electric sector carbon dioxide emissions by 2030 with a variety of renewable energy technologies and flexibility assumptions, such as increased export limits and reduced minimum local generation requirements. Total annual curtailment estimates range from 0.2% (with a balanced portfolio in a more flexible grid) to almost 10% (with a high-solar portfolio in a less flexible grid)."

Nevada has a similar over-generation problem with large-scale solar projects at midday, according to presentations given at the Renewable Energy Transmission Initiative meetings and workshops concluded in 2017 by the California Energy Commission.[2]

The 500 kV Devers-Palo Verde 2 transmission line in California, serving the Riverside East Solar Energy Zone, is already suffering from grid congestion and may need to be reconductered to increase capacity.

Thus both California and Nevada have no need under present grid scenarios for more utility-scale solar power to be stuffed onto the grid. Some developers are looking towards Arizona to send midday generation to load centers in Arizona that use high amounts of air conditioning (NextEra, pers. communication June 2018). The draft EIS should clearly state how the project proponent will interconnect to the grid and what state the generation will be used in. Western grid regionalization may also be crucial to increasing renewable energy, and this needs to be clearly analyzed with respect to the Gemini Solar Project.

In other words, increased curtailment of solar projects (shutting them off during peak times) is likely under higher penetration of photovoltaics onto the California grid, despite storage options.

With increasing penetration of photovoltaic solar energy onto the grid, will instability problems be alleviated with battery storage?

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[2] https://www.energy.ca.gov/reti/

Can an on-site battery storage project alleviate this problem? How many megawatt hours of storage will these batteries provide? Please provide the exact make and model of batteries, detailed descriptions of housing, cooling, and replacement/recycling of used batteries. Given the critical importance of battery storage now as a potential avenue to higher penetration of renewable energy on the grid, the details of battery storage need to be explained.

Would the battery facility need to be cooled? How much energy would be required to do so? This is a hot desert with summer temperatures reaching 118 degrees F at times. How will this heat affect battery efficiency?

To conserve habitat, the BLM should consider a No Action Alternative based on local small-scale distributed battery technology in urban centers. Battery storage is making advances or smaller-scale solar energy and would not require such a large facility that would need cooling. Batteries will create a waste/recycling issue as well and the BLM should be asking how batteries will be recycled.

Alternatives:

A full range of alternatives should be considered in every EIS document. That is required by the National Environmental Policy Act (NEPA). Following the guidelines of NEPA, the final EIS should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public.

The Draft Environmental Impact Statement should consider an alternative that utilizes degraded brownfields and distributed generation in the built environment. Under the National Environmental Policy Act, agencies are required to consider alternatives outside of their jurisdiction. Since our above comments raise the issue of lacking Need for this project, BLM can easily justify a **No Action Alternative** based on available distributed resources located close by, such as the load center of Las Vegas.

Area of Critical Environmental Concern/Conservation/No Project Alternative:

The Basin and Range Watch preferred alternative would be the **ACEC/Conservation/No Project Alternative**. Two Areas of Critical Environmental Concern (ACEC) were nominated for this region under the revision of the Southern Nevada Resource Management Plan. These ACEC alternative are being considered under Alternative 2 for the Southern Nevada Resource Management Plan.

The BLM would have to evaluate an additional Land Use Plan amendment in the DEIS to consider this alternative. An ACEC could be viewed as an action alternative if provisions are made to close illegal roads, eliminate invasive plants, or construct interpretive signage at the ACEC.

The first nomination is the California Wash Area of Critical Environmental Concern. It would designate over 11,000 acres as an ACEC to protect cultural and historic values as well as vegetation communities. It would also be instrumental in protecting desert tortoise populations. Much of the nomination overlaps with the solar project.

The second nomination that partially overlaps with the south side if the solar proposal is the Bitter Springs ACEC. This is a 61,000 acre nomination designed to protect bighorn sheep, scenic values and vegetation communities.

We would also like to request that the Visual VRM Classes be upgraded to VRM I and VRM II to highlight this alternative.

This alternative should be separate from, and in addition to, the "no action" alternative required under NEPA, which would simply deny the right-of-way requested by the developer. This separate action alternative would provide BLM the efficiency of using a single EIS to determine whether to designate the area where the Project is proposed for additional protection as the optimal use of the area for the benefit of the public and the environment.

The Purpose and Need for the Draft EIS should include the same goals and objectives as the Castle Mountains ACEC nomination.

ACEC's can be considered under the following BLM guide-lines and the Castle Mountain region meets at least 4 of the below listed criteria to establish an ACEC:

To be considered as a potential ACEC and analyzed in RMP alternatives, an area must meet at least one criterion for both relevance and importance.
1) Relevance. An area must meet one or more of the following criterion:
a. A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans).
b. A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species, or habitat essential for maintain species diversity).
c. A natural process or system (including but not limited to endangered, sensitive, or threatened plan species; rare, endemic, or relic plants or plant communities which are terrestrial, aquatic, or riparian; or rare geological features).
d. Natural hazards (including but not limited to acres of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action may meet the 6 *relevance criteria if it is determined through the RMP process that it has become part of a natural process.*
2) Importance. The value, resource, system, process, or hazard described above must have substantial significance and values in order to satisfy the "importance" criteria. This generally means that the value, resource, system, process, or hazard is characterized by one or more of the following:
a. Has more than locally significant qualities which give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.
b. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
c. Has been recognized as warranting protection in order to satisfy national priority concerns to carry out the mandates of FLPMA.

Evaluation of Areas of Critical Environmental Concern
d. Has qualities which warrant highlighting in order to satisfy public or management concerns about safety and public welfare.
e. Poses a significant threat to human life and safety or to property[1]

The region meets most of these criteria for an ACEC. The region has *significant historic, cultural, or scenic value, wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species, or habitat essential for maintain species diversity).* The ACEC would also preserve a

Natural Process and System by maintaining connectivity for desert tortoise, keeping the region impact-free for migratory avian fauna and preserving the sandy habitat for the Threecorner milkvetch.

The nomination also meets the criteria of *Importance.* While the visual quality of the region is local, it attracts international visitors. The region is also an important spot for migratory birds, many of which travel hundreds of miles and pass through the region. It connects two recovery units for the desert tortoise and provides connectivity for more than a local population—it would help keep the desert tortoise from being uplisted to federally Endangered status. This would make the area more than *"locally significant".* The region also meets the criteria of *qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.*

This alternative would be beneficial for the future conservation of several species, cultural resources as well as a future tourism potential for the region.

A **No Project Alternative that designates the entire 44,000 acre ROW application as a Large-Scale Solar Energy Free Zone**. The region should also be recognized as an **Area of Ecological Importance**. The location is a poor choice due to the number of resources that would be impacted. This would be an Action Alternative because it does not preclude other uses. We would also like to request that the BLM consider upgrading the VRM Classes on the site to VRM I and VRM II. The BLM should evaluate the growing recreational use statistics of numbers of visitors to the Valley of Fire, Muddy Mountains Wilderness Area and the Bitter Springs Backcountry Byway. The alternative should include measures that would be taken to protect sensitive species and cultural resources from growing visitor use. This would make it an action alternative. Closing illegal OHV tracks and removal of invasive plants could be the "action."

Environmental Consequences

Biological Resources

Avian Mortality/Lake Effect:

There are updated numbers that confirm there are significant numbers of bird mortalities found at solar projects. Photovoltaic project companies are turning in many of these numbers. Since the projects are very large, these numbers only likely represent a smaller percentage of what is actually taking place. Updated information about avian-solar interactions by US Fish and Wildlife Service shows this is a concern. Solar projects can have significant impacts to sensitive species, and those listed under the federal Endangered Species Act. Data reported and gathered from seven solar projects in the southern California desert and arid grassland habitats from 2012 through April 2016 show that 183 bird species have been killed at solar projects, a number that rises with new information. 3,545 individual birds were reported dead at solar projects, from a mix of incidental finds and systematic surveys (Dietsch 2016). This is likely an underestimate.

The Fish and Wildlife Service has identified several Birds of Conservation Concern that use the vicinity of the Gemini Solar Project. The 1988 amendment to the Fish and Wildlife Conservation Act mandates the U.S. Fish and Wildlife Service (USFWS) to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973.

Birds that are of concern have been found dead at solar projects, and may be impacted by the Gemini Solar Project, including these Birds of Conservation Concern:

• Federal Endangered/Threatened – Yuma Ridgeway's (Clapper), Willow flycatcher, and Yellow-billed cuckoo.
• Birds of Conservation Concern – Eared grebe, American white pelican, Burrowing owl, Calliope hummingbird, Bald Eagle, Ferruginous Hawk, Golden Eagle, Peregrine Falcon, Snowy Plover, Long-billed Curlew , Black Swift, Calliope Hummingbird, Lewis's Woodpecker, Willow Flycatcher, Loggerhead Shrike, Virginia's Warbler, and Sage Sparrow.

Many of these Birds of Conservation Concern have been found in or in the vicinity of Lake Mead, the Muddy River and the Pahranagat National Wildlife Refuge as migrants or permanent residents (in the case of the burrowing owl). The arid regions between these water sources (Dry Lake Valley, Muddy Mountains, etc.) serve as flyways and a potential false lake could create issues. The 10 square mile Gemini Solar Project could potentially create this lake effect and polarized light may attract birds to photovoltaic solar projects as they mistake the panels for water. US Fish and Wildlife Service says many of these birds of conservation concern may be at risk.[3]

Because the proposed Gemini Solar Project would be up to 10 square miles in size and would be situated in a significant location for migrating birds in the Pacific Flyway, we believe that the project has the potential to cause significant avian mortality.

In addition, the potential for the project to cause deaths of ESA-listed birds means that the project must undertake ESA section 7 consultation and discuss that consultation in the EIS for this project.

Burrowing Owls:

During the desert tortoise surveys, 14 burrowing owl burrows were observed and 8 burrowing owls. Burrowing owls are declining in population in some parts of the western US. The primary reasons for the decline of Burrowing Owls have been identified as the elimination of burrowing mammals through control programs and habitat loss. In the Mojave Desert the owls also use tortoise burrows commonly. In the case of Southern Nevada, burrowing owls are impacted by off highway vehicle activity, urbanization, overgrazing, solar energy and new roads. To the Southwest of the Gemini Solar Project is a proposal to build the Crescent Peak Wind Project. Wind energy has also been identified as a threat to burrowing owls. The cumulative scenario of building out the 10 square mile Gemini Solar Project in good burrowing owl habitat is presents a future potential list the Burrowing Owl as Threatened or Endangered under the Endangered Species Act.

They are a federal Species of Concern, state protected, considered a high-priority evaluation species by the Clark County MSHCP, and considered a priority species by the Nevada Partners in Flight Working Group. They are typically found in shrub/steppe or desert shrub habitats along valley floors and in association with burrowing animals such as kit fox, desert tortoise, and badgers; often using those animals burrows for nesting.

[3] https://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php

Kit Fox:

The biologists who conducted the desert tortoise surveys for this project found 99 active kit fox burrows on the project site. This is a significant number.

During the construction of the Genesis Solar Project in Riverside County, California, an outbreak of canine distemper spread to several kit foxes because of stray dogs in the area that were brought in by workers. This problem was thought to be caused by the coyote urine that was used to repel kit foxes during the construction of the project or from workers who brought domestic dogs to the construction site.

The ICUN Red List has described the following threats to the Kit Fox"

"The main threat to the long-term survival of the Kit Fox is habitat conversion, mainly to agriculture but also to urban and industrial development. In both western and eastern Mexico, prairie dog towns, which support important populations of Kit Foxes are being converted to agricultural fields (e.g., Ávila-Flores et al. *2012), and in eastern Mexico the road network is expanding, producing a concomitant increase in the risk of vehicle mortality. In the San Joaquin Valley of California, habitat conversion for agriculture is slowing, but habitat loss, fragmentation, and degradation associated with industrial and urban development are still occurring at a rapid pace. More recently, expansive industrial-scale solar energy generating facilities are being constructed throughout the western USA, but particularly in California, Arizona, and Nevada."*
http://www.iucnredlist.org/details/41587/0

We are concerned that the Gemini Solar Project will have a negative effect on the kit foxes in the area.

Desert Tortoise:

The 2017 and 2018 desert tortoise for the proposed Gemini Solar Project surveys found 172 live tortoises, and based on density calculations, estimate that the project site contains 273 live tortoises. In addition to the live tortoises, biologists observed 2,774 desert tortoise burrows, 391 pallets, 323 carcasses, and 241 scats.

Because of the high number of tortoises found here, we recommend that BLM and US Fish and Wildlife Service consider designating this area as new Critical Habitat and an Area of Critical Environmental Concern, since so many Critical Habitat Units are now no longer viable (see discussion below).

The project site is located between two recovery units and in considered an important connectivity corridor or least cost pathway due to suitable topography. The surrounding Areas of Critical Environmental Concern (ACEC's) that contain designated desert tortoise Critical Habitat include the Mormon Mesa, Gold Butte, and Coyote Springs Desert Wildlife Management Areas.

Recent modeling by Sanchez-Rameriz et al. (2018) using single nucleotide polymorphism markers and spatial data consistently associated genetic connectivity with least-cost distance, based on multiple landscape features associated with tortoise habitat, despite landscape distance. Spatial and landscape genetics identified cluster 5 as tortoise inhabiting northeastern Mojave Desert in California, through southern Nevada, to southwestern Utah. The Gemini Project would threaten to disconnect this genetic population and fragment habitats, which have already undergone major development pressures.

Hagerty and Tracy (2010) undertook a finer-level genetic study of the Northeastern Mojave populations of desert tortoises in Nevada, and delineated a Muddy Mountains genetic segment. The Gemini Solar Project would endanger a large part of this unique genetic population.

The cumulative impacts have stacked up in this region for the desert tortoise. The area has a major Interstate highway running through it and there are also several transmission utility corridors in the area. The Dry Lake South Solar Energy Zone (Designated Leasing Area) has filled up 3,000 acres and BLM wants to approve the Dry Lake East DLA which would be built on over 1,500 acres hugging a mountain range. The Moapa Solar Project was built on almost 2,000 acres very close by and there is a proposal to build the 300 MW Eagle Shadow Mountain Solar Project on the reservation as well. This project would be close to 3,000 acres in size, the Red Flats Solar Project near Glendale would be 4,000 acres, the Ayia Solar Project on 900 acres of the Moapa Reservation and the Red Flats Solar Project on 2,000 acres near the Moapa Reservation. To the southwest is Las Vegas, Nevada which is experiencing a big economic urban growth boom now and thousands of acres of undeveloped public lands are being converted to housing subdivisions under the Clark County Multi Species Habitat Conservation Plan. Recently, the county passed a resolution which approved the transfer of over 40,000 acres of BLM lands to the county which would be used for housing subdivisions. If the Senate and Congress agree to this, that would add considerably to the cumulative loss of tortoise habitat in the region. To the north in the St. George, Utah area, the Northern Corridor highway project is proposed to slice directly through the Red Cliffs Tortoise Preserve, further leading to unmitigated mortality. At this rate of growth, there will not be much left for the tortoise if BLM approves the Gemini Solar Project.

The Desert Tortoise Council in recent letters to Congress opposing the Northern Corridor in Utah have stressed that these cumulative impacts, coupled with range-wide declines to the desert tortoise warrant uplisting to Endangered status under the federal Endangered Species Act. The large size of the Gemini Solar Project and its siting in a connectivity corridor between the Northeastern Mojave Recovery Unit and Upper Virgin River Recovery Unit, will only cause more declines in tortoise populations.

US Fish and Wildlife Service in its latest status review (USFWS 2015), based on surveys and sampling from 2004 to 2014, found that 10 of 17 populations of the Mojave desert tortoise declined over that ten year period, and that 11 of 17 populations of the Mojave desert tortoise are no longer viable. These 11 populations represent 89.7 percent of the range-wide habitat in Critical Habitat Units/Tortoise Conservation Areas.

While the BLM is a Multiple Use Agency, you are required to enforce the Endangered Species Act and when BLM just keeps approving large developments like this, there is no longer a balance between development and conservation. The Bureau of Land Management ensures the protection of the nation's federally-listed plants and animals found on its public lands. Collaboration and Partnerships at the national, state, and local level are essential components of successful conservation.

Desert tortoise translocation has created problems in the past. Moved tortoise often become disoriented and can end up pacing fences. This can lead to hyperthermia and increased predation by predators such as coyotes.

A recent study[4] has shown that translocated desert tortoise are not reproducing. Genetic paternity testing of 92 hatchlings by Smithsonian Conservation Biology Institute (SCBI) geneticists revealed that the translocated males are failing in one key way—they are reproducing at a far lower rate than resident males. The findings suggest that for some species, translocation may not be as effective a tool to rescue populations at risk, or bolster genetic diversity and health, as previously thought.

Translocation issues have occurred at the Ft. Irwin National Training Center. During a previous translocation effort to move desert tortoises out of an expansion area in Ft. Irwin Army National Training Center in the 1990’s, 50% of tortoises suffered mortality due to the translocation. A 50% mortality rate over three years or more is usual for tortoises moved out of their home ranges. Predation is the most common cause of tortoise deaths.

The Moapa Solar Project also had some translocation problems. Eight were killed by predators and others suffered from over-heating and fence pacing.

Equally, these problems also occurred in the relocation area for the Silver State South Solar Project.

According to the Fish and Wildlife Service, ten year trend data from 2004 to 2014 has shown a steady decline in the populations of 15 out of 22 recovery units for the desert tortoise. [5]

Construction and solar facility toxic wastes, chemicals, and pollutants could have the potential to trigger diseases in desert tortoise populations surrounding the project. Raven and coyote predation could rise, as well as Sahara mustard and red brome invasions. What wildfire-prevention measures will be used? How will the project mitigate these threats without compensatory mitigation measures?

Bighorn Sheep:

A bighorn sheep horn was found on the project site during the desert tortoise surveys for this project.

Desert bighorn sheep have been well documented within the Muddy Mountains. Including the wilderness area and surrounding non-wilderness lands, the population is estimated to be approximately 265, with a potential population estimate of 505 based on forage supply (*Rangewide Plan for Managing Habitat of Desert Bighorn Sheep on Public Lands*). Two wildlife guzzlers were constructed within the wilderness to convert the area from cool season to year-long habitat. Desert bighorns are a state protected species and considered a watch species under the Clark County MSHCP. Desert bighorn sheep are associated with rugged terrain including canyons, steep slopes, cliffs, and mountain tops. In the Muddy Mountains, desert bighorns could be described as nomadic; remaining mobile throughout their range to take advantage of variable rainfall patterns and available water sources (many of which are ephemeral). NDOW biologists have observed that desert bighorns usually limit summer activity to an area within two miles of water, although some summer movements can be greater.

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[4] https://insider.si.edu/2017/05/smithsonian-study-shows-relocated-desert-tortoises-reproduce-lower-rate/

[5] http://conserveswu.org/wp-content/uploads/Desert-Council-Stewart-letter-May-16-2018.pdf

Bighorn sheep have the potential to cross California Wash when traveling between the Muddy Mountains and ranges to the west, including the Sheep range.

Hunting tags are issued for this herd yearly.

The BLM portion of the Muddy Mountains Wilderness is located within the Muddy Mountain and White Basin Grazing Allotments. These grazing allotments were closed to grazing as of the date the wilderness was designated. Closure of the allotments protects bighorn sheep and desert tortoise, yet now BLM proposes to remove a large portion of habitat adjacent to the Muddy Mountains on this same land.

Gila Monster:

Banded Gila monsters are known to occur in the Muddy Mountains. Gila monsters are typically found below 5,000 feet elevation and are associated with desert wash, spring and riparian habitats that integrate with complex rocky desert scrub landscapes. They spend over 95 percent of their lives underground using deep crevices and caves on rocky slopes for refuge from extreme winter and summer temperatures. Gila monsters are a federal species of concern, a state protected species, and are listed as a high-priority evaluation species in the Clark County Multi Species Habitat Conservation Plan (MSHCP).

How will BLM passively translocate any gila monsters discovered in dens and burrows during construction activities?

Bats:

Suitable roosting and/or foraging habitat for sensitive bat species, such as the spotted bat (*Euderma maculatum*), occurs throughout the Muddy Mountains Wilderness. The spotted bat is on the Watch list for the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and is considered at moderate risk by the Nevada Bat Working Group. The spotted bat is found year round in a wide variety of habitats from low elevation desert scrub to high elevation coniferous forests and is highly associated with rocky cliffs.

Based on known species habitat characteristics and data collected in southern Nevada, the following sensitive bat species may occur within the Muddy Mountains Wilderness: pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), big brown bat (*Eptesicus fuscus*), western mastiff bat (Eumops perotis californicus), Allen's lappet-browed bat (*Idionycteris phyllotis*), California myotis (*Myotis californicus*), small-footed myotis (*Myotis ciliolabrum*), fringed myotis (*Myotis thysanodes*), cave myotis (*Myotis velifer*), long-legged myotis (*Myotis volans*), Yuma myotis (*Myotis yumanensis*), western pipistrelle bat (*Pipistrellus hesperus*), big free-tailed bat (*Nyctinomops macrotis*), and Brazilian free-tailed bat (*Tadarida braziliensis*). Caves, rock crevices and overhangs, and abandoned mines and prospects may serve as roosts. There is no documentation indicating that bat surveys have been conducted within the Muddy Mountains Wilderness area.

How will bats be impacted by the solar project?

Birds of Concern:

Phainopeplas (*Phainopepla nitens*) nest and forage in mesquite and cat claw acacia habitat where stands of the trees and shrubs are infested with mistletoe. No surveys for phainopeplas have been conducted within the Muddy Mountains Wilderness. Ephemeral drainages containing this vegetation may support this species.

Swainson's (*Buteo swainsoni*) and ferruginous hawks (*Buteo regalis*) may be observed hunting within the wilderness in areas vegetated with creosote-bursage scrub and Mojave desert scrub. Ferruginous hawks hunt for rodents and rabbits, while Swainson's hawks hunt small mammals and insects. Both species are state protected and the ferruginous hawk is on the Clark County MSHCP watch list.

Sensitive bird habitat is also found in the wilderness. Le Conte's thrashers (*Toxostoma lecontei*), loggerhead shrikes (*Lanius ludovicianus*), and prairie falcons are all found within the Muddy Mountains Wilderness. Peregrine falcons (*Falco peregrinus anatum*) and golden eagles (*Aquila chrysaetos*) may also be present as the rocky cliffs provide many potential nesting sites and the open valleys and bajadas provide good hunting grounds.

How will these bird species be impacted by the solar project?

Rare Plants:

According to the Nevada Natural Heritage Database[6] Threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*) occurs in the project area in Clark and adjacent Lincoln Counties. On sandy areas. This taxon may have only roughly 5,000 individual plants known since the last surveys. Only 41 extant mapped occurrences at 1.0 km separation are known, and one extirpated occurrence is recorded.[7] The taxon is a species of concern with US Fish and Wildlife Service, and a BLM Special Status Species in Nevada. Apparently a significant part of the population was inundated by Lake Mead. The conservation status rank is G4 (apparently secure, though frequently quite rare in parts of its range, especially at its periphery), S2 (imperiled due to rarity or other demonstrable factors). The Nevada Native Plant Society lists it as threatened.

Three-corner milkvetch is a Fully Protected species in the state of Nevada (on the state Critically Endangered Species List). The Nevada Division of Forestry performs administrative and regulatory actions involving state- protected plants. The Nevada Division of Forestry State Forester Firewarden has an established list of "fully protected" native plant species (NAC 527.010) that are critically endangered and threatened with the potential to become extinct within the state of Nevada. Fully protected native plant species require a special permit from the State Forester Firewarden for their removal or destruction from both public and private lands (NRS 527.270). [8]

The species germinates only in wetter years, potentially resulting in accidental losses of undetected populations—will surveys be done during rainy and wet years to maximize detection probability of this taxon? What percentage of the total population of this taxon in Nevada will be impacted by the project?

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[6] http://heritage.nv.gov/sites/default/files/atlas/astrageyertriqu.pdf

[7] http://heritage.nv.gov/taxon_detail/16691

[8] http://www.clarkcountynv.gov/comprehensive-planning/advanced-planning/Documents/ConservationReport.pdf, pp. 17-18.

The proposed project would remove over ten square miles of desert habitat in the region and also will more than likely block the sand transport corridor that provide habitat for the Threecorner milkvetch. How much of the sand transport corridor will be blocked by the solar panels? BLM will need to study this and create a map showing the process of sand transport. This species has list much of its habitat with the creation of Lake Mead. The BLM may approve a large-scale solar project in the core of this habitat. Will this create an extinction scenario for this species? At what point does BLM have more of a responsibility to protect the remaining habitat for state sensitive species over approving a ROW for yet another speculative solar project? Better options such as moving the project to degraded lands such as old mine sites and abandoned agricultural fields can avoid the need to list taxa such as these under the federal Endangered Species Act.

The largest population of Las Vegas buckwheat, a sensitive species under review for candidate status under the Endangered Species Act, occurs within the Muddy Mountains Wilderness. The Las Vegas bear poppy is a sensitive species which has limited occurrence in the wilderness. Both of these species occur on gypsum rich soils present in the eastern and southern portion of the wilderness. Surveys for these species should be undertaken in the project area.

Microphyll Woodlands:

On the project site, we observed honey mesquite (*Prosopis glandulosa*), desert willow (*Chilopsis linearis*), and catclaw acacia (*Senegalia gregii*). It appears that there is more microphyll on this site than most of the other solar energy site BLM has reviewed. At the public scoping meeting however, BLM told us that no microphyll would be disturbed on the site. But that is inconsistent with what we found. We did find microphyll on the proposed ROW for the project. Will this be avoided? BLM should provide a map of all the microphyll located on the project site.

In the Clark County MSHCP,[9] the mesquite/catclaw ecosystem provides habitat for 11 Covered Species and 5 High Priority Evaluation Species:

> Covered Species: Silver-haired bat, Long-eared myotis, Phainopepla, Vermilion flycatcher, Banded gecko, Desert iguana, Western chuckwalla, Great Basin collared lizard, Western red-tailed skink, Sidewinder, Pahrump Valley buckwheat,
>
> High Priority Evaluation Species: Kit fox, Pale Townsend's big-eared bat, Desert pocket mouse, Banded Gila monster, Southern desert horned lizard.

How will BLM conserve these species and mitigate impacts from a large utility-scale solar project and associated new transmission lines and possible substation nearby?

How will BLM follow the Clark County MSHCP in implementing this measure?

> BLM(99) Enter into conservation agreements or easements with the U.S. Fish and Wildlife Service and the State of Nevada, that if implemented, could reduce the necessity of future

[9] http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-240.

listings of species in question. Conservation agreements may include, but not be limited to, the following: Las Vegas bearpoppy, white-margined penstemon, and phainopepla.[10]

The Gemini Solar Project proposal overlaps with the Valley of Fire Unit proposed MSHCP Reserve.[11] How will this be mitigated?

Cultural Resources/Old Spanish Trail:

The Old Spanish Trail was in use between 1829 and 1848. Spain searched for a trade route between New Mexico and California in the 1700s. Traders with mule caravans stopped here as early as 1829, using the area as a link from the abundantly watered flowing springs of Las Vegas--"The Meadows."

Congress designated the area as part of the Old Spanish Trail in 2002. Several segments in Nevada are listed in the National Register of Historic Places.

The trail goes through the Gemini Solar Project site. If the project is built, it will completely change and disrupt the historic character of the trail and change the original landscape to something unrecognizable, as well as directly remove this trail segment in California Wash.

Air Quality/Fugitive Dust:

The BLM may allow a ten square mile development happen in this location. This will require many massive scraper-grader Earth-moving machines.

If you build roads, transmission, large scale renewable projects and scrape up the Mojave Desert habitat, you will have fugitive dust. When deserts are scraped, a Pandora's Box of air quality issues is opened. Biological soil crust, desert pavement and old growth vegetation will all be lost. This is an **Environmental Justice** issue. The health impacts that will arise from airborne particulates from construction dust could have very negative on the local residents of the area. Dust control in hot, arid climates is very problematic. The removal of established vegetation, biological soil crusts and centuries old desert pavement creates opportunities for dust to be airborne every time the wind blows. Not only does fugitive dust create problems for visual and biological resources, it creates issues for public health as well. Coccidioidomycosis (**Valley Fever**) is a common issue in the desert regions when too much land is disturbed. There have been hundreds of cases of Valley Fever in Clark County and 33 cases reported in Clark County alone in 2016.[12] The rapid growth creates quote a bit of dust. The cumulative impact pf scraping 10 square miles will only add a cumulative

The land rush of large solar projects all over the southwestern US has resulted in approval of many of these projects. In most of the cases, the developers have not adequately mitigated the fugitive dust that has resulted in the removal of large acreages of vegetated desert lands.

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10 http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-251.

11 http://www.clarkcountynv.gov/comprehensive-planning/advanced-planning/Documents/ConservationReport.pdf, p. 46.

12 http://nvophie.weebly.com/home/valley-fever

Visual Resources:

In order to approve the project, the BLM will need to downgrade the VRM Class to VRM IV, the lowest class.

The Gemini Solar Project site location is managed under Visual Resource Management (VRM) Classes II and III. These VRM Classes were created under the 1998 Southern Nevada Resource Management Plan. The BLM will be required to ***downgrade*** all of the VRM Classes on the site to Class IV in order to approve this project. The BLM must do this by amending the 1998 Resource Management Plan. Visual Resource Management under FLPMA and NEPA is very much tied to public perception. We believe it is a premature for BLM to quickly approve this project under the outdated 1998 Southern Resource Management Plan rather than wait for the updated plan to be finalized and it is being reviewed at exactly the same time. We also believe that such downgrading cannot be justified given the scenic quality of the area where the Project is being proposed.

Visual resources must be protected under the Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701 et. seq.;
1. Section 102 (a)(8). States that "...the public lands be managed in a manner that will protect the quality of the...scenic...values...."
2. Section 103 (c). Identifies "scenic values" as one of the resources for which public land should be managed.
3. Section 201 (a). States that "The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values (including...scenic values)...."
4. Section 505 (a). Requires that "Each right-of-way shall contain terms and conditions which will... minimize damage to the scenic and esthetic values...."

Both NEPA and FLPMA recommend that Visual Resource Management be decided on the RMP level. The project site is now managed under VRM II and VRM III standards.

VRM II is managed to: *retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.*

VRM III is managed to: *partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.*

If the BLM approves this project, they will have no choice but to DOWNGRADE the VRM Class to VRM IV. This would be the lowest visual class in spite if the fact that this is along a scenic byway.

VRM Class IV is managed to: provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements. This rating does not necessarily mean the area has low visual value.

Due to the new conservation designations and the very high scenic quality of the area**,** Basin and Range Watch and Western Watersheds Project request that the region be upgraded to both VRM I and VRM II.

- **VRM Class I Objective**: To preserve the existing character of the landscape. Allowed Level of Change: This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

- **VRM Class II Objective**: To retain the existing character of the landscape. Allowed Level of Change: The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

The BLM will need to select a complete range of Key Observation Point simulations. Factors that should be considered in selecting KOP's are; angle of observation, number of viewers, length of time the project is in view, relative project size, season of use, and light conditions. But to accurately disclose the impacts of the Project on the scenic beauty of the area where it is being proposed, KOP simulations should be presented from the Muddy Mountains Wilderness Area, the Bitter Springs Backcountry Byway, the Old Spanish Trail, Whitney Pockets and the Valley of Fire Road. Several simulations at different times of day should be available.

Socioeconomics, Recreation and Public Access:

If a 10 square mile ROW is issued to the applicant, the land is no longer public for all intents and purposes. The project will be completely cut off from public access and be surrounded by a large wire fence. Anyone entering the project would be arrested. The region is vast and a motorsport event crosses through the area each year. Closing off so much public land for only one use is not consistent with the BLM's Multiple Use Philosophy.

The BLM should also evaluate visitor use demographics for the Valley of Fire Road, the Muddy Mountains Wilderness Area and the Bitter Springs Backcountry Byway. The BLM should also evaluate how much money is spent in Clark County relating to these areas. The Valley of Fire State Park is now one of the most popular tourist destinations in Nevada. Do the economic benefits of a solar project that would only create 5 to 15 full time jobs outweigh the growing demographics of tourism in the region? Will the destruction of so much scenery drive people away from the region? How will this impact the region economically?

Wilderness:

How will the large-scale solar project and construction lead to diminishment of the wilderness qualities of the adjacent Muddy Mountains Wilderness Area, which is to be managed for its "scenic qualities" and "to provide for the long term protection and preservation of the area's wilderness character under a principle of nondegradation. The area's natural condition, opportunities for solitude, opportunities for primitive and unconfined types of recreation, and any ecological, geological, or other features of scientific, educational, scenic, or historical value present will be managed so that they will remain unimpaired.”[13]

Restoration:

Clark County requires important habitat to be restored, and we recommend the applicant have a restoration fund to restore this desert habitat after its lease is ended:

> BLM(123) Within desert tortoise critical habitat/ACECs, Las Vegas bearpoppy habitat, and other important habitats for covered and evaluation species, require reclamation of activities which result in loss or degradation of habitat, with habitat to be reclaimed so that pre-disturbance condition can be reached within a reasonable time frame. Reclamation may include salvage and transplant of cactus and yucca, recontouring the area, scarification of compacted soil, soil amendments, seeding, and transplant of seedling shrubs. If necessary subsequent seeding or transplanting efforts may be required, should monitoring indicate that the original effort was not successful. [14]

Conclusion:

The Gemini Solar Project would disturb 7,100 acres (ten square miles) of relatively pristine Mojave Desert ecosystems. Basin and Range Watch and Western Watersheds Project support the move away from fossil fuels and towards renewable energy to help mitigate climate change, but only on previously degraded lands or on rooftops and parking lot structures in the built environment, where resource conflicts will be lessened. This location in California Wash has too many high-value resources for us to support the project: the historic Old Spanish Trail would be directly destroyed here, a popular public lands recreation area and scenic routes would be industrialized, scenic visual resources would be unnecessarily downgraded, and two at-risk taxa would be significantly impacted: the Federally Threatened desert tortoise and rare threecorner milkvetch. With better options available for siting this solar project, we may be forced to consider actions to petition to list or uplist these two taxa for greater protection and conservation because we believe mitigations will not offset the large impacts to these species from direct, indirect, and cumulative impacts that are growing without without relief in Clark County.

Thank you,

[13] https://www.nps.gov/lake/learn/management/upload/MMFinalPlan.pdf

[14] http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-230.

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Abstract

In 2013, the California Independent System Operator published the "duck chart," which shows a significant drop in mid-day net load on a spring day as solar photovoltaics (PV) are added to the system. The chart raises concerns that the conventional power system will be unable to accommodate the ramp rate and range needed to fully utilize solar energy, particularly on days characterized by the duck shape. This could result in "overgeneration" and curtailed renewable energy, increasing its costs and reducing its environmental benefits. This paper explores the duck chart in detail, examining how much PV might need to be curtailed if additional grid flexibility measures are not taken, and how curtailment rates can be decreased by changing grid operational practices. It finds that under business-as-usual types of assumptions and corresponding levels of grid flexibility in California, solar penetrations as low as 20% of annual energy could lead to marginal curtailment rates that exceed 30%. However, by allowing (or requiring) distributed PV and storage (including new installations that are part of the California storage mandate) to provide grid services, system flexibility could be greatly enhanced. Doing so could significantly reduce curtailment and allow much greater penetration of variable generation resources in achieving a 50% renewable portfolio standard. Overall, the work described in this paper points to the need to fully integrate distributed resources into grid system planning and operations to allow maximum use of the solar resource.

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1 Introduction

In 2013, the California Independent System Operator (CAISO) published a chart showing the potential for "overgeneration" occurring at increased penetration of solar photovoltaics (PV).[1] The "duck chart"[2] shows the potential for PV to provide more energy than can be used by the system, especially considering the host of technical and institutional constraints on power system operation.

During overgeneration conditions, the supply of power could exceed demand, and without intervention, generators and certain motors connected to the grid would increase rotational speed, which can cause damage. To avoid this, system operators carefully balance supply with demand, increasing and reducing output from the conventional generation fleet.[3] The overgeneration risk occurs when conventional dispatchable resources cannot be backed down further to accommodate the supply of variable generation (VG). Overgeneration has a relatively simple technical solution, often referred to as curtailment. Curtailment occurs when a system operator decreases the output from a wind or PV plant below what it would normally produce. For wind, this is performed by changing the energy captured from the wind (by changing the blade pitch angle) (Aho et al. 2012). For solar, generation is curtailed by either reducing output from the inverter or disconnecting the plant altogether. This of course requires a plant or system operator to have physical control of the generation resource, which is typically available for large renewable power plants but uncommon for smaller systems, particularly distributed or rooftop systems. While curtailment is technically easy, it has the obvious undesirable trait of reducing the economic and environmental benefits of VG. Each unit of VG curtailed represents a unit of energy not sold on to the grid and a unit of fossil fuel not avoided. As the amount of curtailment increases, the overall benefits of additional solar may drop to the point where additional installations are not worth the cost (Cochran et al. 2015).

Neither the potential for overgeneration, nor the resulting curtailment of variable generation resources is a new concern (Bird et al. 2014). However, the significant attention paid to the duck chart signals an important change in attitude toward integration of variable generation (VG). The duck chart represents perhaps the first major acknowledgement by a system operator that solar energy is no longer a niche technology (at least in California) and that curtailment will be a significant issue in the not-too-distant future. The chart has also raised general awareness of the issues associated with renewable curtailment and system flexibility.

The duck chart is largely illustrative in nature, representing only one day of the year, and it does not quantify the actual curtailment that may occur at increased penetration of solar energy. Nor does the chart reflect the impact of mitigation options.

In this work, we examine how the duck chart shape illustrates potential overgeneration risks in California at increased penetration of PV. We first review previous analyses of the impact of PV

[1] https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

[2] The name is derived from its resemblance to the profile of a duck.

[3] Throughout this document, we use the term system operator to refer to the balancing area authorities responsible for balancing supply and demand through generator scheduling and dispatch. In California, the largest of these is the CAISO, but there are several other system operators, including Los Angeles Department of Water and Power, Imperial Irrigation District, Balancing Authority of Northern California, and Turlock Irrigation District.

on load in California and potential PV curtailment at increased penetration. We then use a production cost model to quantify the amount of overgeneration that can result from the increased PV without measures to increase system flexibility. Finally, we show how the duck shape can be accommodated with different measures to increase flexibility—including flexibility that is provided by the PV itself under appropriate market rules—and how overgeneration risks can be dramatically reduced by introducing multiple flexibility measures.

2 Background: Why Ducks Lead to Overgeneration

The CAISO duck chart itself illustrates the general challenge of accommodating solar energy and the potential for overgeneration and solar curtailment. In the chart, each line represents the net load, equal to the normal load minus wind and PV generation. The "belly" of the duck represents the period of lowest net load, where PV generation is at a maximum. The belly grows as PV installations increase between 2012 and 2020. While the amount of PV in 2020 is not shown directly, it can be estimated by comparing the 2012 curve to the 2020 curve. In this case, the normal load (i.e., no PV and adjustments for load growth) at about 1-2 p.m. on March 31, 2020 appears to be about 22,000 megawatts (MW), while PV is generating about 10,000 MW, leaving about 12,000 MW to be met with other resources. In this case, PV provides perhaps 45% of the total demand in this one hour. The duck chart also points to the period of overgeneration risk, which could result in curtailed energy.

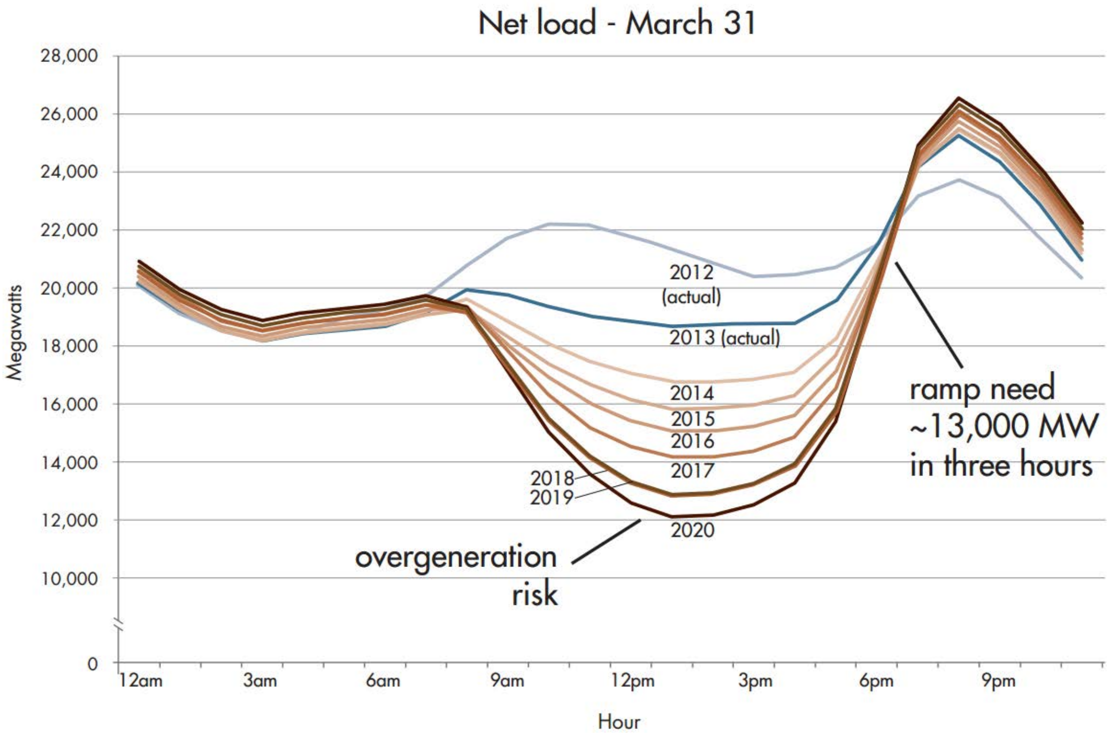

Figure 1. The CAISO duck chart

Source: CAISO 2013

The CAISO duck chart document does not explicitly quantify the amount of expected curtailment during this period, but it describes two main causes:

> The first occurs as the ISO [independent system operator] prepares to meet the upcoming upward ramps [using conventional generation] that occur in the morning and in the late afternoon. The existing fleet includes many long-start resources that need time to come on line before they can support upcoming ramps.

> Therefore, they must produce at some minimum power output levels in times when this electricity is not needed.[4]

The second source of overgeneration and curtailment "occurs when output from any non-dispatchable/must-take resource further increases supply in times of low electricity need, typically in the nighttime hours. Historically, this condition was most likely to occur in the early morning hours when low demand combines with electricity and generation brought on line to prepare for the morning ramp." This second challenge includes the need to accommodate output of all generation resources such as wind and hydro, and plants that produce heat and electricity. Overgeneration can also result from "must-run" plants that are needed for local voltage support and reliability issues, and also from a number of institutional constraints, such as long-term contracts and self-scheduling from certain power plants (GE Energy 2015; Bouillon 2014).

Combined, these issues create an operational challenge which can be described as the "minimum generation" problem which represents the technical and economic limits of thermal and hydro power plants to reduce output or turn off, especially during relatively short periods, such as the few hours of peak solar output. Other factors can produce curtailed VG, including transmission constraints, and at increased penetration of VG, conventional generators that must be online to maintain system stability. (This latter issue is discussed in Section 6).

Because of the economic challenges posed by curtailment, it becomes important to examine how much curtailment may occur, as well as methods to reduce curtailment. The ability to accommodate VG is largely determined by the flexibility of the power grid, and flexibility can be changed over time. Examining the relationship between system flexibility and curtailment can help determine the potential contribution of solar to meeting the energy requirements of a region such as California.

[4] https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

3 Previous Analysis of the California Duck and Estimates of Overgeneration

There are a number of discussions of the California duck chart, and several estimates of curtailment that may result in California from increased penetration of PV. Several of these discussions are part of larger planning and integration studies that consider broader impacts of VG on the system (e.g., system economic and environmental benefits), areas of operational challenges (e.g., additional reserve requirements), and integration costs. Integration studies, along with general grid planning studies use grid-simulation tools that model the operation of the entire generation fleet (Sterling et al. 2013). These have a number of names, including "production cost" and "security-constrained unit commitment and economic dispatch" models (Denholm et al. 2014).[5]

We use the term production cost model (PCM) to represent the class of models that simulate the chronological operation of the power grid, determining which power plants to commit and dispatch during each time interval on the basis of forecasted fuel costs, heat rates and other operational characteristics. In each time interval, the model selects the least-cost mix of generators needed to meet load while maintaining adequate reserves to meet contingency events and other reserve requirements. Such models typically simulate the grid for one year of operation in 8,760 one-hour time steps. PCMs calculate the total cost of system operation, including cost of fuel and cost of operation and maintenance.[6] To model the grid realistically, these tools require extensive databases of generator properties, transmission capacity, and system operational requirements, such as reserve requirements. In theory, a properly designed and implemented PCM simulation should produce results (such as generator dispatch, emissions, and total production costs) close to the dispatch resulting from the market operations or dispatch software used by independent system operators or balancing areas to actually control the grid. However, PCMs cannot completely simulate market environments because they typically do not capture self-scheduling, bilateral contracts, scarcity pricing, bidding strategies, and other factors that can alter system dispatch from the "least-cost" dispatch produced by a model.

An early attempt to model the increased penetration of PV in California using a production cost model is Denholm et al. (2008). This work uses the PROSYM PCM and demonstrates a "proto-duck" chart showing a deep drop in mid-day net demand (Figure 2) that is similar to that in the CAISO duck chart. The net load during this two-day period is from slightly later in the spring (May 6–7), and with the higher solar output, represents the lowest net load of any point during the year. Despite the lower net load and higher ramp range compared to the CAISO duck chart, this analysis did not demonstrate any significant overgeneration or PV curtailment. This is due to a variety of favorable assumptions, including "frictionless" exchange of energy with the surrounding regions without restrictions other than the thermal limits of the transmission network. At the highest level of penetration, nearly half of the incremental PV generation in

[5] Various entities, including independent system operators use these models to simulate system operations for planning purposes. However these are a number of differences between how these models work and the market management software used for actual unit commitment and dispatch. An example is the generation of the commitment and dispatch "stack" (or merit order). Production cost models use plant-level estimates of variable costs while ISO operations use market bids from individual generators

[6] Production cost models only consider the variable costs of operating the system. Fixed costs (capital costs, fixed O&M) are not considered.

California is displacing out-of-state generation. In addition, while the model did include standard generator parameters (e.g., minimum generation and start-time constraints), it did not consider any institutional, contractual, or local reliability constraints that may exist within California.

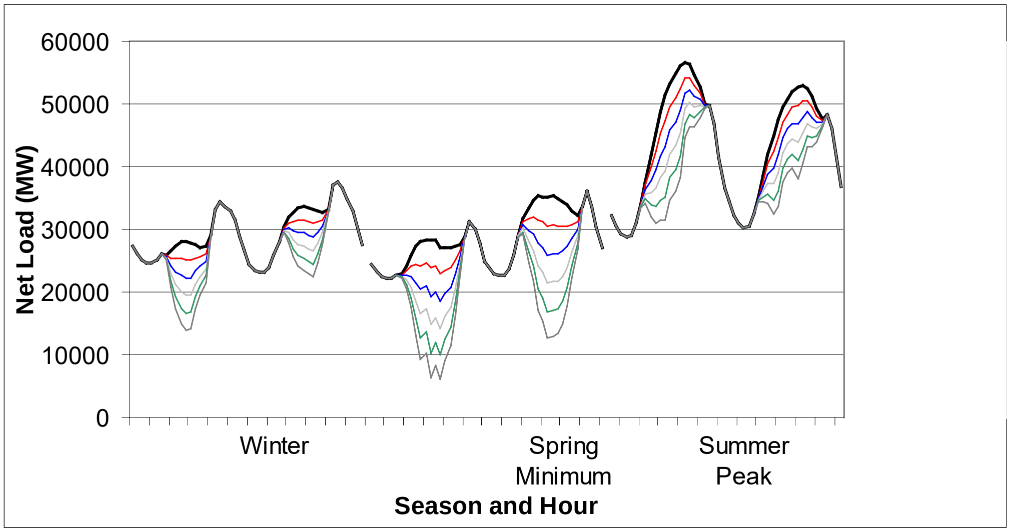

Figure 2. "Proto-duck" chart of California net load with increased penetration of PV

Source: Denholm et al. 2008

The 2013 duck chart and much of the concern regarding overgeneration originates with a series of studies published by the CAISO (CAISO 2010, 2011a, and 2011b, Liu 2014a, 2014b and 2014c) and by emergence of negative prices in the CAISO market driven in part by growth in wind generation (CAISO 2012). The CAISO studies have examined the impacts of an increasing renewable portfolio standard (RPS) starting with 20%, increasing to 33%, and then 40%, and they have demonstrated increasing levels of overgeneration risk. These studies use the PLEXOS production cost model, which is one of several commercially available grid simulation tools. CAISO produces and maintains a database for this model as part of the Long-Term Procurement Plan (LTPP).[7] This database includes generator-level details of California's electricity sector as well the rest of the Western Interconnection. The CAISO has made its PLEXOS databases publicly available, and in addition to California utility studies (Mao and Galjanic 2014), several non-utility research groups have used them directly or in modified forms to analyze sensitivities to various assumptions. Table 1 summarizes several of the previous analyses using some form of the LTPP model.

[7] http://www.cpuc.ca.gov/PUC/energy/procurement/LTPP/ltpp_history.htm

Table 1. Previous Studies Using the Long-Term Procurement Plan Database

Study Lead Organization	Cite	Study Focus
CAISO	CAISO 2011a, CAISO 2011b Liu 2014a, 2014a	Multiple studies of a variety of renewable portfolio standards considering production cost, fuel use, emissions, system flexibility requirements and other factors
Argonne National Laboratory	Koritarov et al. 2013	Value of advanced pumped hydro storage
NREL	Denholm et al. 2013	Value of concentrating solar power
Lawrence Livermore National Laboratory	Edmunds et al. 2014	Value of multiple storage options and demand response
DNV KEMA (now DNV-GL)	Abrams et al. 2014	Value of multiple storage technologies
NREL	Jorgenson et al. 2014	Impact and value of multiple solar technologies
Southern California Edison	Mao and Galjanic 2014	Operational flexibility and flexible capacity requirements
Union of Concerned Scientists	Nelson 2014, Nelson and Wisland 2015	Multiple aspects of VG integration including options to minimize overgeneration

Several of the studies listed in Table 1 have identified the impact of various individual technologies on the duck chart shape of net load. For example, Jorgenson et al. (2014) examined the impact of two different solar technologies on imports into CAISO under increased VG penetration, as illustrated in Figure 3.

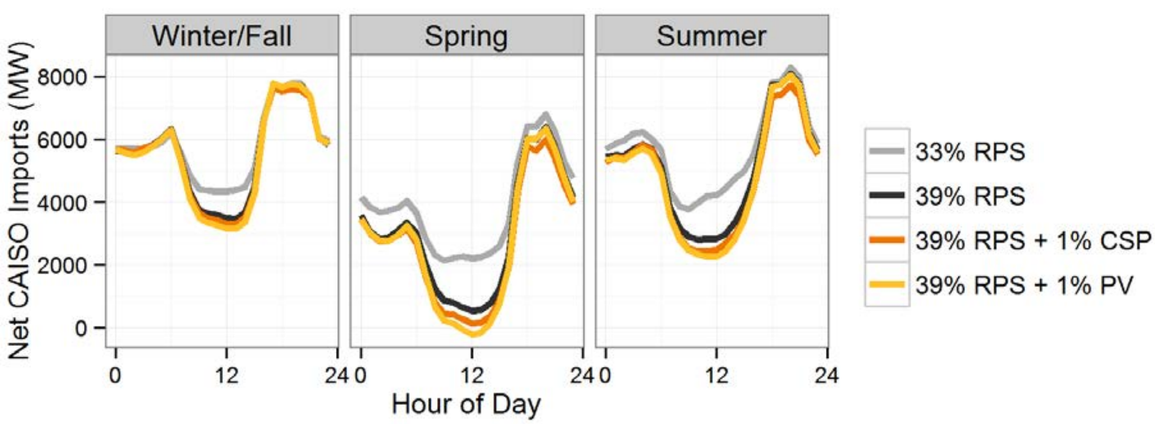

Figure 3. Example of an analysis of the impact of concentrating solar power (CSP) on the duck chart shape

Source: Jorgenson et al. 2014

Other groups have used the versions of the LTPP database to examine how increased grid flexibility could be used to minimize curtailment and enable higher levels of renewable penetration. For example, the Union of Concerned Scientists modified the LTPP database to simulate how increased flexibility could substantially reduce overgeneration risk in 40% and 50% RPS scenarios (Nelson 2014; Nelson and Wisland 2015).

Figure 4 illustrates an example from a 50% RPS scenario, where increasing the amount of "non-fossil" sources of flexibility—including demand response, storage, provision of reserves from renewables[8], and exports—reduced curtailments by more than 75% compared to a base "inflexible" scenario and by 63% compared to a flexible gas scenario (Nelson and Wisland 2015). This figure shows an example day where adding flexibility options, including providing reserves with non-conventional resources, can reduce the minimum generation needed from hydro and gas generation, thereby reducing renewable curtailments.

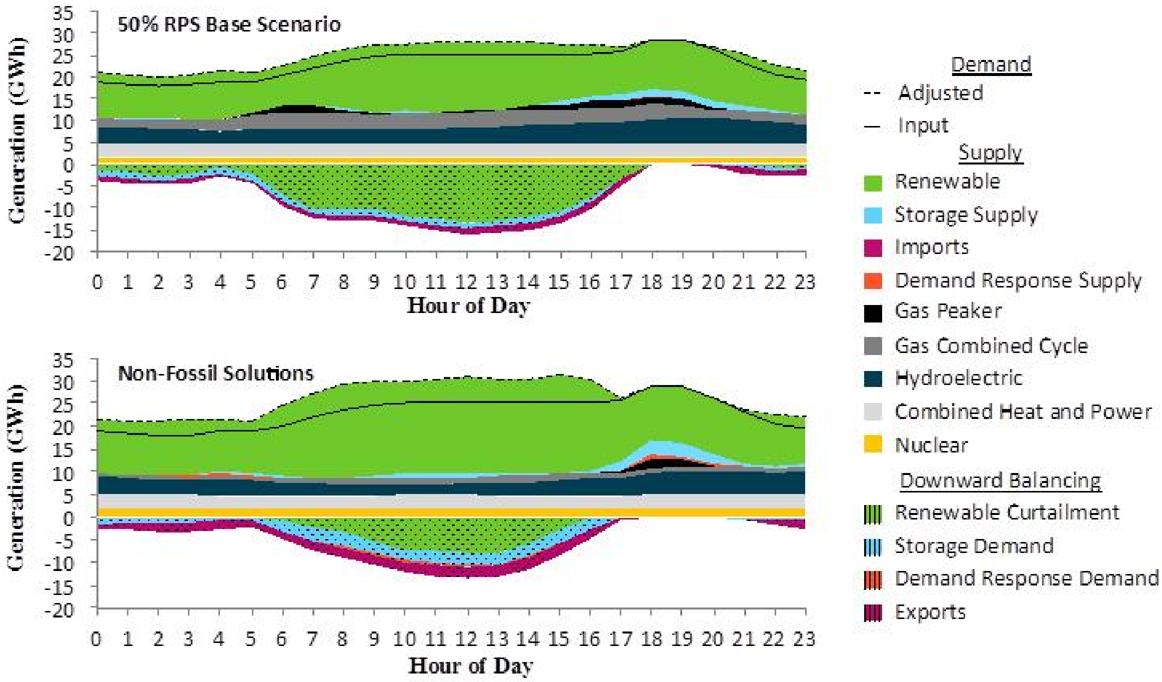

Figure 4. Example of the impact of changing system flexibility on demand shape and curtailment from an analysis by the Union of Concerned Scientists

(modified from Nelson and Wisland 2015)

Similarly, NREL has also examined higher renewable penetration scenarios in California using PLEXOS with a Western Interconnection database derived from the Western Electricity Coordinating Council (WECC) Transmission Expansion Policy Planning Committee (TEPPC), with additional modification based on the LTPP database (Brinkman et al. 2015). The NREL study examined cases where California achieves greater than 50% reduction in electric sector carbon dioxide emissions by 2030 with a variety of renewable energy technologies and flexibility assumptions, such as increased export limits and reduced minimum local generation requirements. Total annual curtailment estimates range from 0.2% (with a balanced portfolio in a more flexible grid) to almost 10% (with a high-solar portfolio in a less flexible grid).

Other modeling tools have been applied to examine the impact of PV on overgeneration in California. A study by Energy & Environmental Economics (E3 2014) using the ProMaxLT production cost model examined RPS levels higher than the previous CAISO studies. It

[8] Reserves from renewables, as discussed in later sections, involves using curtailed VG energy to provide upward reserve capacity, which is traditionally provided by partially loaded conventional generation.

identified a significant increase in solar curtailment, particularly when mitigation options are not deployed. In one 50% RPS scenario evaluated (with PV penetration equal to about 26%), about 8.9% of available RPS energy is curtailed. The E3 study also observed that at the point that PV achieves this high level of penetration, the marginal curtailment (reflecting the curtailment rate of the last unit of PV added to the system) is high as 65%. Figure 5 provides an example from the E3 study showing a duck-shaped chart with a significant hump representing overgeneration.

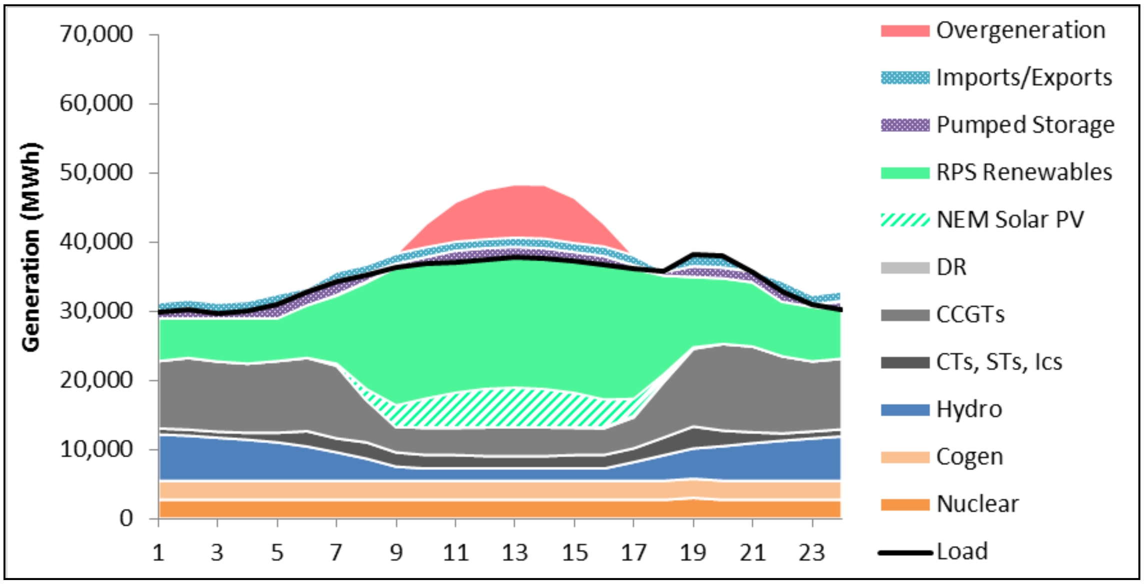

Figure 5. Example of an analysis of the impact of high VG on net load shape and resulting overgeneration

Source: E3 2014

This list includes only studies that have used commercial production cost models; however several other studies demonstrate the challenges associated with PV overgeneration in California. These include a study by Mills and Wiser (2012) that examines the overall decrease in value of PV as a function of penetration including the impacts of overgeneration, and a follow-on analysis that examines the impact of mitigation strategies including energy storage and demand response that effectively change the net load shape (Mills and Wiser 2014).

Finally, an extensive discussion of the duck chart shape and mitigation approaches is provided by Lazar (2014). While the analysis does not perform detailed operational simulations or estimate curtailment, it does provide a conceptual framework for changing the duck chart shape and flattening the net load through a total of 10 strategies including multiple types of energy storage and load shifting/demand response. An example of the analysis is provided in Figure 6, where the original duck shape is “streamlined” with the likely result of decreasing overgeneration and increasing the ability to integrate greater amounts of PV. Other discussions of mitigation options include Lew et al. (2015).

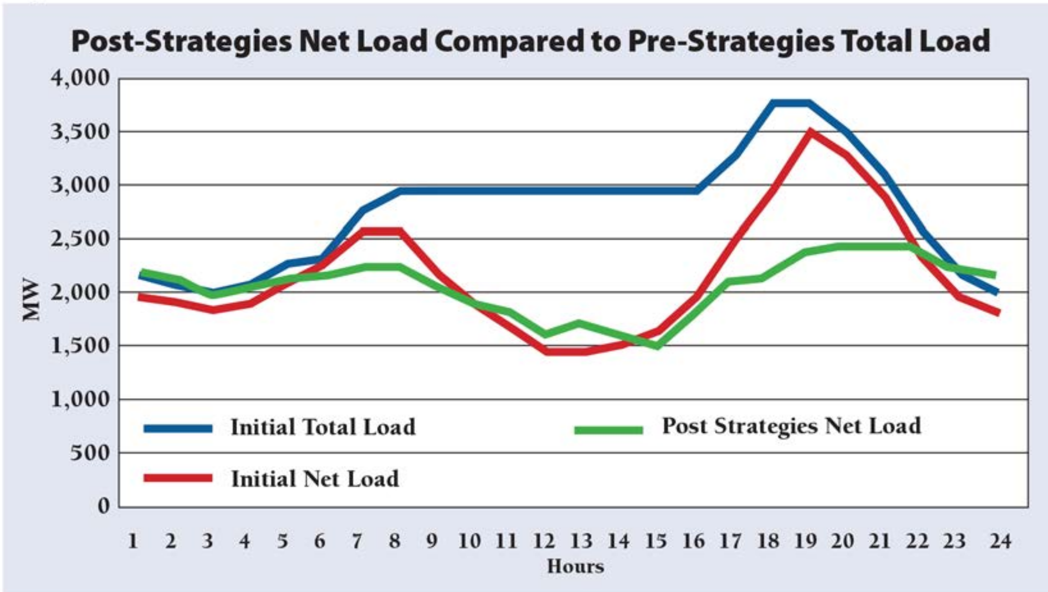

Figure 6. Example of an analysis of how the duck curve shape can be modified to minimize overgeneration

Source: Lazar 2014

It should also be noted that the impact of PV on net load and corresponding overgeneration risk have been studied in other parts of the United States, including Texas (Denholm and Margolis 2007), the entire Western Interconnection (GE 2010; Lew et al. 2013), and the Eastern United States (Bloom et al. 2015).

4 Study Methods and Data

The goal of this study is to explore the duck curve in detail and identify the overgeneration and curtailment challenges associated specifically with increased deployment of solar energy in the California system. The study uses the PLEXOS production cost model[9] to simulate grid operation with as more PV is added. It examines curtailment and considers how curtailment may change with alternative operational practices and technology deployment scenarios. The modeling framework and methods in this study are derived from the California 2030 Low Carbon Grid Study (Brinkman et al. 2015). The dataset for the analysis is based on a combination of the WECC TEPPC 2024 Common Case and the CAISO 2014 LTPP PLEXOS dataset. This dataset represents the power system in the entire Western Interconnection, while representing the California power system (transmission and generation) in more detail. Hurdle rates are included in the model based on the WECC 2024 Common Case to represent friction between balancing authorities. The analysis and results in this document represent all of California, including CAISO and the municipal utilities in California that are not part of CAISO.

The renewable generation is based on profiles developed for the Western Wind and Solar Integration Study and refined for Phase 2 of that study (Lew et al. 2012). The analysis performed hourly unit commitment and dispatch for 1 full year of simulation; however, sub-hourly renewable profiles were used to generate the day-ahead reserve requirements for up regulation and upward flexibility reserves.[10]

We begin by considering a scenario where wind provides about 11% of California's electricity. This represents a modest growth; in 2013, California generated 12.7 terawatt-hours (TWh) from wind in-state and imported another 12.7 TWh of wind for a total of 25.4 TWh, which provides about 8.6% of the total demand (296.6 TWh).[11] We also assume a total of about 1,900 MW of concentrating solar power (CSP), which provides about 1.5% of total demand. Most of this CSP capacity does not have thermal storage, so it is considered a variable generation resource for this analysis. Other qualifying renewables (geothermal, biomass, and small hydro) provide about 13.6% of total demand. As a result, our initial (base) scenario represents a renewable potential of about 36%, not including large hydro. To this base system, we incrementally add PV to analyze the progression of the duck chart shape and the resulting overgeneration, considering various changes to grid operation and conditions that can effect the net load shape. Table 2 summarizes the scenarios analyzed including renewable potential (before curtailment), and reserve requirements.

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[9] Plexos V6.4 R01 x64 using the Xpress-MP 26.01.04 solver with a MIP relative gap of 0.5%

[10] Following Brinkman et al. (2015), we do not enforce a downward reserve constraint, under the assumption that downward reserves can easily be provided by curtailing renewable energy generation during times when downward reserves are called. This assumption needs further analysis considering the actual curtailment that would result when using renewables for down reserves.

[11] http://energyalmanac.ca.gov/electricity/total_system_power.html and http://energyalmanac.ca.gov/electricity/electricity_generation.html

Table 2. Summary of PV Penetration Scenarios Evaluated

Solar Pre-Curtailment Potential Scenario (%)	Total Solar (PV + CSP) Potential (GWh)	Total Pre-Curtailment RPS Potential (%)	Annual Regulation Up Requirement (GW-hr)	Annual Flexiblity Up Requirement (GW-hr)
11%	35,331	36.0%	3,499	10,590
15%	46,473	39.6%	3,671	11,089
18%	56,438	42.7%	3,947	11,651
21%	66,155	45.8%	4,282	12,240
24%	77,329	49.4%	4,718	12,947
31%	98,964	56.3%	5,652	14,361
37%	119,682	62.9%	6,607	15,746

5 Results: Base "Most Conservative" Case

We begin with an exploration of PV curtailment in a case with a set of conservative assumptions about power system operation based on a "2015 grid" without enhanced grid flexibility. These assumptions include:

- Wind and solar cannot provide upward reserves.
- No net exports of electricity from California are allowed and at least 70% of California owned or contracted generation (including Hoover, Palo Verde and certain renewable generation) from outside of the state must be imported.[12]
- Up to about 1.3% of peak demand (as much as about 900 MW during periods of peak demand) can be shifted via economic demand response programs.[13]
- No new storage is installed beyond what is in service in 2015.[14]
- Twenty-five percent of all generation within certain zones must be met with local thermal or hydro generation.[15]
- Diablo Canyon remains online as a baseload (non-dispatchable) generator. The plant does not contribute to the 25% local generation requirement.[16]
- Instantaneous penetration of VG (including PV, wind, and CSP without thermal energy storage) is limited to 60% of the normal load.

It should be noted that the CAISO does not include the 60% penetration limit in their formulation of the LTPP model; this limit is based on concerns stated in the CAISO duck chart fact sheet, indicating that at 60% penetration:

> the grid may not be able to prevent frequency decline following the loss of a large conventional generator or transmission asset. This situation arises because renewable generators are not currently required to include automated frequency response capability and are operated at full output (they can not increase power). Without this automated capability, the system becomes increasingly exposed to blackouts when generation or transmission outages occur.[17]

[12] Following Brinkman et al. (2015) we allow non-imported VG to meet the California renewable requirement through the purchases of unbundled renewable energy credits (RECs). In the very high penetration cases described in the results, up to about 2% of renewable energy is not directly imported and acquired through RECs.
[13] This value is about equal to the existing "price response" demand response available from the three investor-owned utilities in CAISO, as reported in the "Demand Response Monthly Reports" at (www.cpuc.ca.gov/PUC/energy/Demand+Response/Monthly+Reports/2015_DR.htm).
[14] The impact of storage mandated by California State Assembly Bill 2514 is discussed in the Section 6.
[15] In the database from which this study is derived (the Low Carbon Grid Study from Brinkman et al. 2015), the zones that require the 25% local generation limit are SDGE, SCE, PG&E (Valley Zone), and LADWP, which account for 77% of all California load. For additional analysis of the impact of the local generation requirement, see Nelson (2014) and Brinkman et al. (2015).
[16] This is a conservative assumption based on the fact that nuclear power plants typically do not vary load to provide operating reserves.
[17] https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

We added this limit to our base case explicitly to examine its impact and the importance of changing grid operations to allow greater penetration of VG at any moment in time.
The combination of constraints on system operations can result in significant overgeneration, particularly in the spring. Figures 7–11 demonstrate the drivers behind overgeneration and PV curtailment in greater detail. Figure 7 shows the normal load, wind, and solar (combined PV and CSP) profiles in a scenario with the potential to meet 11% of annual demand from wind and 11% of the annual demand from solar (9.5% from PV and 1.5% from CSP). This figure is for March 29, which is two days before the CAISO duck chart but actually the "worst" day in terms of PV-driven overgeneration for the load and PV demand patterns for this particularly meteorological year across all of California. (Because of the relatively low load, the potential generation from VG on this day is about 18% from solar and 16% from wind.) The figure also shows the resulting net load that would need to be met by the remaining generation fleet, assuming all solar and wind generation could be used. In this example, the new minimum load point (of about 7,700 MW) is shifted from 4 a.m. to noon.

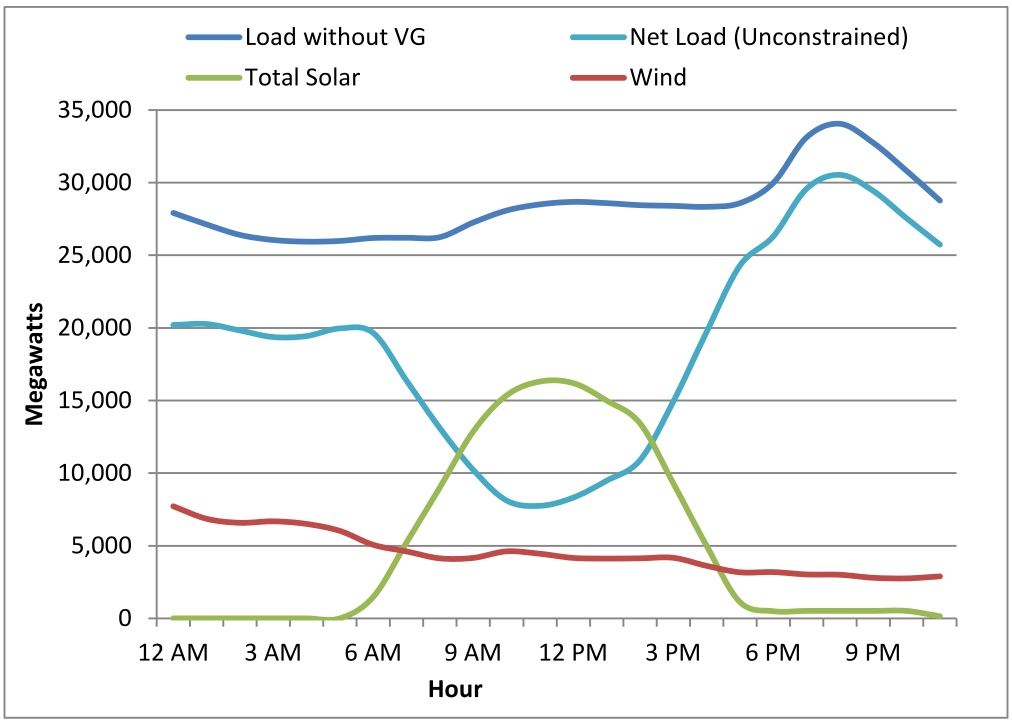


Figure 7. Load, solar, and wind profiles for California on March 29 in a scenario with 11% annual wind and 11% annual solar assuming no curtailment

The net load shown in Figure 7 does not consider the operational constraints that actually occur in the dispatch, and these constraints do not allow all renewable energy potentially generated on this day to be used.

The remaining figures in this sequence are from the results of the power system simulation. Figure 8 shows the net load resulting from the VG that can actually be used in the simulated system. In this case, the net load met by conventional generation is not allowed to drop below about 12,600 MW. This represents a California system-wide minimum generation constraint, meaning on-line generators in California—and certain contracted generators outside California—

cannot reduce output to below this level, considering the individual generator parameters and system limitations described at the beginning of this section.[18]

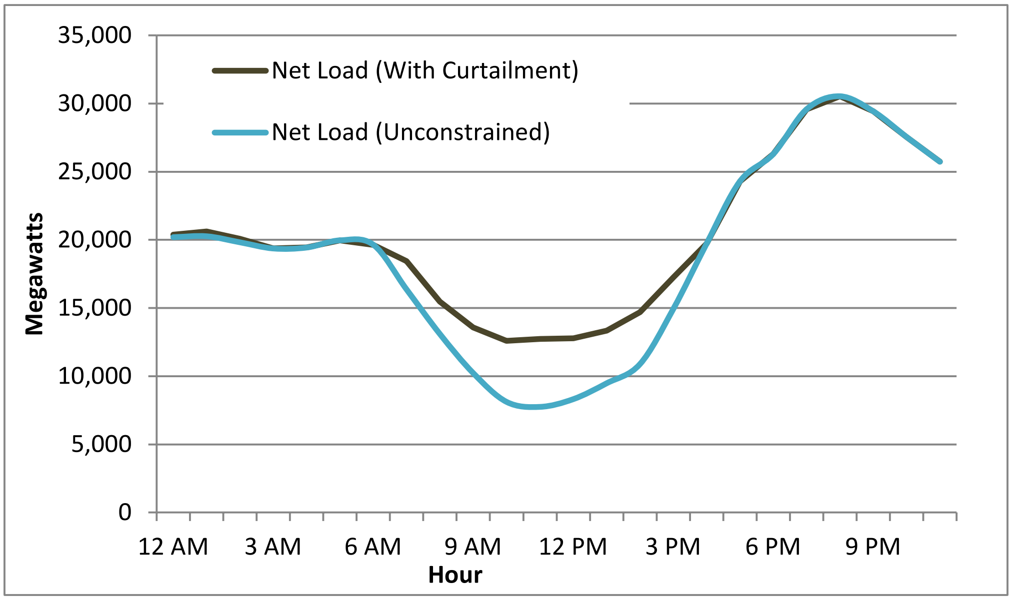


Figure 8. Modeled net load in California on March 29 in a scenario with 11% annual wind and 11% annual solar in a system with a 60% instantaneous penetration constraint

These constraints result in curtailed energy, illustrated in Figure 9, which includes the combined VG potential, the amount of VG used by the system to meet load, as well as the curtailed VG. Curtailment is defined as any VG that cannot be used for any reason. Overall, about 5% of the potential wind and solar energy on this day is curtailed. However, during most days, higher mid-day load does not produce a dramatic duck-curve shape and there little or no curtailment. Over the entire year, about 0.2% of VG is curtailed.

[18] This minimum generation value is already below a CAISO-only estimate of the lowest net load point of about 15,000 MW in the current system (Bouillon 2014). The lower minimum generation point in this analysis results from several factors including greater flexibility from customer-owned cogeneration assumed in the LTPP model. The LTPP model also does not include fixed-scheduling contractual limitations on plant dispatch. Also, Diablo Canyon unit 2 was out for maintenance on this day in the simulation, which removed 1,122 MW of non-dispatchable capacity. The net load in the system is less than 15,000 MW during only 12 hours of the year in this simulation.

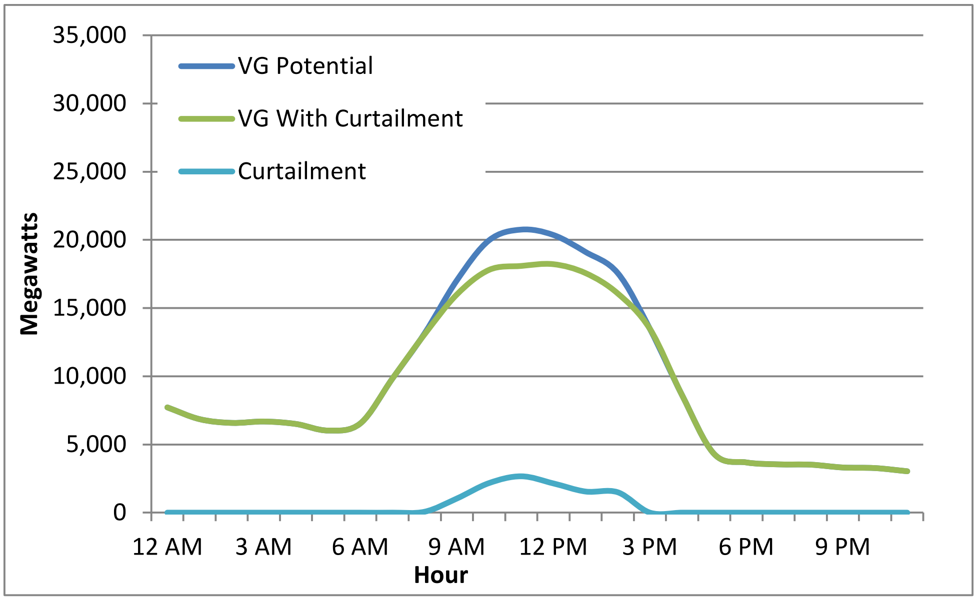


Figure 9. Used and curtailed VG in California on March 29 in a scenario with 11% annual wind and 11% annual solar

Figure 10 shows how the 60% instantaneous penetration limit results in overgeneration and curtailed VG. The bottom curve shows the instantaneous penetration of VG from the model, while the top curve shows the theoretical penetration if all VG could be used. In this case, the VG potential exceeds the 60% threshold for four hours.[19] In this scenario, the vast majority (about 95%) of all curtailment occurs during periods where the potential VG penetration would exceed 60%. During a few hours of the year there is curtailment at VG penetration levels significantly below 60%, indicating that ramping constraints might force some curtailment. However the total amount of curtailment during these periods is very small compared to the amount created by the 60% limit. While the average net load ramp rate increases, the existing system appears to be sufficiently flexible address these ramp rates. The normal load (without additional VG) achieves a maximum hourly upward ramp rate of 6,721 MW/hr on December 22th at 5 pm. In the 11% annual solar case, only 5 hours of the year demonstrate net load ramp rates that exceed this value, with the maximum net load ramp rate of 7,379 MW/hr. The maximum upward ramp rate on the duck curve day is 3,142 MW/hr. Analysis in later sections evaluates the relationship between a lower penetration limit and possible ramp rate constraints at higher PV penetration.

[19] The actual penetration of VG is slightly less than 60% because the constraint does not consider a small amount of schedulable load within the model.

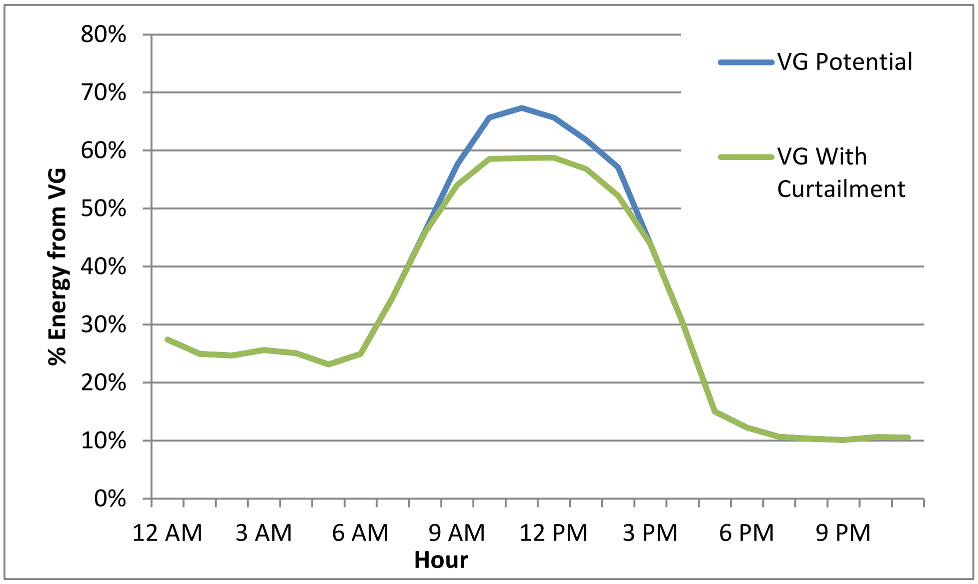


Figure 10. Instantaneous penetration of VG on March 29 with and without curtailment in a scenario with 11% annual wind and 11% annual solar

Of note in these results is the use of existing pumped storage in the California system, which represents a total of 2,518 MW of generation capacity[20] including 2,264 MW of schedulable pumping load that can be used to increase total demand during periods of high solar output.

Figure 11 shows the simulated storage pumping load that occurs, and how storage results in an increase in VG used. As noted previously, because this conservative base case considers grid conditions that approximate those of 2015, this simulation does not consider the 1,325 MW of additional storage that will be deployed as part of the California storage mandates, which is evaluated in later sections.

[20] These values are for the four existing California pumped storage plants in TEPPC common case (Castaic, Eastwood, Helms, and Lake Hodges). The CAISO LTPP model has a combined capacity of 2,728 MW for these four plants.

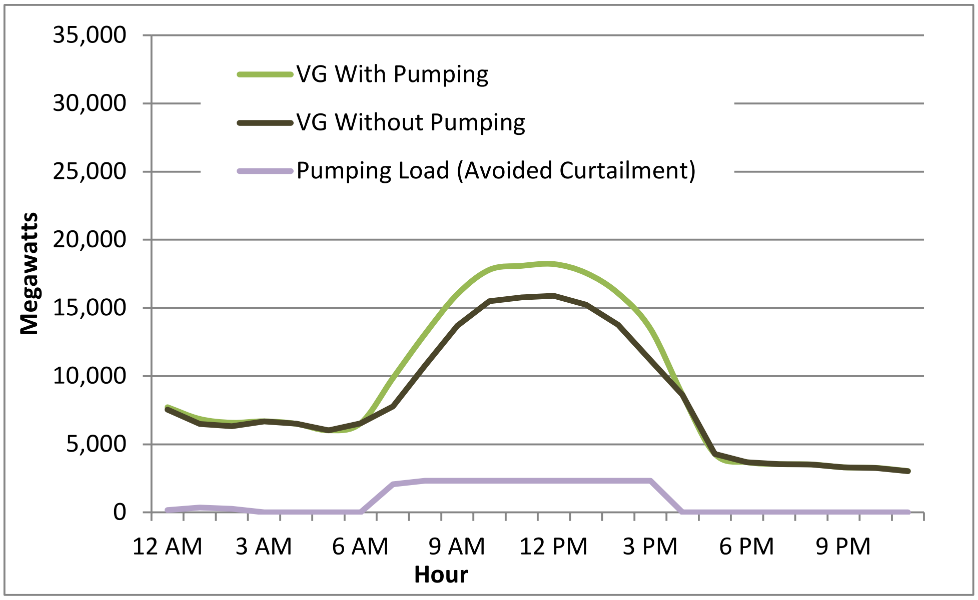


Figure 11. Increase in VG use resulting from schedulable pumped storage in a scenario with 11% annual wind and 11% annual solar

On most days of the year, significant additions of PV are possible without causing significant curtailment. Figure 12 duplicates Figure 7, but for July 27, the day with the highest demand (note the scale change on the y-axis due to the significant increase in demand). On this day, there is no VG curtailment, and instantaneous penetration is well below the 60% threshold, as illustrated in Figure 13.

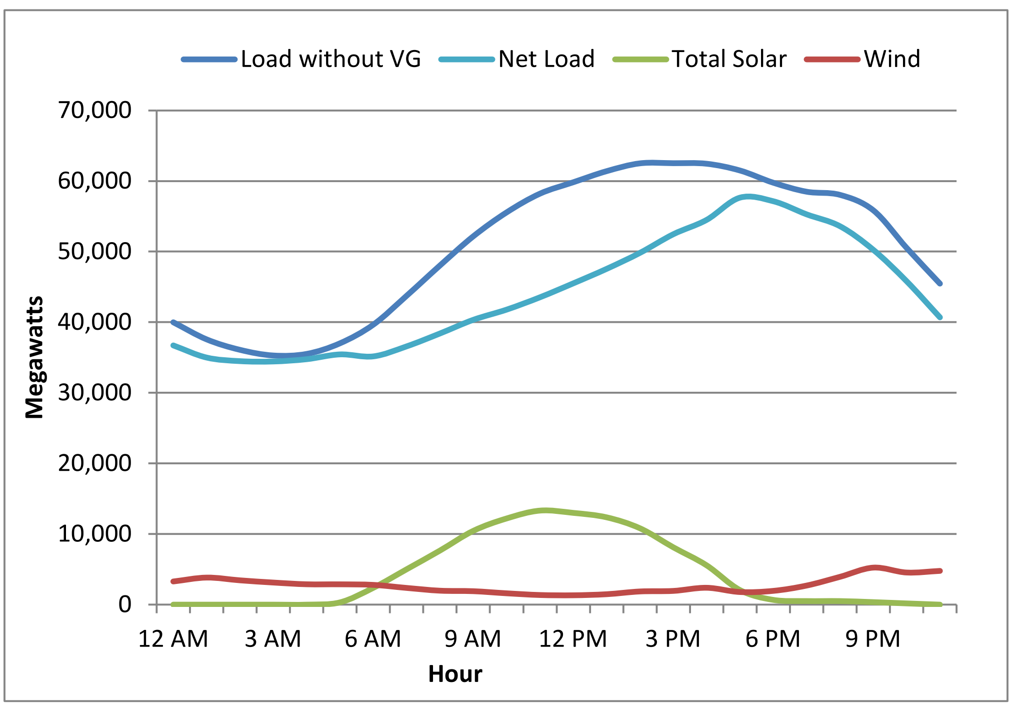


Figure 12. Load, solar, and wind profiles for California on July 27 in a scenario with 11% annual wind and 11% annual solar

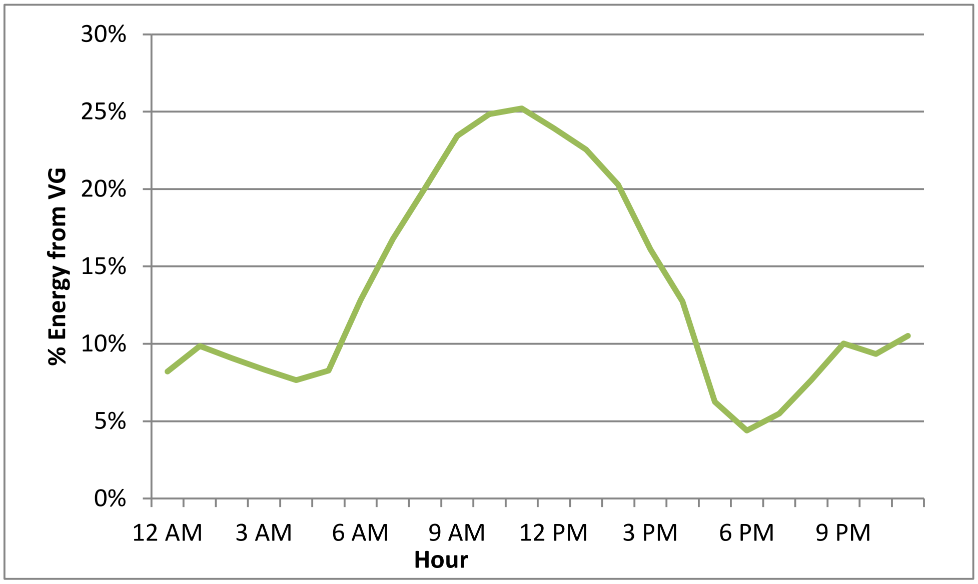


Figure 13. Instantaneous penetration of VG in California on July 27 in a scenario with 11% annual wind and 11% annual solar

The duck chart figures show the challenge of additional PV penetration without increasing system flexibility. Adding PV to help reduce the use of peaking capacity on July 27 also produces more energy on March 29. Without flexibility changes that will allow additional units to reduce output or be de-committed, only a relatively small amount of additional PV generation can be accommodated on March 29 (during the shoulder periods in the morning and evening). And as more PV is added, there will be a greater number of days with associated PV curtailment.

Figures 14–16 show the progression of the duck curve and associated overgeneration as additional PV is added. Figure 14 shows what the net load would be on March 29 without curtailment in both the base case illustrated previously and a case where we add sufficient PV to meet 15% of total annual demand (pre curtailment). In this case, the pre-curtailment net load drops significantly, to below 5,000 MW.

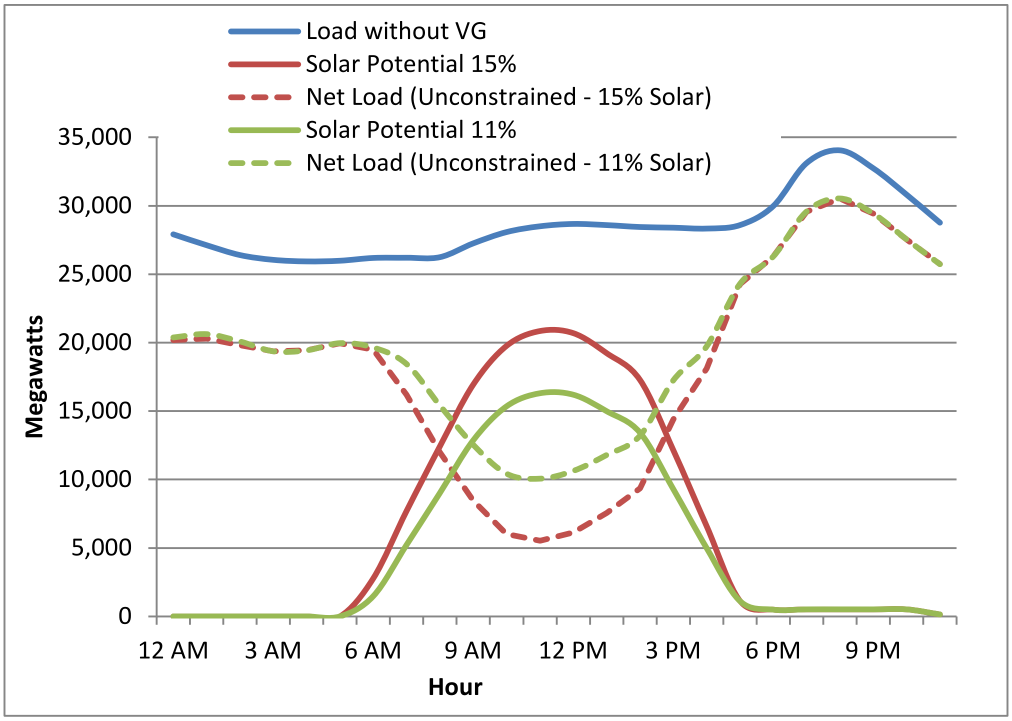


Figure 14. Load in California and VG Profiles on March 29 in a scenario with 11% and 15% annual solar assuming no curtailment

While Figure 14 shows the belly of the duck growing as more solar as added, the net load changes very little at the higher PV penetration due to the 60% penetration constraint in the base case. Figure 15 shows how the belly of the duck curve is prevented from growth due to this constraint, and very little additional PV can be used in the simulated system on this day. Figure 16 shows the hourly curtailment and the used PV in the two cases. At the lower penetration, nearly all the PV (95%) is used on this day, but in the case with additional PV, most of this additional PV is curtailed. Only a small amount of PV in the morning and late afternoon is actually useful, and the total curtailment on this day increases from 5% to about 13%. However, the marginal curtailment on this day, or curtailment of the additional PV added to the system between the two scenarios is about 65%. This illustrates the importance of differentiating the total curtailment and incremental, or marginal curtailment of PV. On an annual basis, the total curtailment increases from 0.2% to 0.9%, while the marginal curtailment is 5.5%.

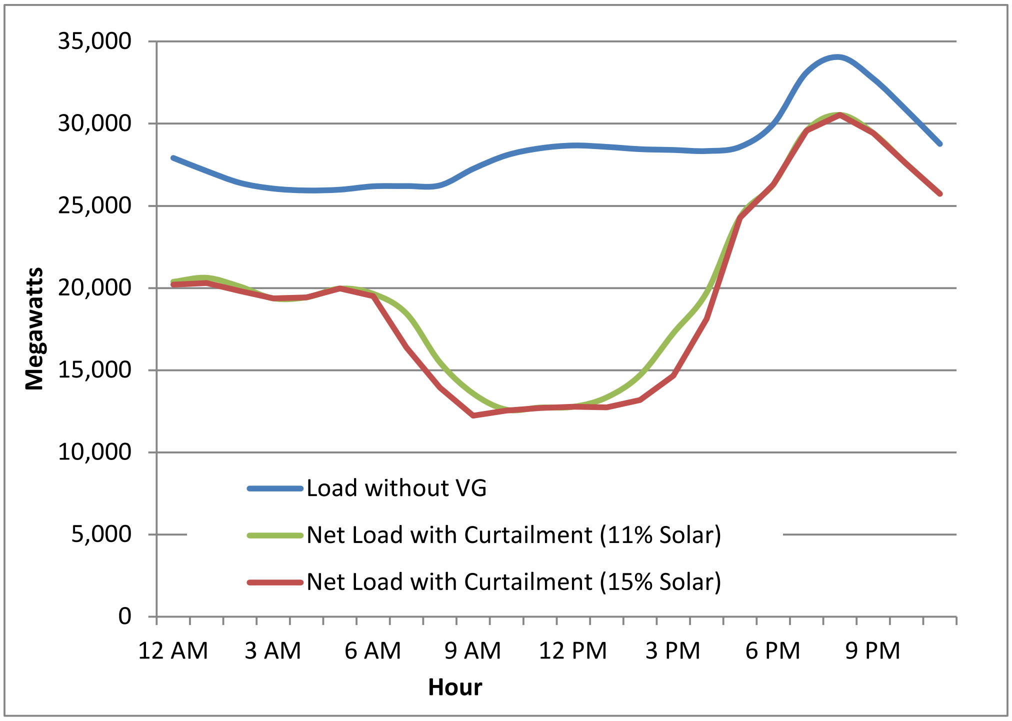


Figure 15. Net load on March 29 in a scenario with 11% and 15% annual solar considering operational constraints

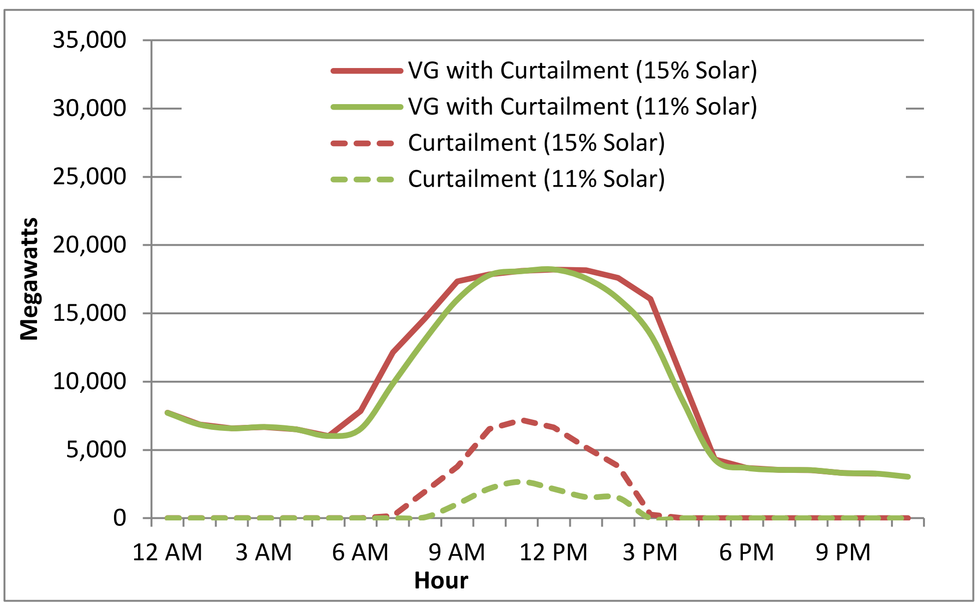


Figure 16. Usable and curtailed VG on March 29 in a scenario with 11% and 15% potential annual solar

As even more PV is added to the system, more days acquire the duck shape, and overgeneration increases. Figure 17 illustrates the resulting fraction of variable generation curtailment due to overgeneration as a function of penetration. The bottom x-axis shows the total penetration of solar energy sources (PV plus CSP), while the top x-axis shows the penetration eligible renewable resources (solar plus wind, geothermal, biomass, and small hydro). Only PV is added and the overall penetration is defined as the annual contribution of renewable energy to the total energy demand in California,[21] after removing curtailed energy.

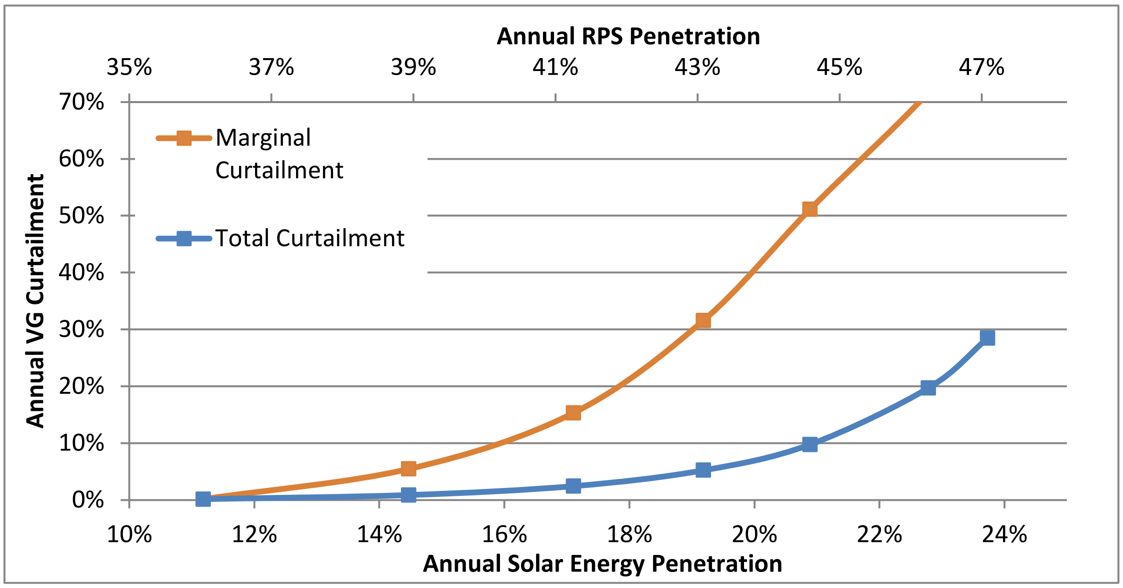


Figure 17. Marginal and average curtailment due to overgeneration under increasing penetration of PV in California with a 60% instantaneous penetration limit

The rapid increase in marginal curtailment rates as a function of PV penetration is a significant limitation for PV to remain competitive with other sources of low-carbon energy once it achieves a certain penetration (in this case perhaps 15%–20% of annual demand). This challenge can be observed by examining the impact of curtailment on the levelized cost of energy (LCOE) of PV. As curtailment increases, and capacity factors decrease, the LCOE increases. This is illustrated in Figure 18, which provides PV LCOE as a function of penetration for the base case scenario. In this figure, the PV cost is based on the DOE solar program goal of an LCOE equal to six cents per kilowatt-hour. This goal is largely dependent on being able to actually use all the energy available from PV and on minimizing curtailment.

[21] Where the total demand is equal to the consumer demand plus storage losses associated with pumped hydro

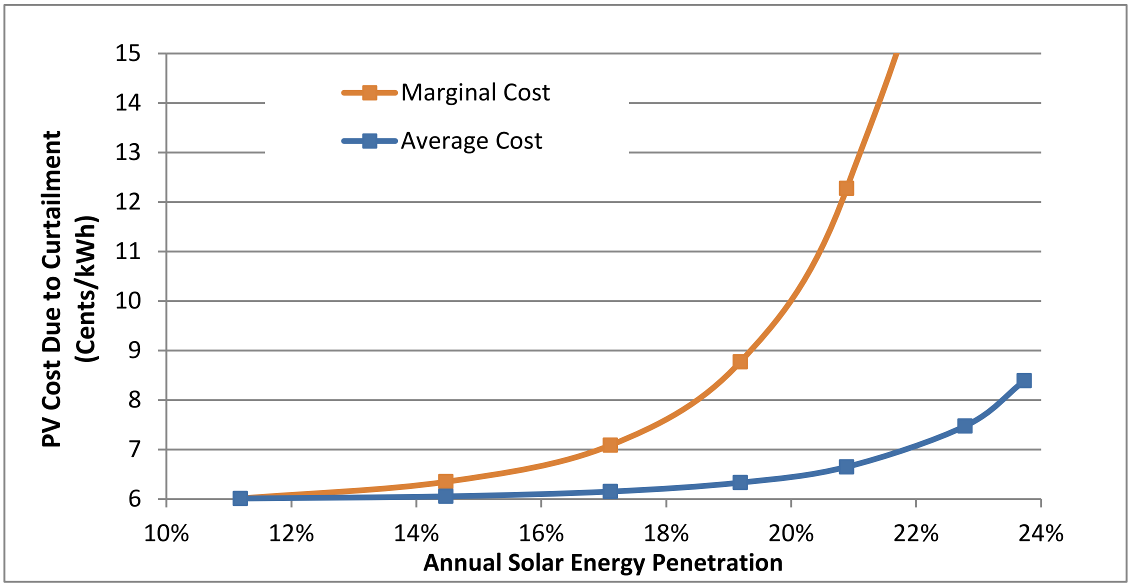


Figure 18. Marginal and average PV LCOE (based on SunShot goals) due to overgeneration under increasing penetration of PV in California with a 60% instantaneous penetration limit

Figure 18 shows the importance of examining marginal curtailment rates. While average rates can remain relatively low, marginal rates determine the cost and value of adding the next unit of solar to the grid. Actual investment decisions may be driven by these marginal values, with actual allocation of curtailment driven by a variety of factors, including local grid conditions, the underlying contractual agreements with suppliers, production tax credits, and other regulatory issues. It should be noted that in Figure 18 all incremental curtailments of non-zero cost renewable energy resources (CSP, wind, hydro, and geothermal) were assigned to PV. For example, if at the lowest penetration of PV there is no curtailment of wind, and when PV is added wind is curtailed, this wind curtailment is actually assigned to PV for accounting purposes.

The very high marginal curtailment rates of PV observed in Figure 17 would likely limit contribution from solar without changing system operation to accommodate variable generation resources. Examination of the duck curve provides insights into how improved flexibility can both accommodate and change the net load shape and increase penetration of solar energy resources.

6 Enabling Greater Solar Penetration: Flatten or Fatten the Duck?

Accommodating greater amounts of PV will likely require multiple approaches to increasing the overall flexibility of the power system. Previous work by the CAISO (Bouillon 2014) and other groups (listed in Section 3) suggest many individual approaches, but these can be summarized by two more general approaches, which we illustrate below as *fattening* the duck and *flattening* the duck.

Fattening the duck represents all approaches that increase the flexibility of the grid and allow greater instantaneous penetration of variable generation resources. Typically, this means (1) changing operational practices to allow more frequent cycling, unit starts and stops, and (2) minimizing the amount of thermal units held at part load by improving accuracy of VG forecasts and not holding excessive reserves. This also means allowing VG to provide operating reserves and other services that stabilize system frequency (Gevorgian et al. 2015). These changes can reduce the overall system-wide minimum generation requirement, and they allow the natural belly shape of the duck to grow larger and provide a greater fraction of the normal load during periods of high solar output.

Figure 19 illustrates the change in minimum generation requirements that would be needed to eliminate curtailment on our lowest net load day in the 15% solar penetration scenario. The net load in this figure is from the constrained system illustrated in the previous section (Figure 15). In this case, the system's minimum generation point of about 12,600 MW results in significant curtailment. If the system were able to operate at a lower minimum generation level (about 5,400 MW), curtailment would be eliminated.

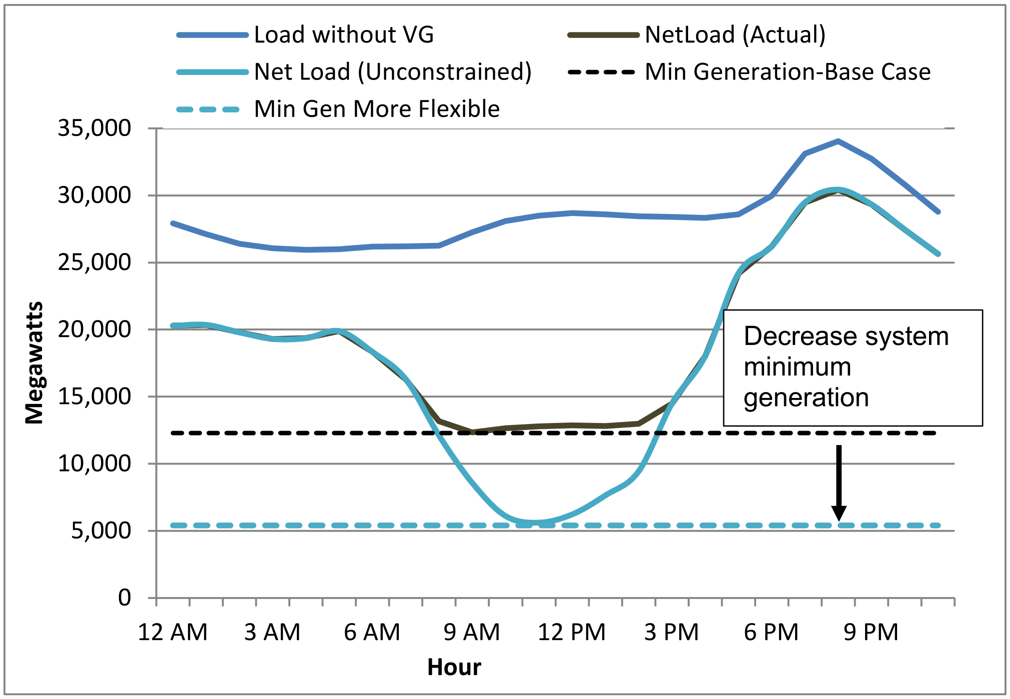


Figure 19. Accommodation of increased penetration of PV by reducing system minimum generation requirements and fattening the duck

Alternatively, flattening the duck acts to shrink the belly shape by shifting supply/demand patterns to allow solar energy to meet parts of the load that would not normally be provided in the middle of the day. This includes either shifting load via responsive demand or shifting supply by the use of energy storage (Lazar 2014).

Figure 20 illustrates the amount of load shifting that would be required to eliminate curtailment. In this example, we keep the 12,600 MW minimum generation level associated with the 60% instantaneous penetration limit. We add load (from shiftable demand or storage) with timing and amounts that exactly match curtailment of PV. As much as 7,200 MW of additional demand or storage charging would be required to eliminate all curtailment in this case. The impact of load shifting/storage is shown on both the normal (no VG) load (the top curve) as well as the net load with VG. On the normal load, additional demand produces a "hump" on the back of duck. This stored energy will be used later (or demand later in the day will be shifted earlier), reducing demand in the evening (represented by the flat line where the load has been reduced). The impact on the net load is to increase the net demand to the minimum generation level, with the added benefit of reducing peak demand in the late evening.

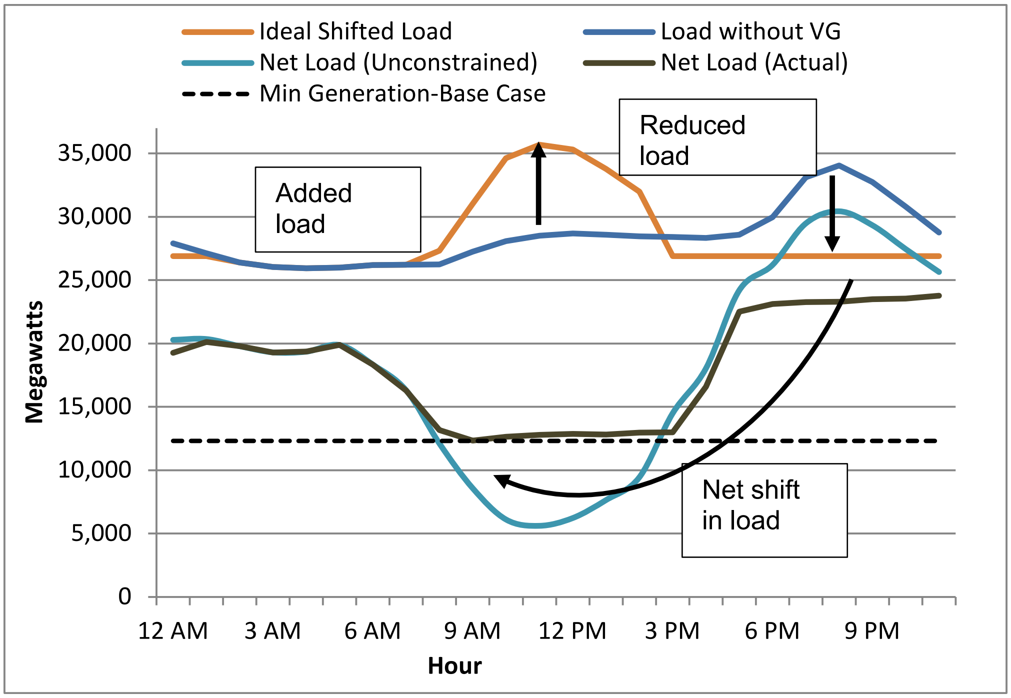


Figure 20. Accommodation of increased penetration of PV by flattening the duck (increasing mid-day demand)

Increased penetration of PV can occur by applying either approach individually, but the greatest impact will occur when the approaches are applied collectively.

7 The Impact of Improved System Flexibility

Increasing Instantaneous Penetration and the Impacts of the California Storage Mandate

The base case analyzed in Section 5 does not consider several grid changes that will likely occur by 2020 that will help reduce the impact of solar generation on grid operations. Among these changes is the deployment of new energy storage. In October 2013, the California Public Utilities Commission (CPUC) finalized Decision 13-10-040, which adopts procurement targets and requirements for 1,325 MW of "viable and cost-effective" energy storage systems by 2020, as directed by the California State Legislature in 2010 (CPUC 2010; CPUC 2013).

This new storage can help accommodate increased use of VG by shifting load and flattening the duck. We consider the addition of 1,290 MW of storage, following the modeling assumptions of the TEPPC 2024 database.[22] The size and characteristics roughly follow CPUC R.13-12-010 and include 550 MW with two-hour discharge duration, 520 MW with four-hour discharge duration, and 220 MW with six-hour discharge duration. The devices are assumed to have 83% round-trip efficiency and are distributed among the three California investor-owned utility zones in accordance with the storage mandate. We assume all of the storage added is optimized by the system operator to minimize the overall cost of system operation and can provide multiple services including provision of reserves.[23] This is a critical assumption, and it would require optimization either (1) directly by a system operator in the case of utility-scale storage or (2) indirectly through real-time pricing or other mechanisms that would optimize behind-the-meter storage. Figure 21 illustrates how this additional storage shifts load to flatten the duck and reduce curtailment. This figure shows the normal load from the 15% PV case and load with the additional storage. The resulting curtailment is also shown, and is compared to the case without the added storage.

[22] The 40-MW Lake Hodges plant is eligible for the storage mandate, and it existed in the base case, so the additional storage is less than the 1,325-MW requirement.
[23] This is a deviation from the current assumptions in the LTPP model, which assumes a mix of transmission, distribution, and customer sited storage, of which only a fraction can provide reserves (Liu 2014a).

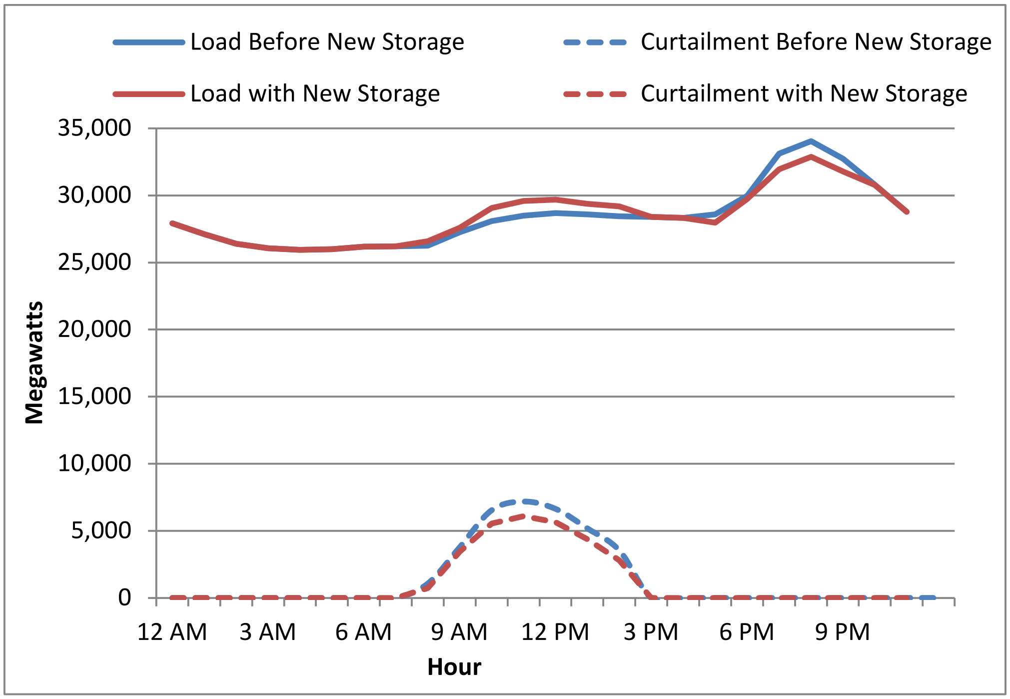


Figure 21. Impact of flattening the duck on March 29 with 1,285 MW of added storage in a scenario with 15% annual solar

The amount of avoided curtailment in Figure 21 is relatively modest, but it does not consider a potentially even greater benefit of distributed storage by provision of grid flexibility services. By providing these services (including grid stability), storage can help reduce the need to run partially loaded thermal generation to provide reserves.

The previous section shows the significant impact of the 60% instantaneous penetration limit, which creates the flat belly on the duck curve and results in significant overgeneration. While we impose the 60% limit in our base case, the CAISO LTPP model imposes a 25% local generation limit, which requires 25% of local load in all hours to be met by conventional generators (which we also include in our base case in the previous section). Renewables, demand response, and storage are ineligible in the CAISO model to meet this requirement. The motivation for this limit is described as:

> The constraint is necessary for the balancing authority to comply with the NERC control performance standards. A balancing authority must have at least 25% of its internal generation on-line with adequate available capacity for dispatch or risk non-compliance. Within the CAISO's footprint, a contingency that results in the tripping of Path 26 would separate the north from the south. Without a minimum amount of generation in southern California, there is a risk that the CAISO could completely lose the load if Path 26 were to open.[24]

[24] Liu 2014a

The common theme behind these concerns is the ability of a system operator to maintain system stability, including voltage stability and frequency stability.[25] While there is little direct experience in operating grids in the United States with extremely high levels of instantaneous VG penetration,[26] studies suggest a variety of approaches to maintaining system stability under increased VG penetration. One example is Phase 3 of the Western Wind and Solar Integration Study (WWSIS-3) (Miller et al. 2014), which examined frequency and transient stability at instantaneous VG penetrations of up to 53% across the Western Interconnection and 62% in California. The study simulated the frequency declines after severe disturbances, and found that at the levels of penetration simulated, the system was able to maintain enough primary frequency response to avoid under-frequency load shedding (blackouts). The study also concluded that the use of active power controls in wind turbines and PV could improve frequency response, which could allow greater instantaneous penetration of VG. Currently available wind turbines are now being deployed that can provide active power control, including both synthetic inertia and primary frequency response. Wind turbines can draw stored energy from the rotor to help arrest a frequency decline, or they can be operated at reduced output during periods of high VG penetration to provide primary frequency (governor) response. PV can also provide these services, although both require curtailment.

Fast-responding energy storage, such as batteries and flywheels, can provide rapid response to grid events. The amount of new storage in the California storage mandate significantly exceeds the WWSIS-3 estimated frequency response obligation for California, and WWSIS-3 found that a relatively small amount of storage (less than that in the California storage mandate) could provide significant benefits across the entire Western Interconnection.

As active power controls become more common on renewable generators, and if the system operator has greater control over the new storage being installed in California, these resources could be employed to replace the services now provided by conventional thermal resources.

To demonstrate how commercially available grid flexibility options can effectively fatten the duck, we consider a case where control of distributed resources allows for increased instantaneous penetration of VG. We also allow curtailed wind and solar to provide upward regulation, contingency, and flexibility reserves. While this provides a system benefit, we do not count curtailment that provides upward reserves as "used" energy. However this has a small impact as curtailed VG typically provides less than 4% of the total reserve requirement (During hours of large curtailment, there is typically a significant amount of partially loaded hydro or thermal plants that can provide upward reserves.)

[25] A summary of stability issues is provided by Kundur et al. (2004). They give the following definitions: "Voltage stability refers to the ability of a power system to maintain steady voltages at all buses in the system after being subjected to a disturbance from a given initial operating condition" and "Frequency stability refers to the ability of a power system to maintain steady frequency following a severe system upset resulting in a significant imbalance between generation and load."

[26] In October 2014, the Xcel service territory in Colorado provided 61.1% of demand with wind, which was partially enabled by utilizing wind to provide regulating reserves. However, because this system is connected to the larger Western Interconnection, it does not provide a realistic example of high-penetration of non-synchronous generation across a large balancing area or interconnection.

Figure 22 shows an example of a fatter duck that results from increasing the allowable instantaneous penetration from 60% in the base case to 80% (with no local generation requirement). The top curve shows the net load in the 15% base solar case (the same curve as shown in Figure 15). The bottom curve shows the impact of increasing maximum penetration to 80%, which substantially reduces curtailment on this day.

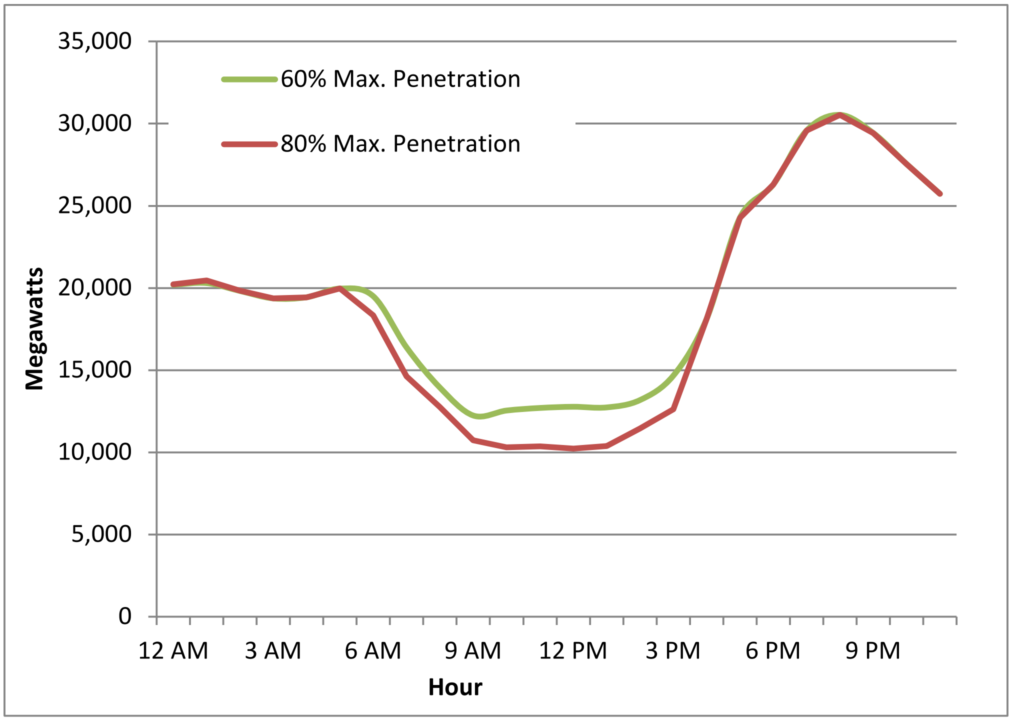


Figure 22. Net load on March 29 in a scenario with 15% annual solar increasing the maximum penetration of VG to 60% to 80%

The corresponding curtailment curves are provided in Figure 23. In this case, the curtailment of PV has been substantially reduced from about 13% on this day to about 7%.

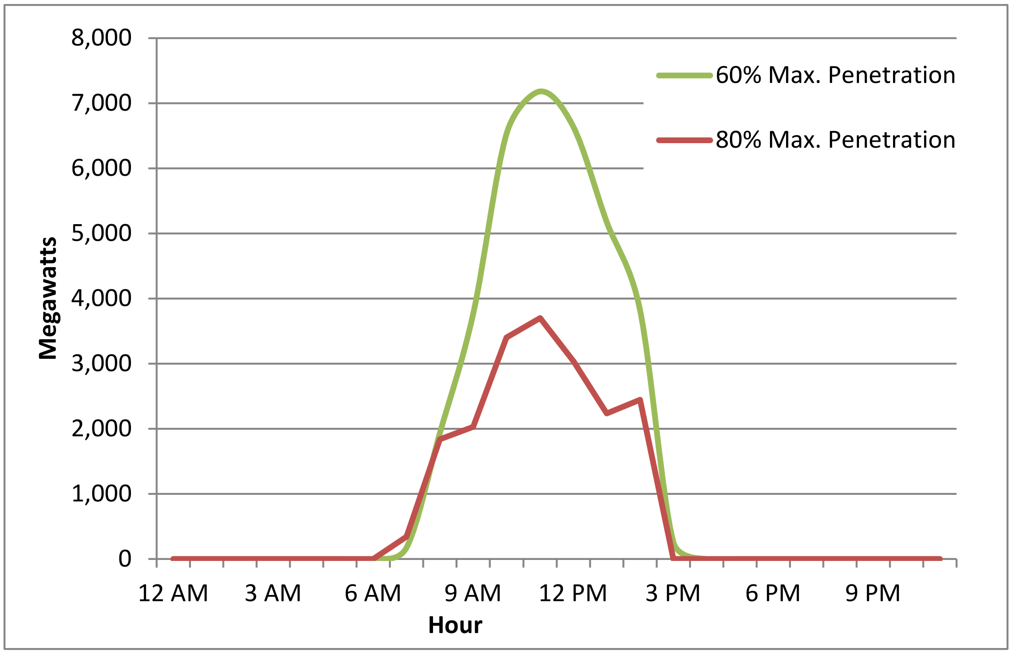


Figure 23. VG curtailment on March 29 in a scenario with 15% annual solar increasing the maximum penetration of VG to 60% to 80% and removing the local generation requirement

While curtailment has been reduced, it has not been completely eliminated due to other constraints on the system. The 10,000 MW net load in Figure 22 is close to the minimum output of "must-run" capacity in the system. Overall, the model identifies about 8,000 to 9,000 MW of minimum generation from nuclear, geothermal, hydro, biomass, and gas-fired combined heat and power (CHP) units.[27]

Overall, these changes to grid operation reduce curtailment and allow greater penetration of VG. Figure 24 compares the impact of replacing the original base case (including the 60% instantaneous limit and the 25% local generation constraint) with an overall 80% instantaneous VG penetration constraint. It is important to emphasize that this assumption requires the system operators to have greater visibility and control of multiple distributed resources, including both PV and storage. These distributed resources will likely be needed to perform many functions currently met by conventional generation resources, with appropriate controls and market mechanisms put in place to compensate owners for providing these services.

Compared to the base case, the curtailment curves are shifted to the right by about 8 percentage points, meaning greater energy penetration from solar can be achieved at the same level of curtailment. In this case, a solar penetration of 25% is achieved with a marginal curtailment rate of about 20%, with the total RPS level approaching 50%.

[27] As noted previously, this low level is made possible in part by the fact that one unit of Diablo Canyon nuclear units was out for maintenance on this simulated day.

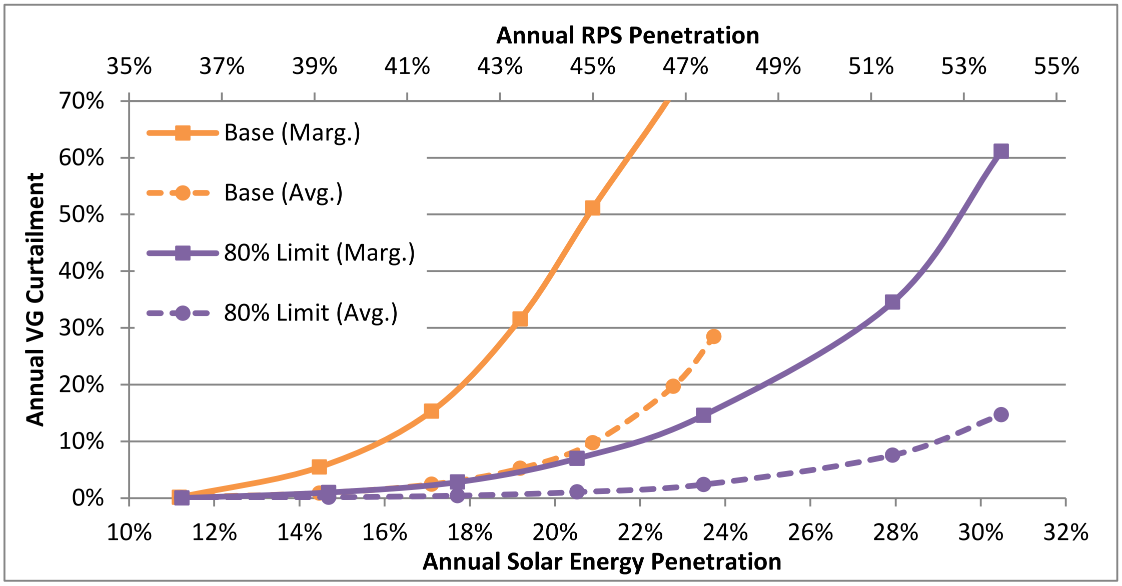


Figure 24. Marginal and average annual curtailment due to overgeneration under increasing penetration of PV in California after adding mandated storage, removing local generation constraint, and increasing maximum instantaneous VG penetration to 80%

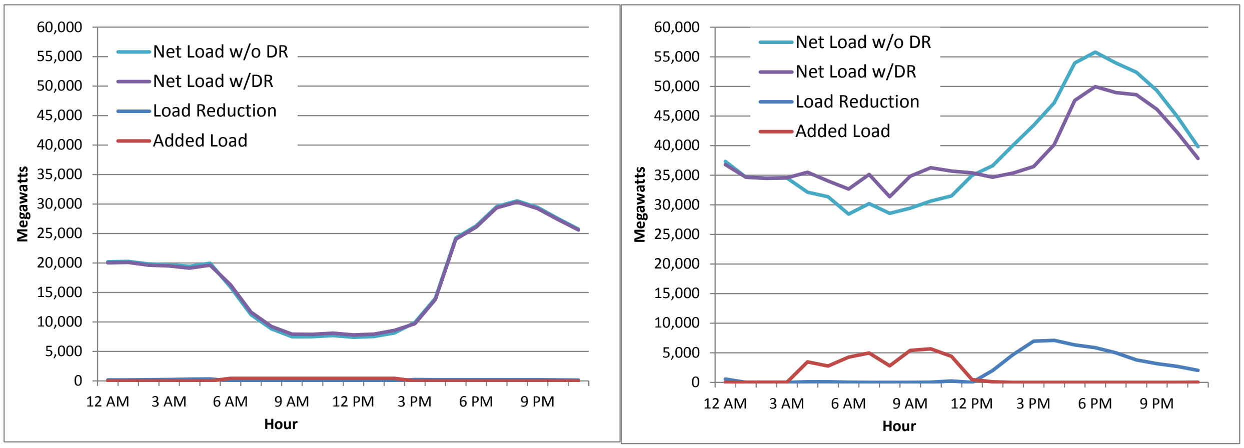
Engaging Further Demand Response

The solutions in the previous section fatten and flatten the duck by applying commercially available control technologies to local generation and storage resource. However, the base cases assume a very small amount of responsive demand that could allow greater PV penetration. As with energy storage, demand response (DR) can both flatten the duck (by shifting load) and fatten the duck (by providing grid services that reduce need to operate conventional plants at part load). Fattening the duck with DR will require provision of services not typically provided by loads. While demand shifting can occur through market-based incentives (e.g., time-varying prices), using DR to allow for increased VG penetration will likely require DR to provide grid stability services (e.g., primary frequency response). This will require loads to sense system frequency and automatically reduce load during low frequency events.[28] This incurs both an implementation cost and any costs associated with paying customers when load is curtailed.

To consider the possibility of how responsive demand could aid in PV integration, we consider two steps similar to the previous case. First, we assume a greater fraction of load (up to about 11% of instantaneous demand) can be incentivized to shift demand to times of lower energy prices (corresponding to low net demand).[29] Second, we increase the VG instantaneous penetration limit to 90%. This assumption reflects the possibility that directly controllable responsive demand can provide the system operator with increased flexibility including frequency stability measures such as primary frequency response.

[28] An example of an existing program that uses frequency-responsive loads is the ERCOT “Non-Controllable Load Resource” that provides Responsive Reserve Service. This program pays loads to reduce output automatically when the frequency drops below a certain threshold (ERCOT 2014).
[29] This and other changes to system operation will likely require new market mechanisms. Hogan and Paulos (2014) discuss several of these.

Figure 25 illustrates the impact of the added demand response on net load shape in the 24% potential solar case. Figure 25a shows the result for the duck curve day (March 29), while Figure 25b shows the result for the peak load day (July 27). The scales are the same for comparison. The impact on March 29 is very small due to the assumptions regarding the amount of shiftable demand, which is based largely on heating and cooling demand. The basis for this is discussed in Brinkman et al. (2015). On March 29, there is little need for either cooling or heating in the middle of the day, meaning there is low potential for demand shifting on this day based on the model assumptions. The impact on July 27 is more significant, and while DR adds significant economic benefit from load shifting, no curtailment occurs on this day.



(a) March 29 (b) July 27

Figure 25. Impact of additional demand response on system net load on March 29 and July 27

Further analysis is needed to estimate the actual potential for demand shifting and associated costs; however, there likely are additional opportunities for shiftable loads. As an example, the CAISO LTPP model includes about 1,200 MW of schedulable pumping loads. The pumping load profile in the LTPP model is pre-scheduled and generally corresponds to match historical (low-VG) demand profiles. The scheduled pumping load is highest during the traditional off-peak period in the early morning, and it drops by about 700 MW in the late morning, exactly when the PV output increases and overgeneration may occur. Assuming there is flexibility when this pumping load can occur, re-scheduling this load could accommodate some additional PV.

Overall, based on the assumptions made in this simulation, the impact of load shifting and the increase in maximum penetration has modest impact on avoided curtailments. The impact of the added DR case on PV curtailment is illustrated in Figure 26.

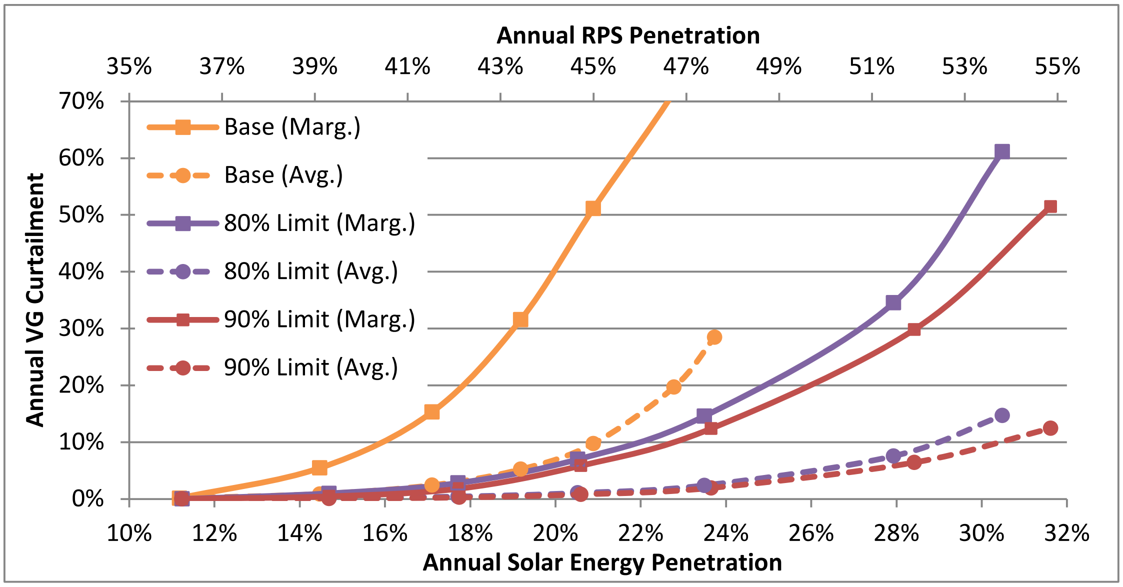


Figure 26. Marginal and average curtailment due to overgeneration under increasing penetration of PV in California after additional demand response and increasing maximum penetration to 90%

The relatively modest reduction in PV curtailment observed moving to the 90% penetration limits is due to the constraints on thermal and hydro plant operations. The presence of baseload non-carbon resources in the system, including nuclear, geothermal, and hydro, in addition to must-run combined heat and power plants limits the maximum penetration of wind and solar to well under 90%. During days with very high penetration of PV, nearly all the non-CHP fossil-fueled thermal capacity in California is turned off for the 11 hours of solar production. However, the results in this section imply that deploying new communications and control technologies that allow distributed resources to participate in grid functions and could significantly increase PV potential. In these examples, total penetration of about 25% solar on an annual basis appears possible with about 5% annual curtailment.

8 Additional Opportunities to Fatten and Flatten the Duck

In the previous section, we indicate that near-term technology options are capable of helping mitigate challenges of the duck chart and increase solar penetration to as high as 25% with limited curtailment. Moving beyond this point with exclusively solar resources becomes increasingly challenging; however, several additional options can help fatten and flatten the duck. While we evaluated demand response in this work, further analysis of load shifting potential is needed, as we assume that during the hours of high VG output, less than 1.5% of total demand may be shifted over a period of hours or more.

Other options that have been suggested to address overgeneration include regional interchange, more flexible generation, and energy storage. While this analysis has significant interaction between California and neighboring states, additional interchange, including exports from California, could potentially further reduce curtailment (Nelson and Wisland 2015). This may require broader implementation of various market mechanisms that allow for exchanging energy across regions.[30] A long-term challenge may occur when surrounding states also adopt increasing amounts of wind and PV, leading to regional surpluses of renewable energy during spring afternoons.

Finally, additional storage (beyond existing and mandated storage) could be used to shift load. In addition to electricity storage technologies such as batteries or pumped hydro, concentrating solar power using thermal energy storage can shift solar generation to periods of low PV output. Storage with high capacity value could enable further retirements of the thermal generation fleet that could reduce minimum generation constraints (Denholm and Mehos 2011). Finally, while this analysis focuses primarily on enabling high solar penetration, it should be noted that a more balanced portfolio could more generally reduce the challenges of integrating VG. When PV is at 25% penetration, additional wind (or non-VG renewables such as geothermal) has significantly lower levels of marginal curtailment than PV. This has been noted previously (E3 2014; Brinkman 2015), and it suggests the need for a more comprehensive analysis of different renewable portfolios to achieve the most cost effective mix of generation technologies.

[30] An example is the Western Energy Imbalance Market (https://www.caiso.com/informed/Pages/EIMOverview/Default.aspx).

9 Conclusions

Accommodating increased levels of PV in California will require understanding and addressing changes in net load shape created by large power production over a relatively short period in the middle of the day. System planners and operators will need to consider changes to a system historically dominated by dispatchable thermal and hydro resources. In the near term, changes underway or proposed in California and elsewhere—such as shorter scheduling intervals, increased interaction across regions, and the creation of new market incentives for generator dispatch—will reduce the minimum generation challenge and enable greater utilization of VG. In the longer term, grid operators will need non-traditional resources to supply reserves and grid stability services. This shift in operating practices will in turn require system operators to have visibility and control of distributed PV, storage, and load, and it will likely require new market mechanisms to incentivize these resources to participate in providing grid services. Without utilizing PV or other distributed resources to provide grid services— which is technically feasible—excessive curtailment of PV could occur at penetrations well below 20% on an annual energy basis

Because of the limited coincidence of PV supply with demand, additional mechanisms will be needed to maximize load-shifting. Simple historical methods, such as time-of-use pricing with fixed price intervals will likely be insufficient to address the variability and uncertainty of the solar resource, which changes on a daily and hourly basis.

By using a combination of grid flexibility options, the duck shape of net load can be accommodated and shaped to allow annual PV penetrations that exceed 25%, with limited curtailment, even without considering the impact of large-scale energy storage. Many of the needed grid flexibility options are already being deployed in various locations around the United States. Additional portfolio analysis can assist in designing a mix of VG resources and associated “enabling” technologies that could achieve very high penetration while maintaining grid reliability.

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Multiagency Avian-Solar Collaborative Working Group: Stakeholder Workshop

Welcome and Overview of Workshop Objectives

Dan Boff

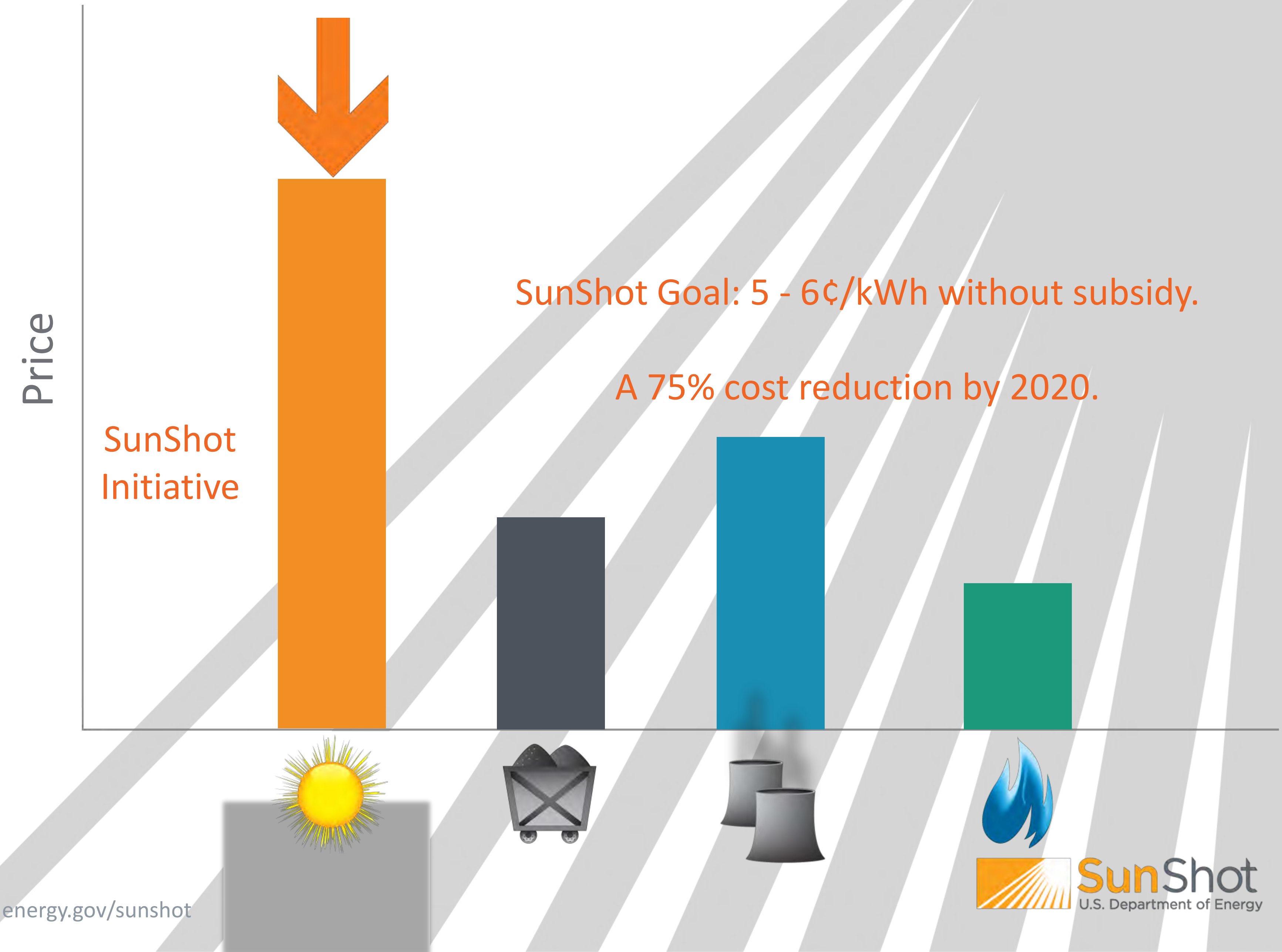
U.S. Department of Energy

SunShot Initiative

May 10-11, 2016

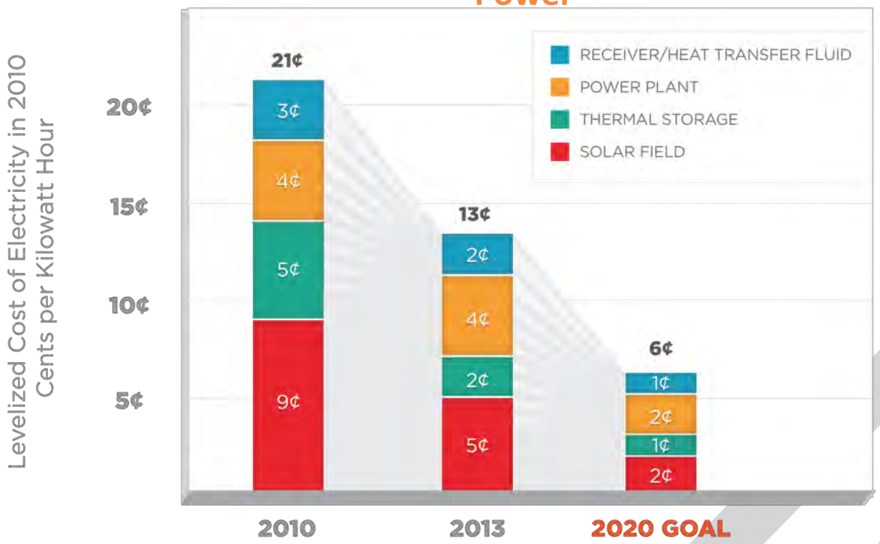
Sacramento, California

SunShot

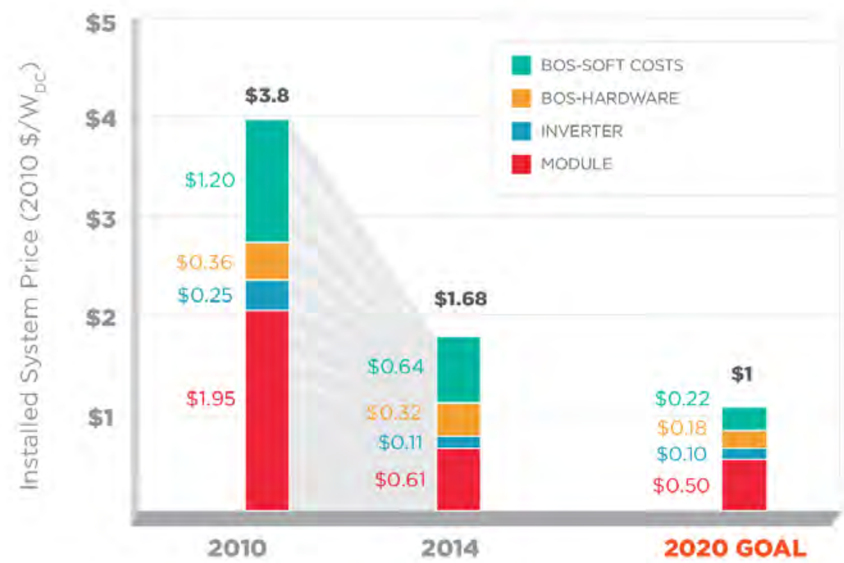


Price
SunShot Initiative
SunShot Goal: 5 - 6¢/kWh without subsidy.
A 75% cost reduction by 2020.

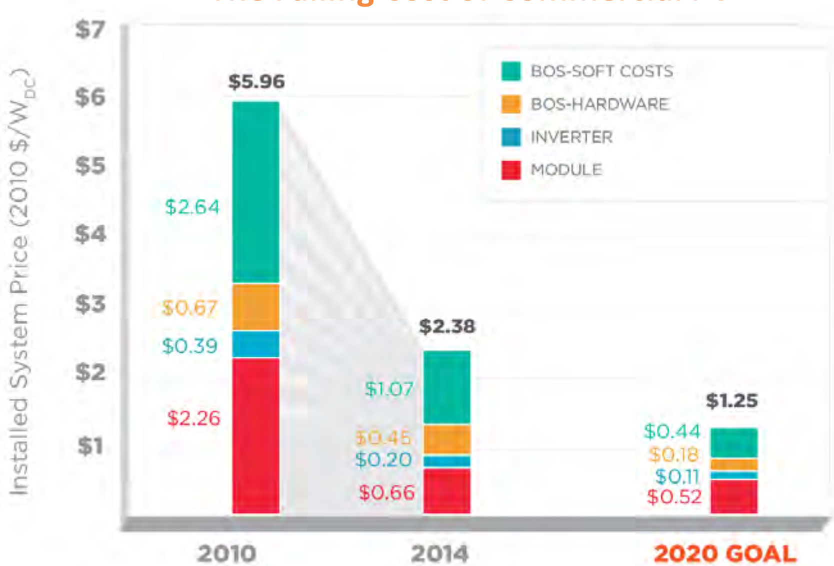
The Falling Cost of Concentrating Solar Power



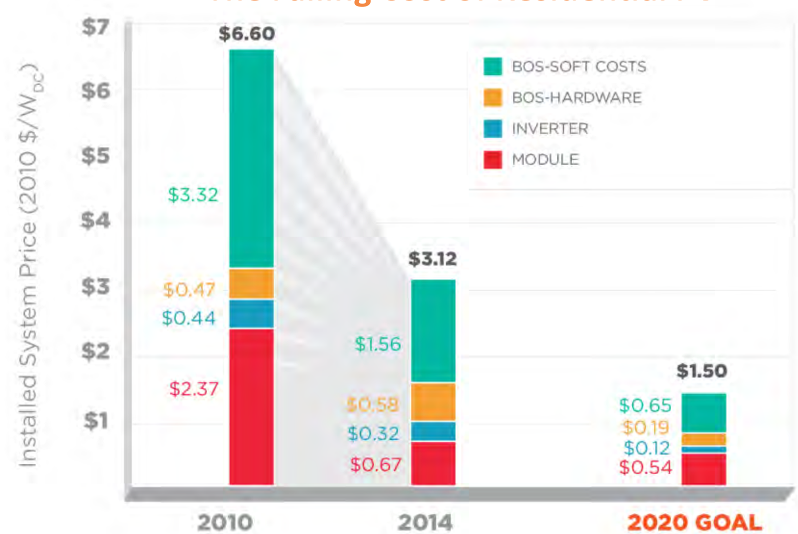
The Falling Cost of Utility PV



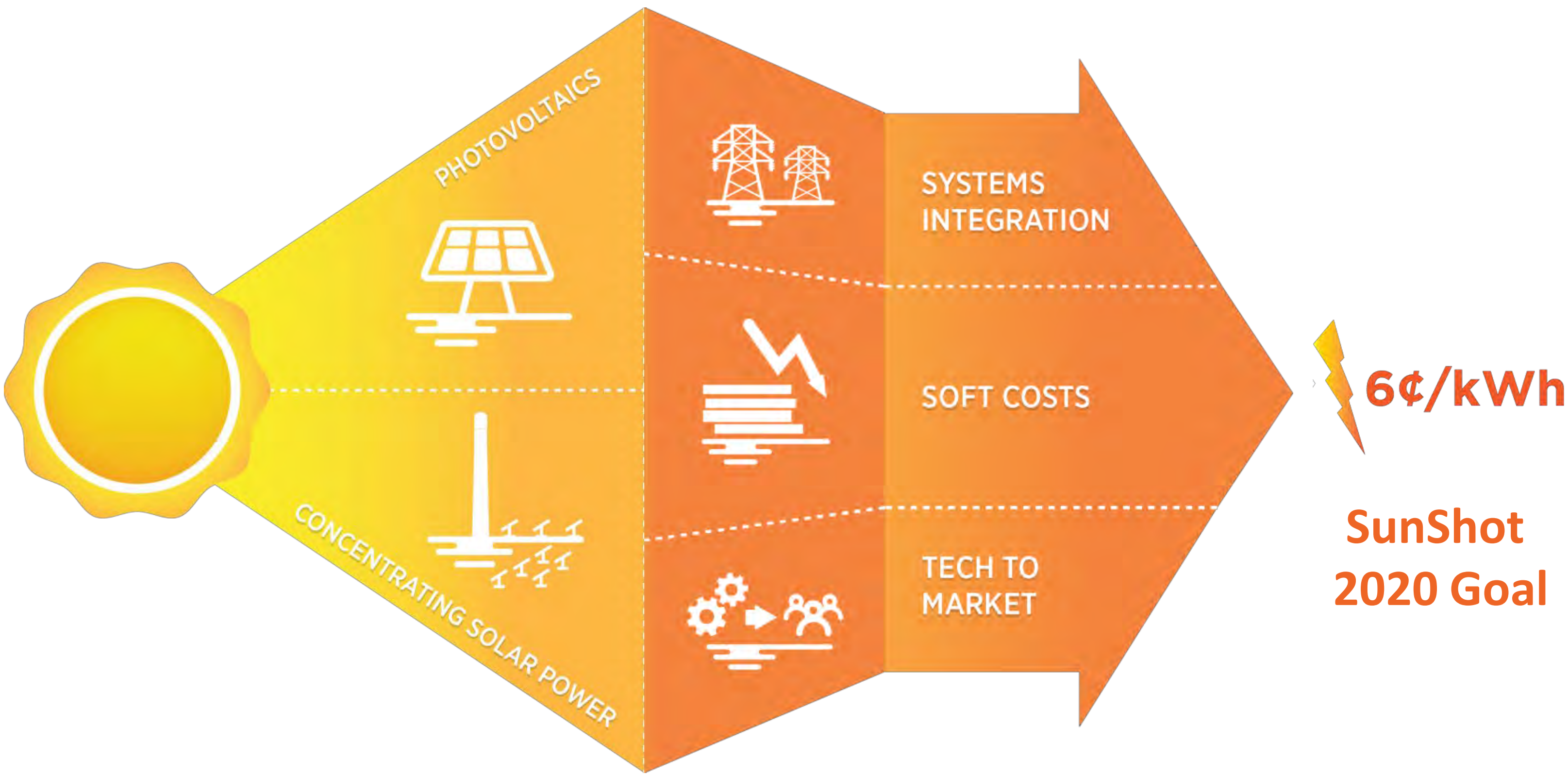
The Falling Cost of Commercial PV



The Falling Cost of Residential PV



SunShot Program Structure



SunShot
2020 Goal

Balance of Systems (Soft Costs)

NETWORKING AND TECHNICAL ASSISTANCE

Empowering state and local decision-makers through timely and actionable resources, peer networks, and technical assistance

BUSINESS INNOVATION

Developing solar finance and business solutions to expand access to capital and accelerate market growth

DATA ANALYSIS

Harnessing big data analysis and technical solutions to support the many stakeholders involved in solar deployment

TRAINING

Training an innovative solar workforce to enable the solar industry to meet growing demand

Objectives of this Meeting

Bring together CWG members and stakeholders to:

- Share information about the CWG objectives, scope, activities, and timeline
- Provide a forum for stakeholders to provide comments relevant to the CWG efforts:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG

Agenda - Day 1

Time Slot	Topic
9:30-10:00	Welcome & Workshop Objectives
10:00-10:30	Information About the Multiagency CWG
10:30-10:45	Break
10:45-11:00	Summary of Available Avian-Solar Information
11:00-12:30	Lunch
12:30-2:15	Ongoing Related Initiatives
2:15-2:30	Break
2:30-4:30	Break-out Discussions
4:30-5:00	Wrap Up

Agenda - Day 2

Time Slot	Topic
9:00-9:15	Recap of Day 1
9:15-9:45	Conceptual Framework of Avian-Solar Interactions
9:45-10:15	Agency Management Questions & Related Research Needs
10:15-10:30	Break
10:30-12:30	Break-out Discussions
12:30-1:00	Wrap Up & Next Steps

Logistical Details

- All handouts and presentations will be available on the CWG webpage: http://blmsolar.anl.gov/program/avian-solar/
- If you want to continue to receive information about the CWG efforts, subscribe for email updates
  - Send request to rollins@anl.gov
- Using the microphone ensures everyone can hear you
- Identify yourself and your affiliation when you speak
- Please mute or turn off cell phones

Information About the Multiagency Avian-Solar Collaborative Working Group (CWG)

Greg Helseth

Bureau of Land Management

Multiagency CWG Stakeholder Workshop

May 10-11, 2016

Background

- Avian-solar concerns that have emerged in the past 2-3 years present potential barriers to utility-scale solar development
- Existing data are inadequate to define the magnitude and extent of potential avian impacts and causal factors
- Research is underway by multiple parties, including federal and state agencies, industry, and academics
- There is a growing consensus regarding the value of collaborating on defining research objectives and data needs, and on allocation of funding

Goal and Objectives

To develop better information to support future agency decisions regarding potential avian impacts at utility-scale solar facilities

<u>OBJECTIVES</u>

- Establish collaborative working group among federal and state agencies
- Develop multiagency avian-solar science plan
  - Document current and planned research activities
  - Identify cost implications and information gaps
  - Identify agency roles in funding and oversight
  - Develop feasible mitigation measures, if warranted
- Prepare education and outreach materials

CWG Members

Representatives of federal and state agencies with relevant missions and/or project authorization responsibilities

Federal Agencies	State Wildlife and Energy Agencies *
DOE Solar Energy Technologies Office	AZ Game and Fish Dept.
Bureau of Land Management	CA Dept. Fish and Wildlife
U.S. Fish and Wildlife Service	CA Energy Commission
U.S. Geological Survey	NV Dept. Wildlife
DOI Solicitor's Office	
U.S. Department of Defense	

** Other state energy agencies have been invited to participate*

Scope and Organization of the CWG

Scope

- Utility-scale solar technologies
  - All technologies
  - All facility components
- Initial geographic focus: Arizona, California, and Nevada

Organization

- CWG is led by a chair and co-chair
- Technical support and facilitation is provided by Argonne National Laboratory and the National Renewable Energy Laboratory

CWG Tasks, Deliverables, and Timeline

Task	Activities	Milestone(s) / Deliverable(s)
1 Establish the CWG and conduct meetings	Formalize CWG. Conduct quarterly CWG and stakeholder meetings.	Establish CWG charter, quarterly CWG meetings, and stakeholder events
2 Develop an Avian-Solar Science Plan	Summarize current activities, information gaps, and research needs; consolidate data and mitigation measures/BMPs. Develop hypothesis-based science plan applicable to all solar technologies and sites.	Avian-solar science plan by end of Oct. 2016
3 Prepare education and outreach materials	Prepare fact sheets or news items to inform the public of CWG activities, avian-solar data, and clarify information.	At least two in FY16: • Fact sheet • News item • Public webinar

Timeline & Progress in 2016

Red – complete; Black - anticipated

January	February	March	April	May	June	July Oct
• Recruited agency participation • Held CWG kickoff meeting	• Finalized Charter • Assembled existing information	• Published 1st fact sheet • Launched CWG website • Developed conceptual framework	• Finalized workshop agenda • Developed CWG MQs	• Hold 1st public workshop • Incorporate stakeholder input • Finalize MQs & research needs	• Draft science plan	• Revise & finalize science plan • Hold public workshop or webinar • Release final public outreach publication

CWG = collaborative working group, MQ = management question

Avian-Solar Science Plan

Kirk LaGory, Argonne National Laboratory

Purpose: *Provide a consistent framework for research and monitoring of avian-solar interactions*

Objectives

- Define research questions and future research needs;
- Support development of monitoring protocols, evaluation of avian risk, and development of effective mitigation measures;
- Qualitatively discuss potential associated costs; and
- Define agency roles and processes for implementation.

Elements of an Avian-Solar Science Plan

- Executive Summary
- Introduction
  - Describe current solar energy development and trends, observed avian-solar interactions
  - Describe objectives of the plan, desired outcomes, CWG
  - Identify agency-specific management questions
- Conceptual Framework of Avian-Solar Interactions
  - Provides framework for science plan
  - Impacting factors
  - Technology-specific impacts
  - Direct, indirect, and cumulative effects
  - Factors that contribute to risk, including location, seasonality, type of birds
  - Local and population-level effects

Elements of an Avian-Solar Science Plan (Cont.)

- Summary of Existing Information
  - High-level summary with focus on published DOE “rapid report” and subsequent findings, technical reports, and communications with researchers
  - Which portions of the conceptual model are best understood?
- Information Gaps Related to Avian-Solar Interactions
  - Identify the information gaps that impede development of effective avoidance, minimization, and mitigation strategies
  - Which portions of the conceptual model are poorly understood?

Elements of an Avian-Solar Science Plan (Cont.)

- Research and Monitoring Needs
  - Based on management questions, conceptual model, and information gaps, identify research and monitoring that is needed to understand avian-solar interactions
  - Identify priorities for research and monitoring activities based on relative risk to birds
- Program Implementation
  - Identify best approaches to research and monitoring
  - Agency roles
  - Collaboration with ASWG and other stakeholders to ensure consistency and complementary activities
  - Role of adaptive management
  - Tiering from the plan
  - Approximate costs of activities

Stakeholder Engagement

- Agencies are seeking input from stakeholders on all matters relevant to the CWG objectives:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG

- Stakeholders can comment during this meeting and/or in writing following the workshop (target due date of June 1, 2016)

- A stakeholder webinar will be hosted to present and take comments on the draft avian-solar science plan (late summer 2016)

- For more information:
  - Subscribe for email updates: send request to rollins@anl.gov
  - CWG webpage: http://blmsolar.anl.gov/program/avian-solar/

QUESTIONS?

A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities

Lee Walston*, Katherine Rollins,
Karen Smith, and Kirk LaGory
Environmental Science Division
Argonne National Laboratory

Karin Sinclair, Craig Turchi,
Tim Wendelin, and Heidi Souder
National Renewable Energy Laboratory

* lwalston@anl.gov

What is Utility-Scale Solar Energy Development?

- Large solar fields – 10+ megawatt (MW); requires 5-10 acres per MW
- Three main technologies: 1) photovoltaic (PV) and concentrated solar power (CSP) technologies – 2) parabolic trough and 3) power tower

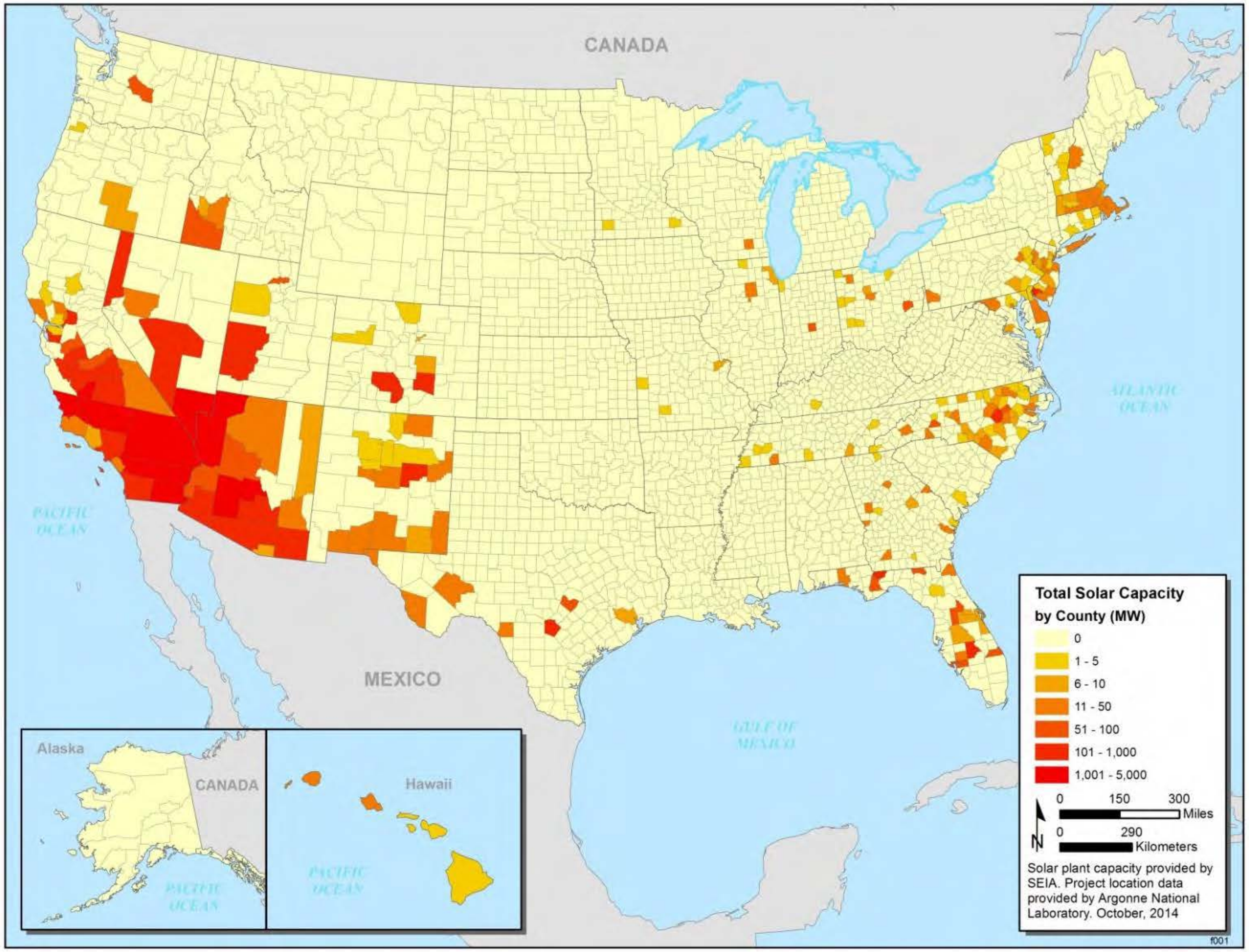
What is Utility-Scale Solar Development? (cont'd)

Ivanpah Solar Energy Generation Station (SEGS)

- 3 Solar power towers (377 MW)
- >3,400 acres of public land

Utility-Scale Solar Energy Development in the U.S.

- >14 GW utility-scale solar capacity (in operation or under construction)
- >1,200 facilities (>1 MW)
- >50% of this electric capacity in southern CA, NV, and AZ.



Source: Walston et al. 2015

Avian Impacts of Solar Development

2 direct sources of solar-avian fatalities

- Collision-related: documented at solar projects of all technology types.
- Solar flux-related: resulting from the burning/singeing effects of exposure to concentrated sunlight. Observed only at facilities employing power tower technologies.

Photo Credit: Robert Sullivan, Argonne National Laboratory

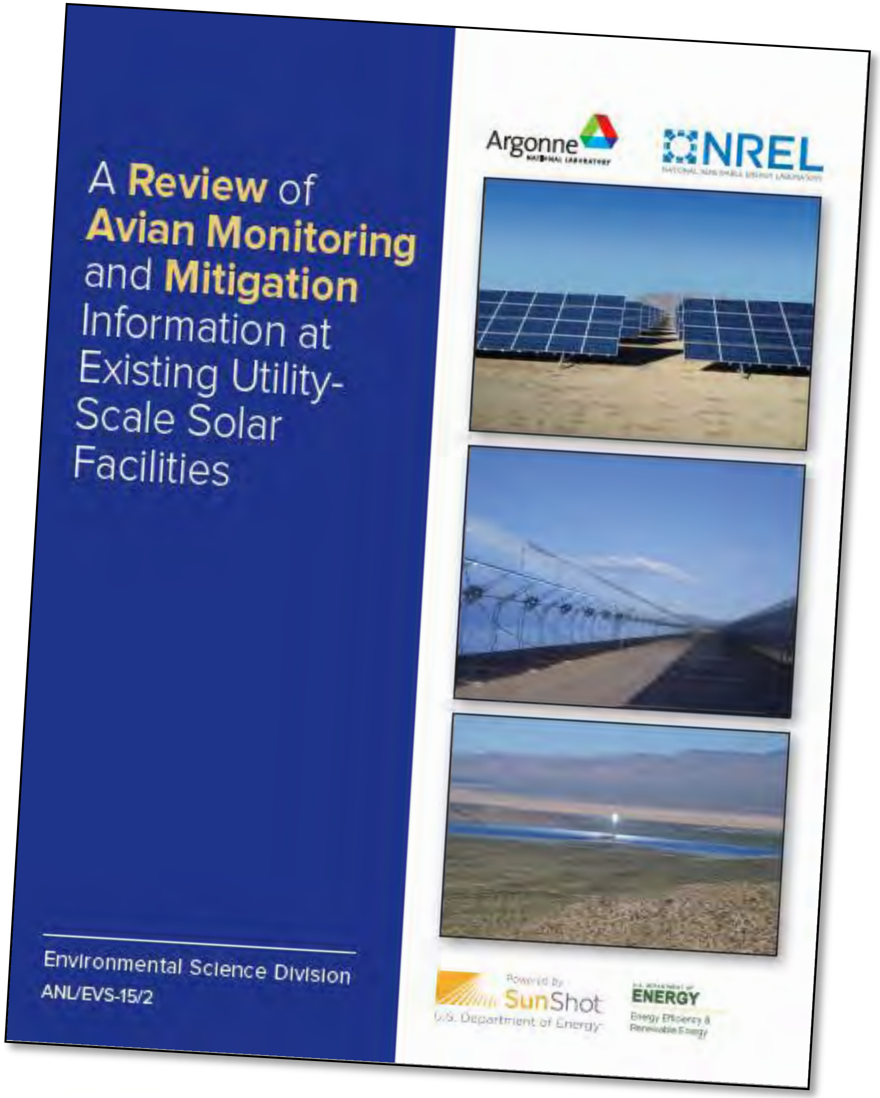
Factors that Affect Mortality Risk

- Project location
  - Near aquatic/riparian areas, stopover sites, etc.
- Project size
- Project technology / design
  - PV vs CSP
  - Evaporation ponds
  - Ancillary infrastructure

Copper Mountain PV facility in southern Nevada. Example for the "lake effect" hypothesis.
Photo Credit: Robert Sullivan, Argonne National Laboratory

"A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities"

- Objectives:
  - Summarize avian fatality issues at solar facilities
  - Summarize current monitoring and reporting activities
  - Evaluate mitigation measures and BMPs used for other industries
  - Examine solar technology-specific aspects of avian fatality
  - Identify information gaps and next steps



Avian Fatality Information at Solar Facilities (updated)

- 16 Facilities with available avian monitoring information.
- Collection of avian fatality information:
  - Incidental or unknown survey effort at 6 facilities
  - Systematic survey effort at 10 facilities

Summary of Current Avian Monitoring Activities at Utility-Scale Solar Facilities as of May 2016

Project Name	Location	Technology Type and MW (in Parentheses)	Current Status	Land Type	Available Avian Monitoring Plan	Known Collection of Avian Fatality Data
Blythe Solar	Riverside County, CA	PV (485)	Under Construction	Public	Yes	Yes – Incidental and systematic
California Solar One	Daggett, CA	CSP – Power Tower (10)	Decommissioned in 1987	Private	NA	Yes – Systematic
California Valley Solar Ranch	San Luis Obispo County, CA	PV (250)	Operational – Oct 2013	Private	Yes	Yes – Systematic
Campo Verde	Imperial County, CA	PV (139)	Operational – Oct 2013	Private	NA	Yes – Incidental
Centinela Solar Energy	Imperial County, CA	PV (170)	Operational – August 2013	Private	Yes	NA
Crescent Dunes	Nye County, NV	CSP – Power Tower (110)	Construction completed	Public	Yes	Yes – Systematic

Avian Monitoring at Solar Facilities

- Fatality monitoring (and reporting) at very few solar facilities
  - Not required at all facilities
- Differences in monitoring designs and survey effort
  - Affects the ability to compare and integrate data
- Systematic vs. incidental fatality information
  - Systematic information allows hypothesis testing
  - Incidental observations may still be useful in understanding patterns of fatalities

Barn swallow with singed feathers observed at the California Solar One demonstration facility (Source: McCrary et al. 1986).

Avian Monitoring at Solar Facilities, Cont'd

- Variation in factors influencing mortality rate estimation and evaluation
  - **Search effort and searcher efficiency**
  - **Feather spots**
  - **Predation and scavenging**
    - Potential for predators to influence mortality rates by transporting carcasses to the project footprint from offsite locations
  - **Background mortality**
    - Mortality estimates at some solar facilities include adjustments for background mortality

Conclusions & Recommendations

- Avian monitoring
  - Not all utility-scale solar facilities are required to prepare and comply with project-specific avian monitoring protocols

- Existing avian fatality data
  - Standardization is important for integration and comparison

- Flux-related factors (power tower technologies)
  - Various approaches to heliostat standby aiming could significantly reduce flux levels and their impact on avian fatality

- Better collaboration among agencies, industry, and stakeholders to (1) collect scientifically rigorous and comparable data; (2) identify research priorities; and (3) identify appropriate mitigation measures.

Questions?

Photo Credit: http://cleaneasyenergy.com/

Presentations on Ongoing Related Initiatives

1. Tom Dietsch – U.S. Fish and Wildlife Service

2. Mona Kahlil – U.S. Geological Survey

3. Avian Solar Work Group Representatives: Julie Falkner, Defenders of Wildlife and Laura Abram, First Solar

4. Tim Wendelin – National Renewable Energy Laboratory (NREL)

5. Elise DeGeorge - NREL

U.S. Fish & Wildlife Service

Update on Solar-Avian Interactions in Southern California

Thomas Dietsch
Migratory Bird Division
US Fish and Wildlife Service

CWG Public Meeting
Sacramento, CA
May 10, 2016

Objectives for Presentation

- Provide a review of solar-avian interactions in Southern California
- Discuss hypotheses for avian interactions
- Provide update on actions being taken

Avian Impacts

Direct Effects: Collisions

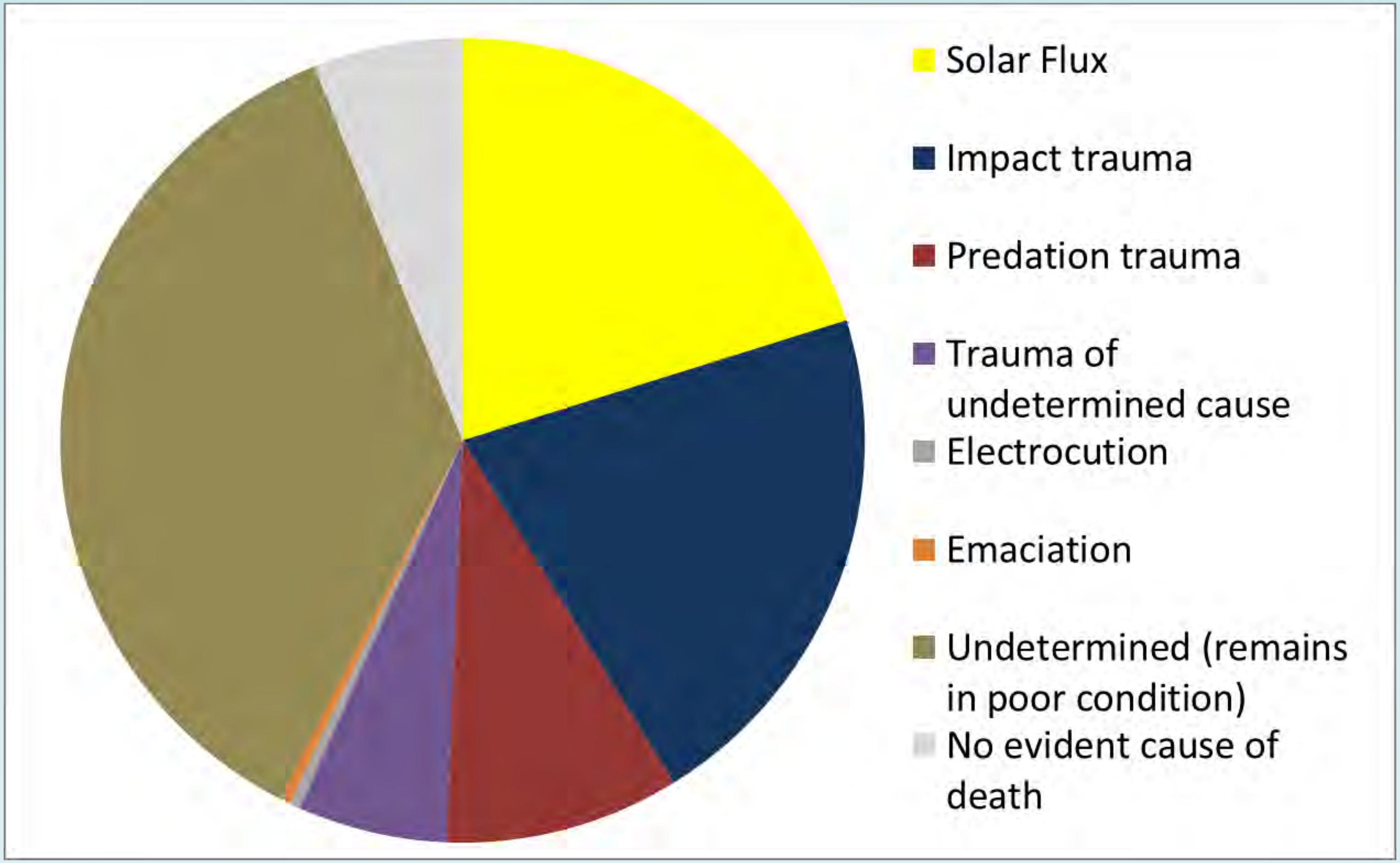
Collisions with panels are common

Concentrated Solar Technologies

Direct Effects

Solar Flux (power tower)

Cause of Death from National Fish and Wildlife Forensics Lab Report (Kagan et al. 2014)



From 3 solar projects, 233 carcasses from 71 species.

Data for Today’s Presentation

- Mortality monitoring and reporting is required by lead agencies on many projects.
- Data from 7 projects in Southern California
  (4 Photovoltaic, 2 Solar Trough, 1 Power Tower)
- Data reported from 2012-April 2016.
- Each species was categorized by habitat, migratory group, and foraging guild.

Caveats on Solar Avian Mortality data

- Data are from a mix of incidental reports and systematic surveys on several projects.
- Magnitude of mortalities are not reported here.
- Only projects in Southern California are included in this presentation.
- Data can provide information on which species or taxonomic groups may be at risk.
- Project features and types of injuries also indicated.

Initial Findings

- National Fish and Wildlife Forensics Lab Report (Kagan et al. 2014)
  - "Significant Bat and Insect Mortality, including Monarch Butterflies".
- 3545 mortalities from 183 species (2012-April 2016)
  - Only mortalities found and reported included, no estimation.
  - Mix of reports from incidental finds and systematic surveys.
  - Many mortalities occur due to dehydration/heat stress after initial injury/stranding.
- Birds of Conservation Concern

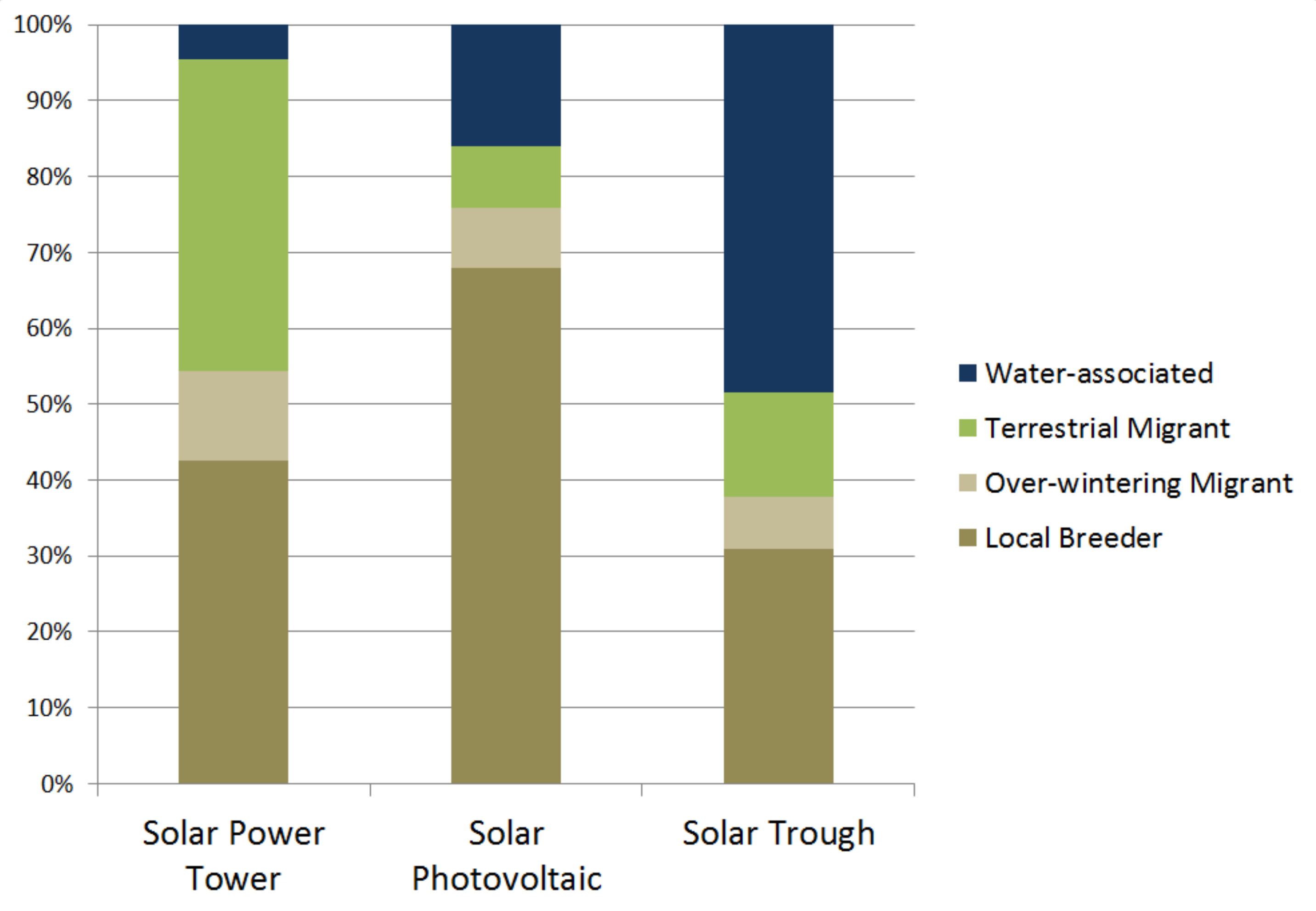
Species of Concern

- Federal Endangered/Threatened
  - Yuma Ridgeway’s (Clapper) Rail
  - Willow Flycatcher
  - Yellow-billed Cuckoo
- State-listed/Fully Protected
  - Peregrine Falcon
  - Bank Swallow
- 19 Birds of Conservation Concern
  - Western Grebe
  - Horned and Eared Grebes
  - American White Pelican
  - Burrowing Owl
  - Calliope Hummingbird

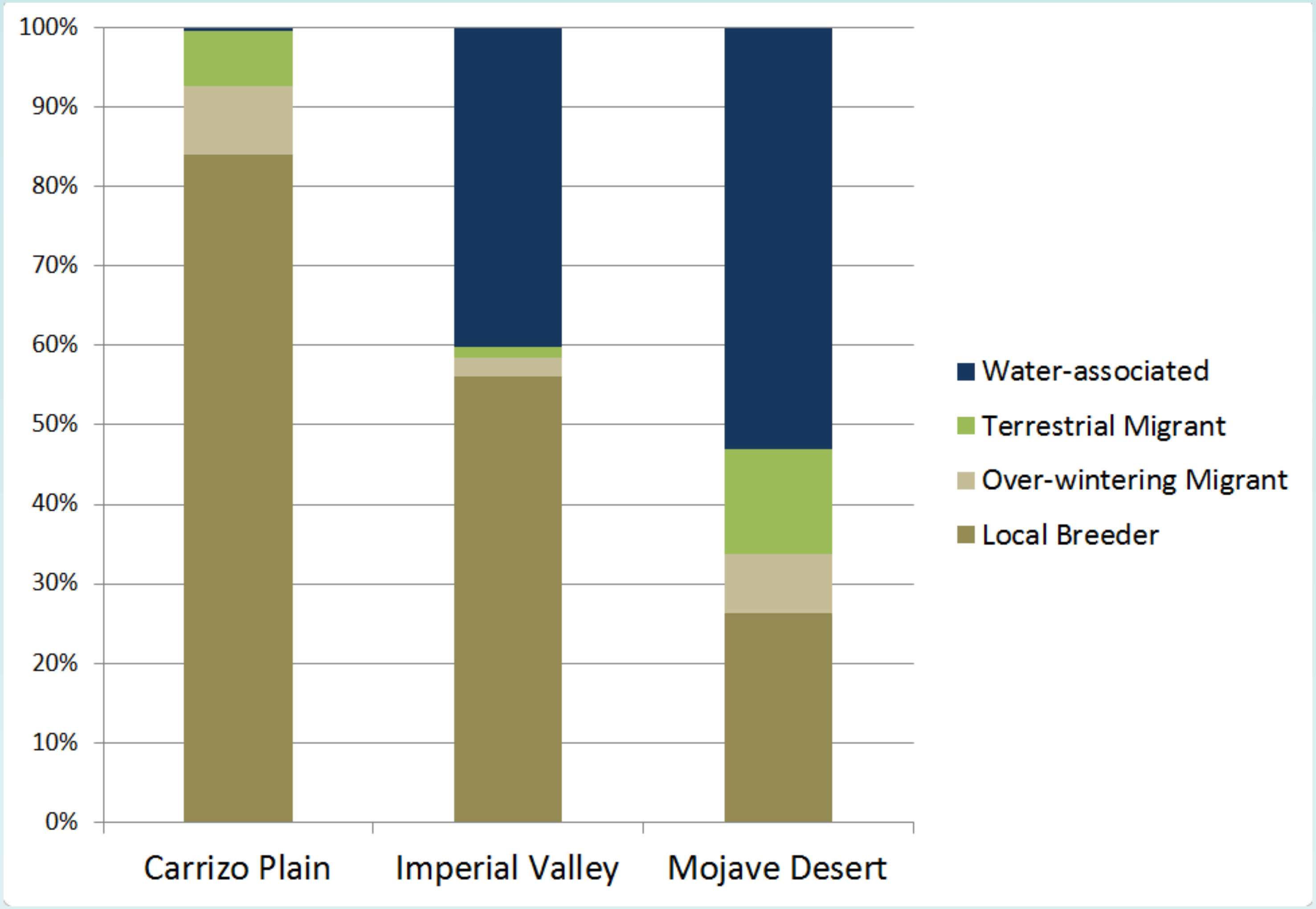
Hypotheses

- Mortalities represent background mortality.
- Mortalities occur during normal bird movements (Anthropogenic, no landscape-scale attraction).
- Polarized light may attract birds and insects to solar projects in the Mojave Desert (Horvath et al. 2009).
- Other resources attract birds to solar projects (Insects and Ponds).

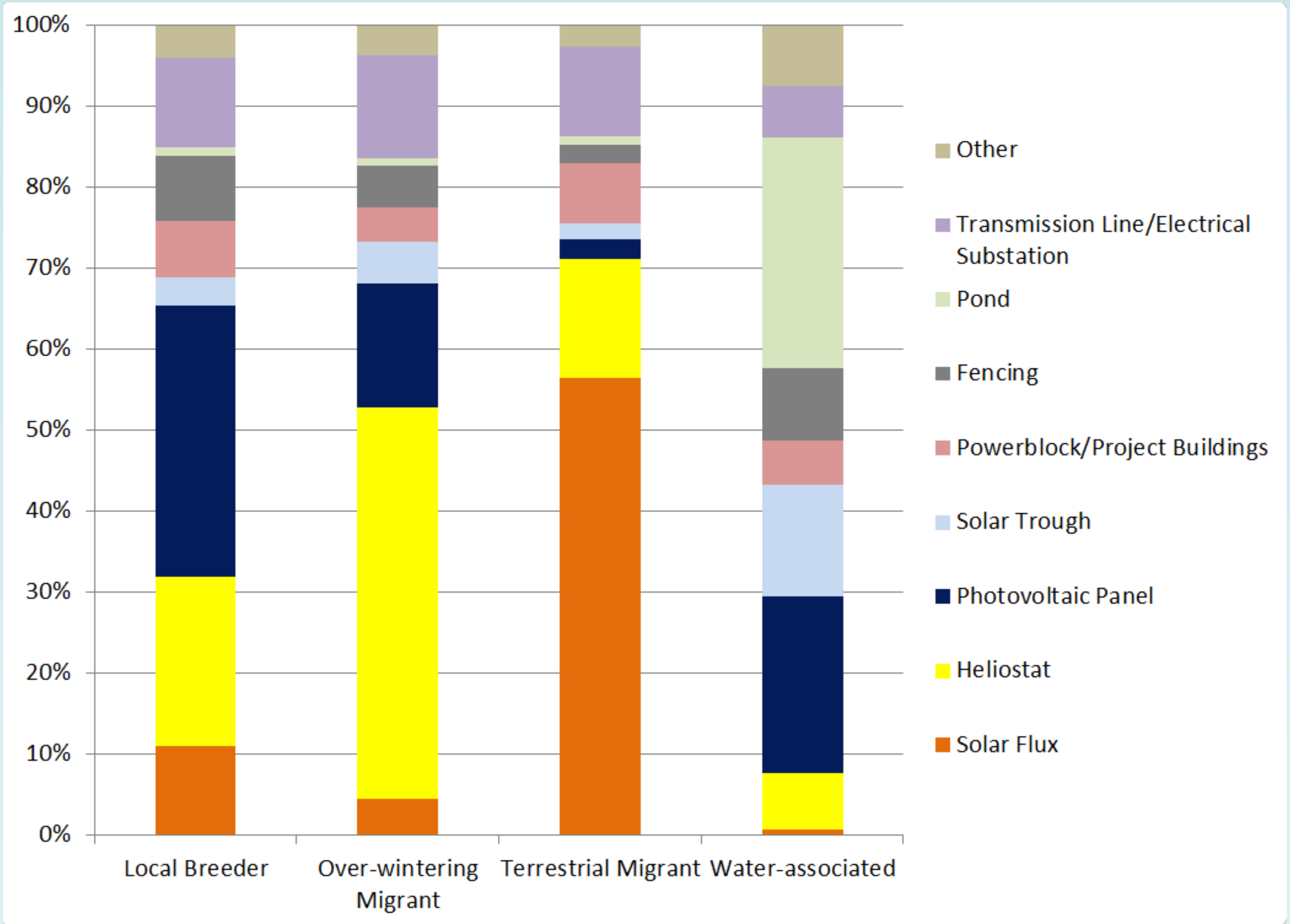
Habitat/Migratory Status of Birds found injured on Solar Projects



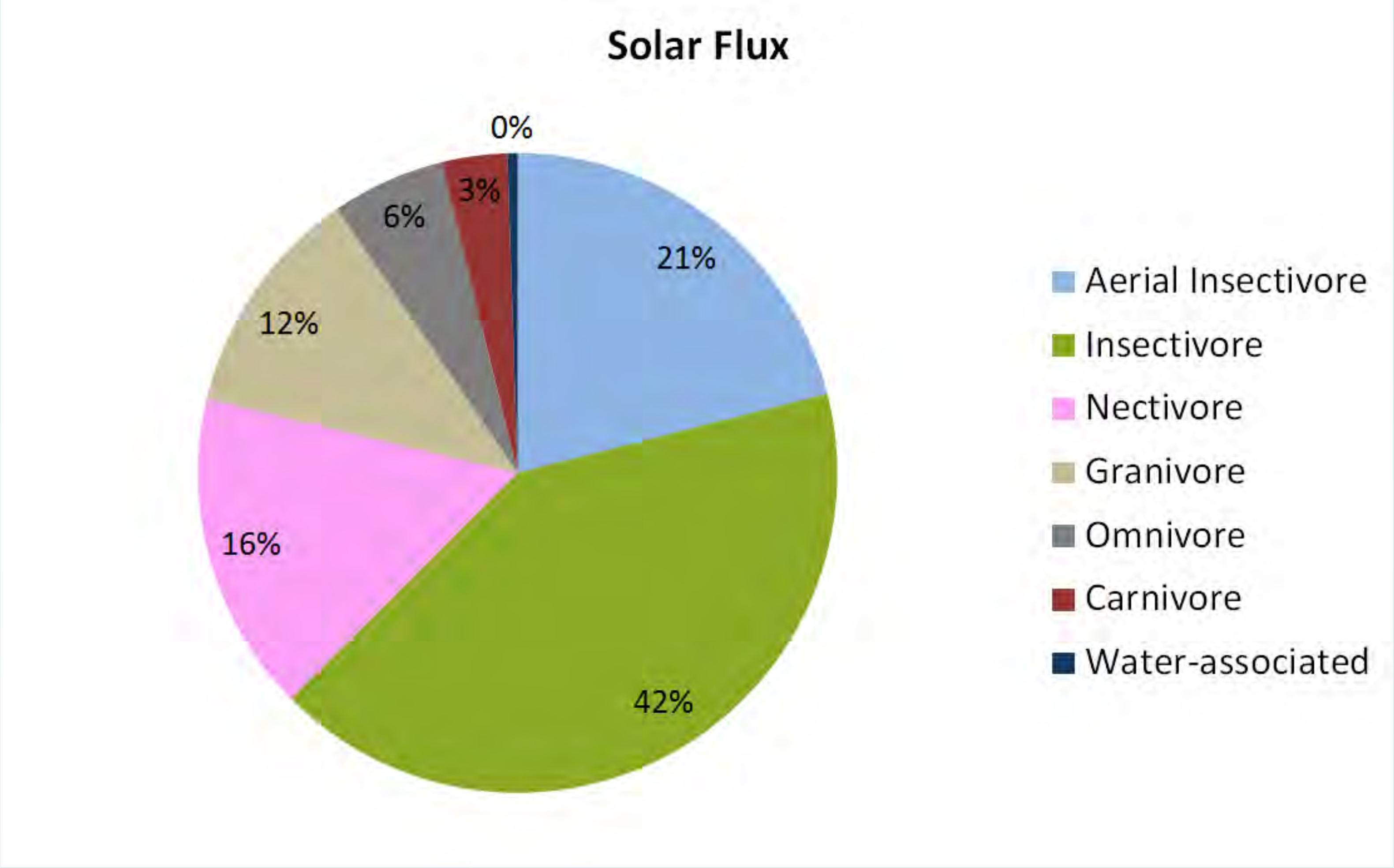
Regional Differences for Photovoltaic



Solar Project Features Associated with Mortalities



Foraging Guilds of Birds with Solar Flux Injuries



Findings

- There may be a "lake effect" associated with utility-scale solar projects similar to that described by Horvath et al. 2009.
- Many birds of conservation concern may be at risk.
- Regional (and site-specific) differences may affect which species are at risk.
- Insects may be attracting some birds to areas with elevated levels of solar flux.
- Many species affected are long-distance migrants, thus population level effects may be difficult to determine.
- Robust monitoring needed to better understand these phenomena and to support adaptive management.

Mortality Monitoring Objectives

- Estimate the total number of birds and bats killed at a facility within a specified time period.
- Determine whether there are spatial or temporal/ seasonal patterns of total bird fatality.
- Evaluate species composition and which taxonomic groups may be at risk.
- Provide results that allow comparisons with other solar sites and to evaluate changes in fatality due to adaptive management.

Research Needs

- Project-scale information needs
- Mojave and Sonoran Desert Migratory Pathways
- Migratory Connectivity Research to identify populations affected
  - Populations affected may be distant from the source of mortalities
  - Stable Isotopes (USGS)
  - Genotypes (UCLA)
  - Telemetry of appropriate-sized birds
- Avian Behavior related to projects
  - Perception and Settling Response
  - Technological Fixes
- Identify Best Management Practices and Deterrent Methods

Update on actions being taken

- Working with solar industry to implement robust mortality monitoring.
  - Searcher Efficiency and Carcass Persistence Trials.
- Solar Bird and Bat Conservation Strategy Guidelines in development.
  - Public meeting on June 22nd in Sacramento.
- Collaborated with USGS to develop Mortality Monitoring Protocols for Solar
  - Protocols for monitoring at each technology type.
- Coordinating with other agencies to find ways to avoid and minimize avian mortalities.
- Coordinating with Avian Solar Working Group (industry and other stakeholders)
- Supporting ongoing research efforts by USGS and UCLA

U.S. Fish & Wildlife Service

Questions?

Research to Address Wildlife Interactions with Solar Energy Facilities

Avian-Solar Collaborative Working Group

May 10, 2016

USGS Ecosystems Mission Area

U.S. Geological Survey

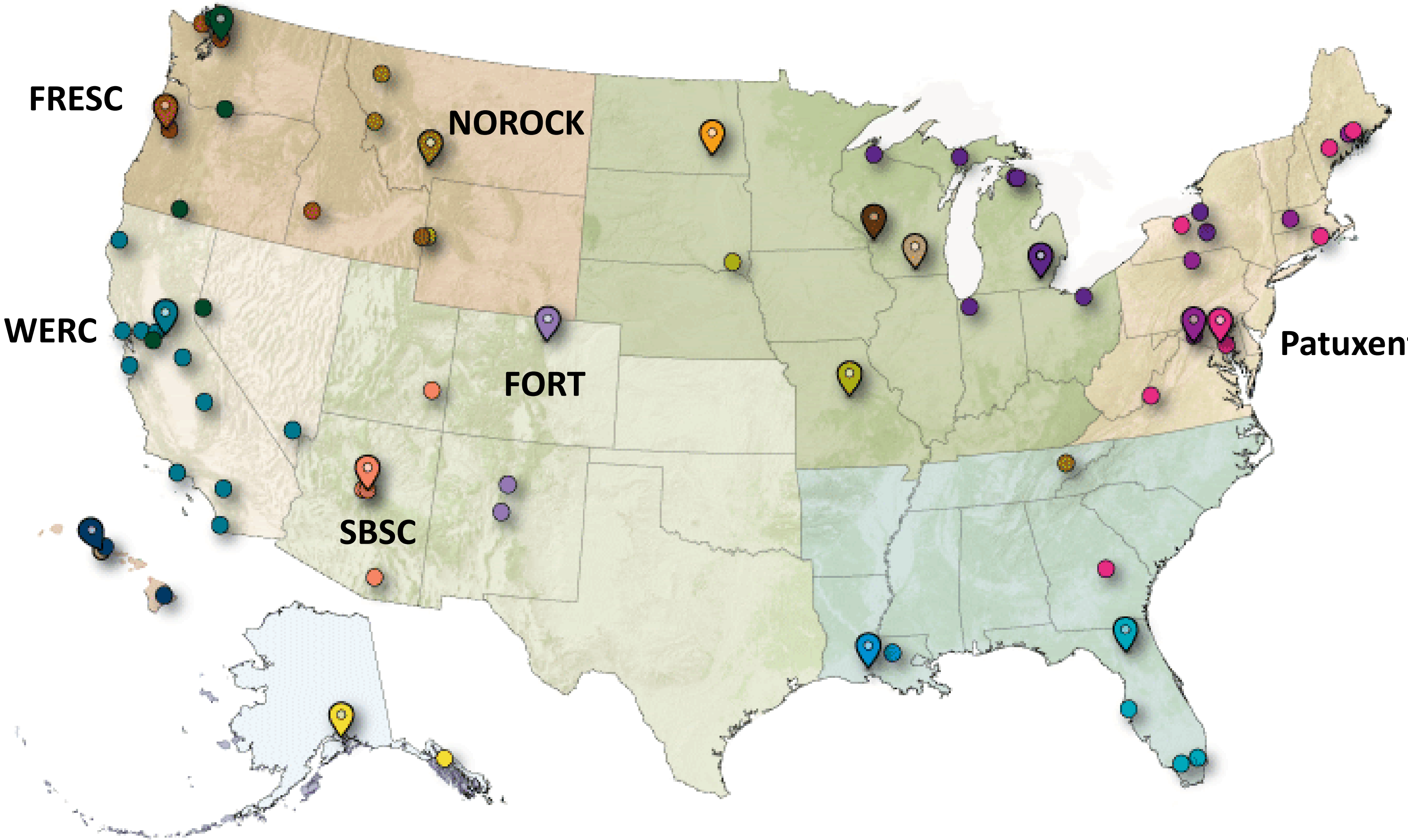
Ecosystems

Natural Hazards **Energy and Minerals** **Core Science Systems**

Environmental Health **Water** **Climate and Land Use Change**

Provide the scientific information required for sound natural resource management and conservation decisions

USGS Ecosystems Mission Area
17 Science Centers



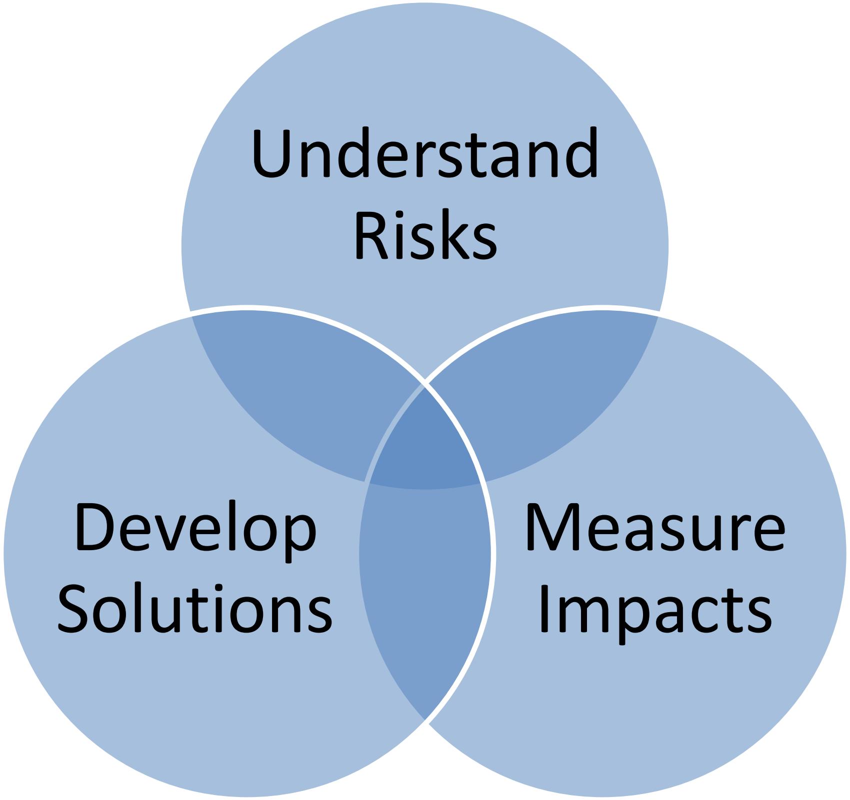
+ 40 Cooperative Research Units

USGS

Energy and Wildlife Research

Goals

- **Understand risks:** when and where wildlife occur and how they use space
- **Measure impacts** to wildlife, both direct and indirect
- **Develop solutions:** minimize impacts through technological fixes, management, mitigation



USGS

Measuring Impacts

- Characterize direct and indirect impacts to wildlife
- Define sources of fatality
- Develop consistent and accurate methods to detect and estimate fatalities

Efficacy of Wildlife Monitoring Technologies at the Ivanpah Solar Electric Generating System

Objective:

- Evaluate efficacy of monitoring technologies to detect birds, bats, and insects flying in the vicinity of flux fields produced at the ISEGS
- Tested technologies concurrently (portable radar, surveillance video, thermal video). Also performed invertebrate sampling
- Monitoring period covered ~20 days in May and September 2014 during bird migration season
- Developing data handling and analysis software (presence/absence, speed, direction, abundance)

PIs: Robb Diehl (NRMSC), Paul Cryan & Ernie Valdez (FORT)

Status: In review. Full data release will accompany publication

USGS

Monitoring Methodology for Solar Facilities

- No guidance currently exists for addressing wildlife conservation concerns at solar energy facilities
- Published studies have not directly addressed the methodology needed to accurately estimate fatality of birds and bats at solar facilities

Objective:

- Develop monitoring methodology for solar facilities to produce a consistent carcass search methodology

PI: Manuela Huso (FRESC)

Project completion: May 2016

US FWS Pacific Southwest Region

Solar Fatality Estimator and *"Evidence of Absence"* Software

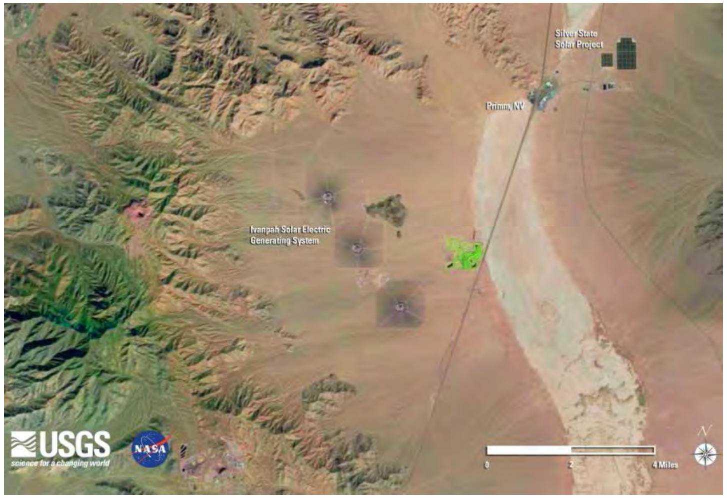
Need consistent and accurate methods to detect and estimate fatalities from carcass searches at solar facilities

Objective:

- Modify existing software to produce unbiased estimates of fatalities at utility-scale solar facilities and "Evidence of Absence" software for rare species
- Define sources of fatality
- Estimate searcher efficiency and carcass persistence
- Determine when thresholds have likely been exceeded and mitigation might be considered

PI: Manuela Huso (FRESC)

Anticipated completion: April 2017



Ivanpah Solar Electric Generating System

Golden eagle at wind farm in CA.
Credit: Jeff Lovich

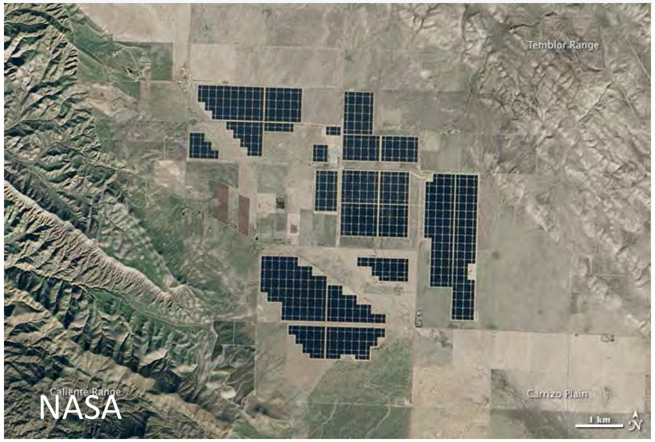
USGS

Assess Energy Development Impacts to Sensitive Bird and Bat Species and Populations

Need to more accurately estimate fatality rates and effectiveness of mitigation techniques

Project Objective:

- Estimate geographic scope of species impacted
- Use demographic modeling to assess how fatalities affect population increases or declines
- Determine best practices for conducting risk assessments and predicting mitigation outcomes

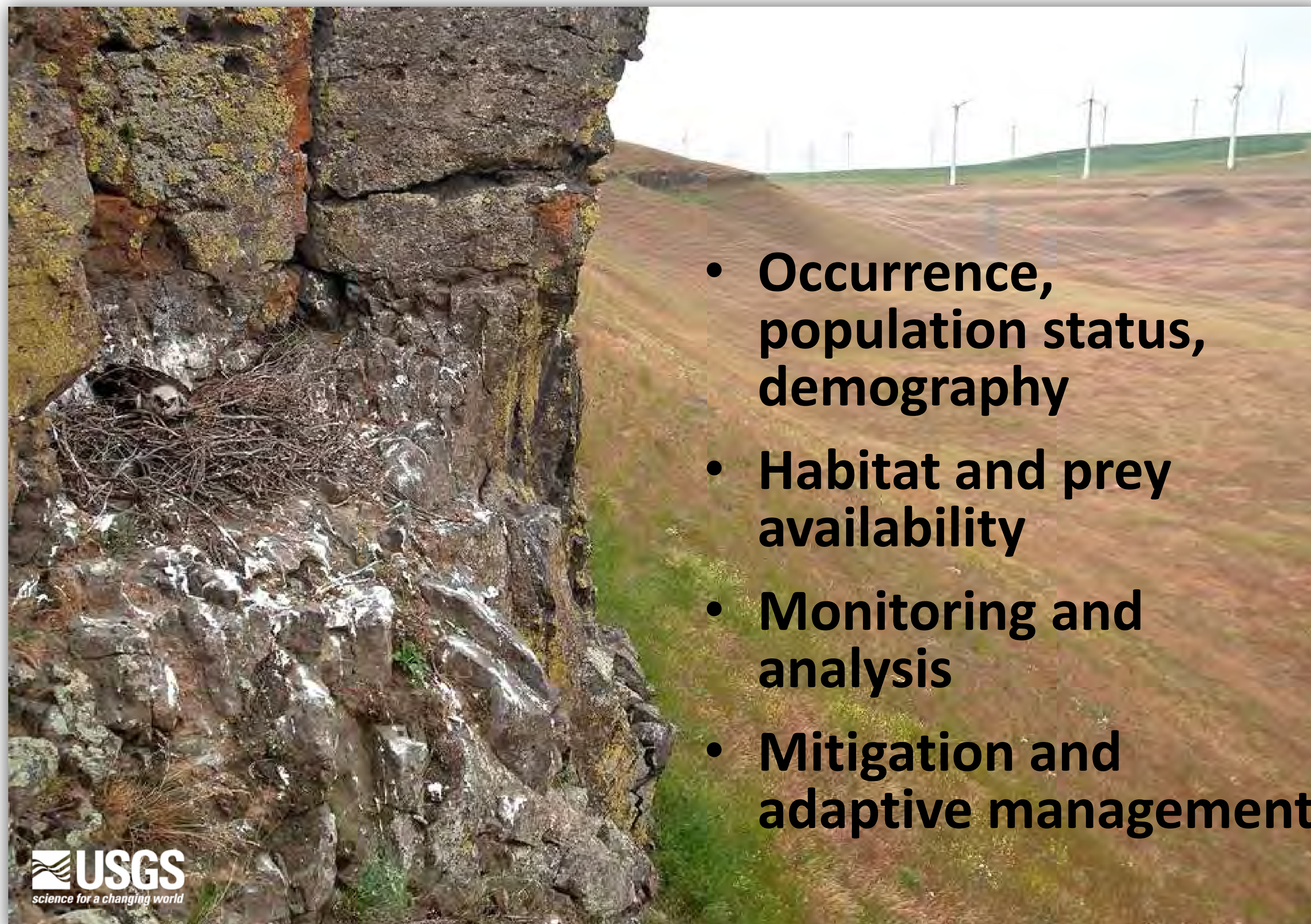


PI: Todd Katzner (FRESC)

Project period: 2015-2018

USGS

Understanding Risks



- Occurrence, population status, demography
- Habitat and prey availability
- Monitoring and analysis
- Mitigation and adaptive management

Habitat Modeling to Inform Energy Development

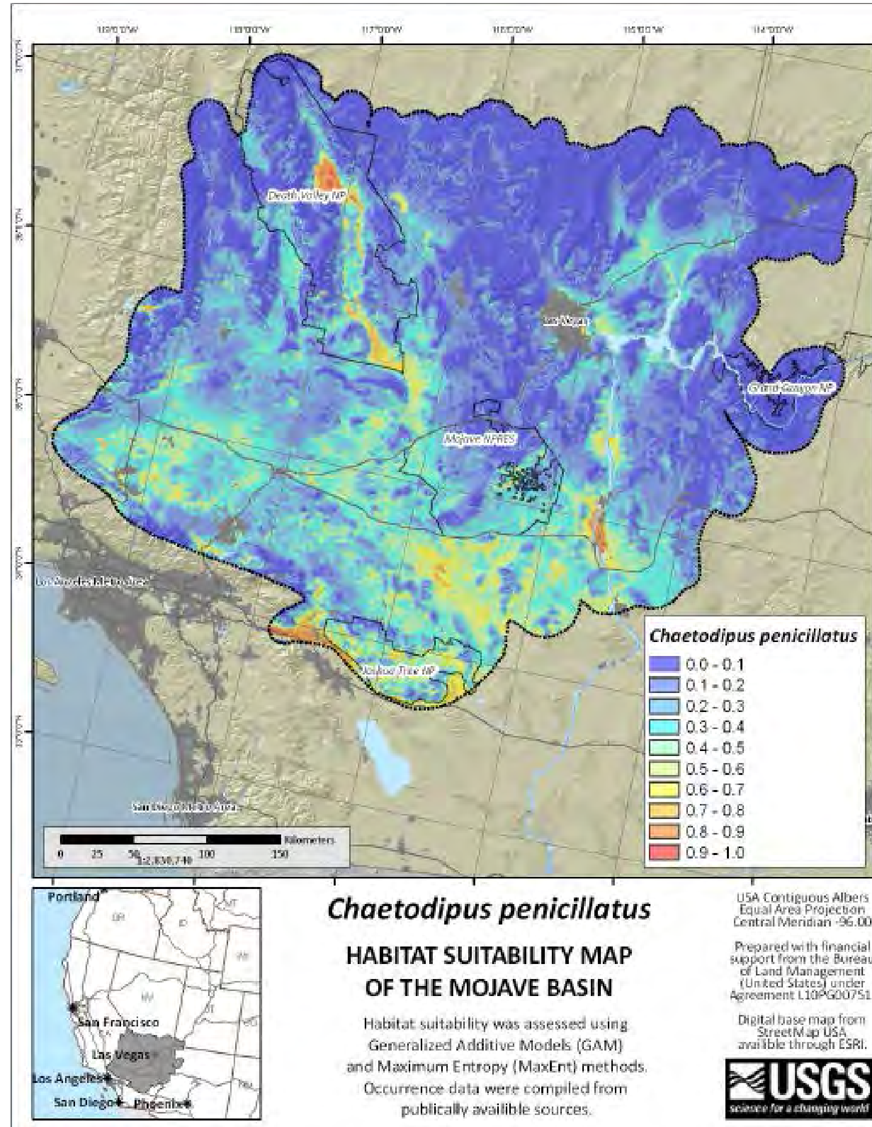
Renewable energy development in the Mojave Ecoregion is creating potential impacts to multiple species of wildlife

USGS Published Research

- Habitat suitability models for over 50 desert plant and animal species can be used to rank potential habitat loss
- Golden eagle status assessments and monitoring protocols

PIs: Todd Esque, Amy Vandergast (WERC)

Publication: Inman, R. D. et al., 2014. Mapping Habitat for Multiple Species in the Desert Southwest. Open File Report 2014-1134.



USGS

Linking Habitat and Prey Availability to Golden Eagle Ecology and Solar Energy in the Mojave

Inform energy and land-use planning ; assist with delineating conservation and development zones

Golden Eagle. Credit: USFWS

Objectives:

- Assess food habits, reproductive success and prey availability of nesting golden eagles in the Mojave
- Synthesize and review rabbit distribution and abundance in the Western US
- Develop a regional prey database for rabbit populations across 17 western states

PIs: Kathleen Longshore & Todd Esque (WERC)

Product completion: Spring/Summer 2016

USGS

Surveying and Monitoring Golden Eagles and Other Raptors in the DRECP Area

Effective surveys for eagles and status monitoring and mapping are needed to meet DRECP objectives

Objective:

- Develop survey designs and field procedures to determine the distribution of golden eagles
- Assess their occurrence and nesting success in the DRECP area
- Compile and analyze eagle population data for CA & NV, and the larger context of their full migratory range into a geospatial database

PI: David Wiens (FRESC)

Project Completion: Summer 2016

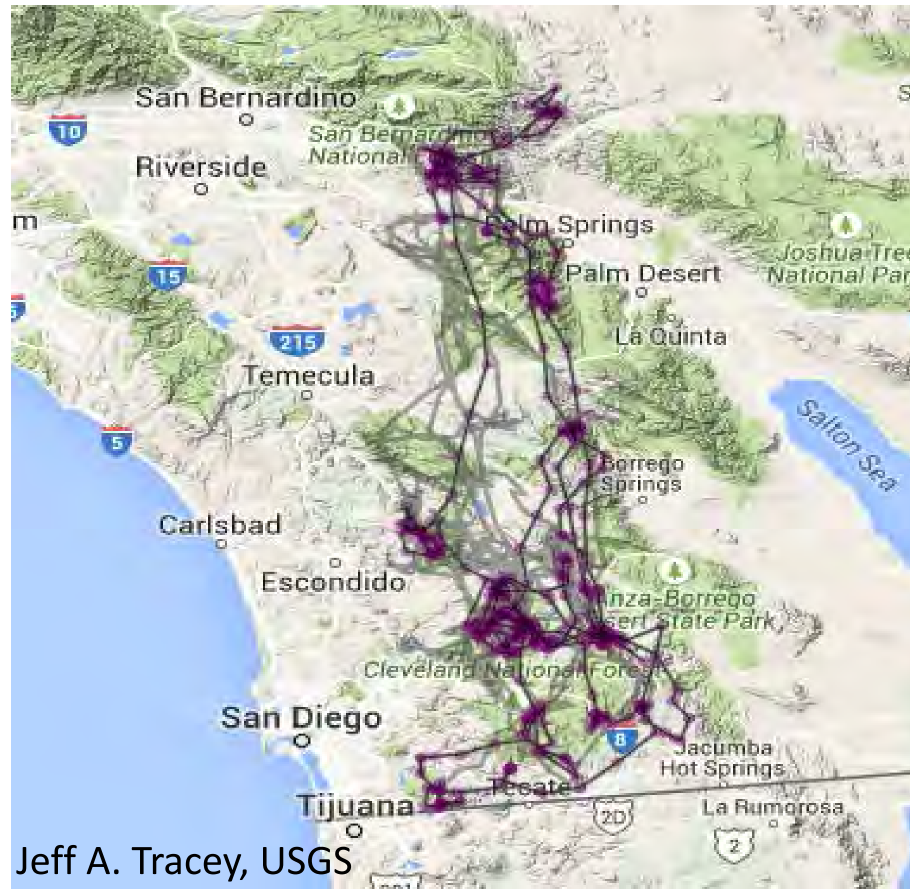
USGS

Helping Inform Siting Decisions

What are regional golden eagle nesting and foraging behaviors that may lead to eagle – infrastructure interactions?

Objectives:

- Population surveys, biotelemetry and genetics
- Focus on occupancy and movement
- Abundance and survival in relation to prey dynamics
- Regional understanding



PIs: Jeff Tracey & Robert Fisher (WERC)

Products: Biotelemetry data for 24 eagles released May 2016

USGS

Needs and Future Directions

- Expand research on wildlife interactions with large scale solar power facilities
- Understand direct and indirect effects on species and landscapes
- Expand knowledge of where species are on the landscape
- Continue efforts to develop deterrents to minimize interactions of wildlife with facilities and effective mitigation strategies

USGS

USGS Energy and Wildlife Contacts

Todd Esque
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USGS

Recent USGS Publications of Relevance to Solar Energy Development

- Braham, M.E., Miller, T.A., Duerr, A., Lanzone, M., Fesnock, A., Lapre, L., Driscoll, D., Katzner, T.E., 2015, Home in the heat- Dramatic seasonal variation in home range of desert golden eagles informs management for renewable energy development. DOI- 10.1016/j.biocon.2015.03.020: Biological Conservation, v. 186, p. 225-232.
- Duerr, A., Miller, T.A., Duerr, K.C., Lanzone, M., Fesnock, A., Katzner, T.E., 2015, Landscape-scale distribution and density of raptor populations wintering in anthropogenic-dominated desert landscapes. DOI- 10.1007/s10531-015-0916-6: Biodiversity and Conservation, v. 24, no. 10, p. 2365-2381.
- Simes, M.T., K.M. Longshore, K.E. Nussear, G.L. Beatty, D.E. Brown, and T.C. Esque, 2015, Black-tailed and white tailed jackrabbits in the American West: History, ecology, significance, and survey methods. Submitted to Western North American Naturalist 75(4):491-521. DOI: 10.3398/064.075.0406
- Simes, M.T., K.M. Longshore, K.E. Nussear, G.L. Beatty, D.E. Brown, and T.C. Esque. *In Review*. An annotated bibliography for the black-tailed jackrabbit (*Lepus californicus*) and white-tailed jackrabbit (Lepus townsendii). Prepared and submitted as a USGS Open-File Report
- Dilts, T. E., Weisberg, P. J., Leitner, P., Matocq, M. D., Inman, R. D., Nussear, K. E. and Esque, T. C. (2016), Multi-scale connectivity and graph theory highlight critical areas for conservation under climate change. Ecol Appl. Accepted Author Manuscript. doi:10.1890/15-0925
- Tracey, J.A., Madden, M.C., Sebes, J.B., Bloom, P.H., Katzner, T.E., and Fisher, R.N., 2016, Biotelemetry data for golden eagles (*Aquila chrysaetos*) captured in coastal southern California, November 2014–February 2016: U.S. Geological Survey Data Series 994, 32 p., http://dx.doi.org/10.3133/ds994.

ASWG Mission

The ASWG is a collaborative group of environmental organizations, academics, solar companies, and solar industry representatives that will advance coordinated scientific research to better understand how birds interact with solar facilities. Given the threat that climate change poses to avian species, participants will work with the shared interests of protecting avian species and developing solar projects in an environmentally responsible and a commercially viable manner.

Participants and Roles

- Convener: Large-scale Solar Association
- Facilitation team: Pivot Point
- Decision-making members:
  - Audubon California
  - Defenders of Wildlife
  - Duke Energy
  - First Solar
  - Large-scale Solar Association
  - Natural Resources Defense Counsel
  - NextEra Energy Resources
  - Recurrent Energy
  - SunEdison
  - SunPower

Progress to Date

2016

January	February	March	April
• ASWG meeting with Research Panel (1/13) • Finalizing Terms of Reference • Multiagency CWG meeting	• Research panel works independently • ASWG call with research panel	• ASWG meeting • Progress report on Research Panel from Science Advisors	• Research Panel develops draft report

Ongoing Engagement with Multiagency Avian-Solar Collaborative Working Group

ASWG Next Steps

2016

May	June	July-August
• Multiagency CWG meeting (Week of 5/9) • Research panel shares draft report with ASWG	• ASWG meeting with research panel (6/1-2) • ASWG discussion of priorities	• ASWG and agency observers to meet to discuss final report • Finalize priorities after agency input

Ongoing Engagement with Multiagency Avian-Solar Collaborative Working Group

Research Panelists

Science Advisors		
Thomas Smith	UCLA	Director, Center for Tropical Research
Kristen Ruegg	UCLA / UCSC	Institute for the Environment and Sustainability, Center for Tropical Research
Research Panelists		
Steve Beissinger	UC Berkeley	Professor of Conservation Biology
Wally Erickson	WEST Consulting	CEO / Senior Statistician
Vasilis Fthenakis	Brookhaven National Lab	Principal Investigator
Luke George	Colorado State University	Senior Research Associate
Rodney Siegel	Institute for Bird Populations	Executive Director

ASWG Research Questions

I. Siting

1) Do avian mortality rates at PV solar power plants differ from background rates at control sites?

2) What is the relationship of mortality rates to site characteristics (e.g., panels, fence lines, overhead transmission lines, scale/configuration of installations, proximity to other solar facilities or other natural or human landscape features such as levels of fragmentation and loss of habitat, migratory flyways and stop over sites, etc.)?

3) How might siting be optimized to reduce potential impacts on vulnerable bird populations in a cost-effective manner?

ASWG Research Questions

II. Population level effects

1) Are solar sites causing avian mortality that is significant at the scale of the population for individual species?

   a) How should populations be defined in this context?

   b) What research and data would be required to determine if mortality associated with solar sites is additive or compensatory?

   c) How do population impacts differ by species, guild, migratory pathway, taxonomic unit and classification (threatened versus non-threatened), etc.?

ASWG Research Questions

III. Lake Effect

1) Are water or other birds attracted to solar panels because they perceive them as water bodies (i.e., a “Lake Effect”)?
2) Is a possible Lake Effect related to geographic and environmental/infrastructure characteristics of sites?
3) Do birds show evidence of attraction to large solar arrays (e.g. show changes in flight direction or behavior as they approach arrays)?
4) What types of birds are affected?
5) Is possible mortality due to stranding, strikes or some other process?
6) If the Lake Effect is demonstrated, what cues are causing the birds to mistake the solar array as a water body (e.g., what wavelength of reflected light are they responding to)?
7) If a Lake Effect can be demonstrated, how might the threat be mitigated or eliminated?

ASWG Research Questions

IV. Avian attraction/mitigation/deterrents

1) What are the avian risk-reduction options that might lower avian mortality?

V. Feather spots

1) What do feather spots represent? Can feather spots be better defined and quantified?

   a) What methods can be used to identify the species and number of individuals that comprise feather spots? Are feather spots a reliable indicator of avian strikes and/or fatalities.

   b) Do feather spots from larger carcasses persist in the environment longer than spots from smaller ones?

ASWG Research Questions

VI. Climate change and other broader impacts

1) What demographic effects may result from climate change in the absence of large-scale solar development, and how do these compare with the impacts of solar facilities for specific bird populations?

2) Using historical and contemporary data on the abundance and distribution of avian species with future climate projections, what are the predictions for the future avian distribution and population trends in California?

  a) How can this be used to mitigate the impacts of PV facilities?

Achieving Mutual Goals

- Understanding common research interests
- Identifying key priorities
- Identifying funding mechanisms
- Continued collaboration to drive short and long term results

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Development of Tools, Training, and Outreach to Address Solar Glare and Flux-Related Avian Impacts

Multiagency Avian-Solar Collaborative Working Group Public Workshop

Timothy Wendelin
National Renewable Energy Laboratory

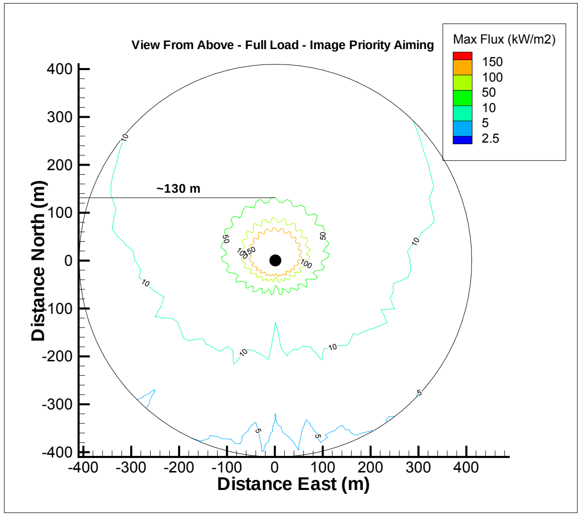
Clifford K. Ho
Sandia National Laboratories

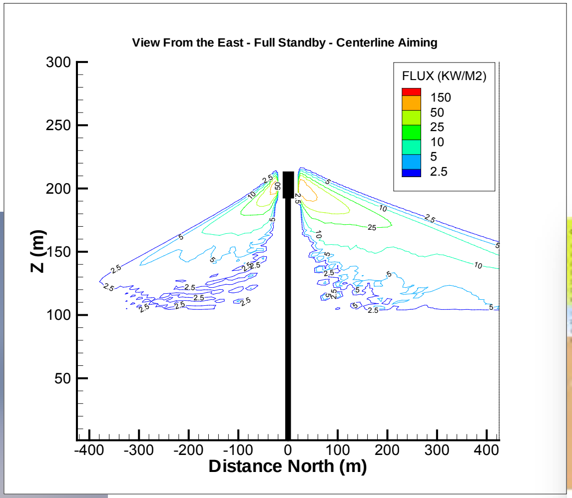
Cianin Sims
Sims Industries

May 10, 2016

Goals

- **DOE is funding work to address avian flux hazards**
  - o Develop models and tools to quantify flux (power/unit area) from heliostat aiming strategies
  - o Mitigate impacts of avian (and glare) hazards
  - o Optimize operational performance





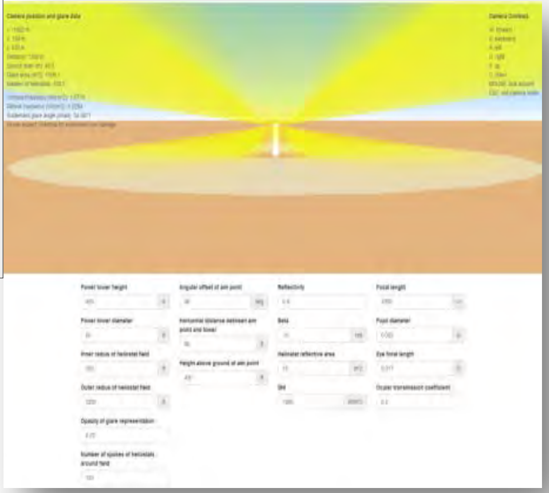
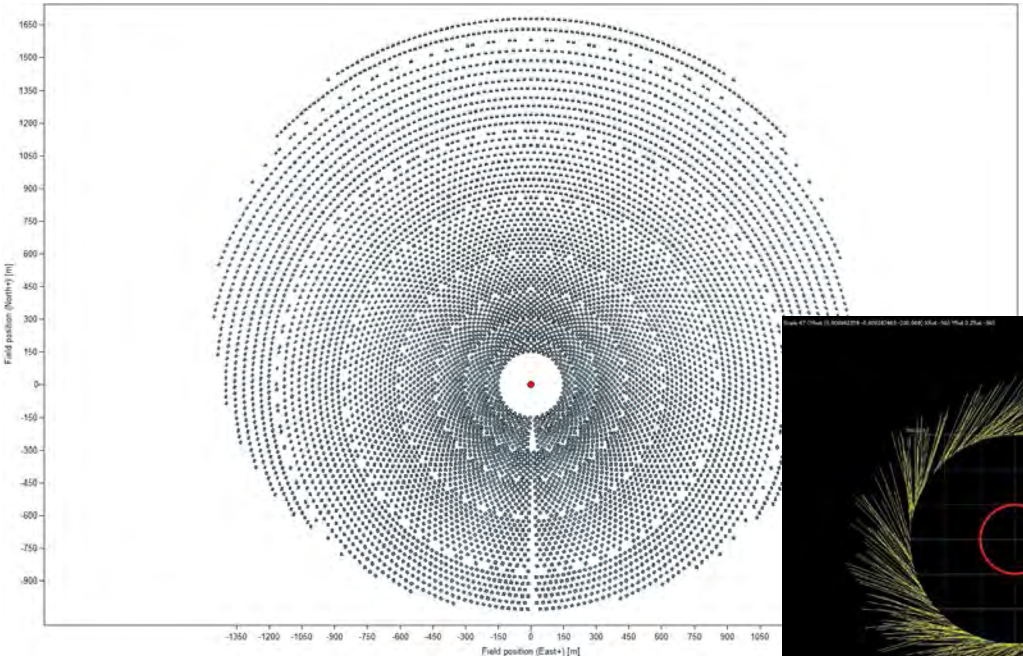
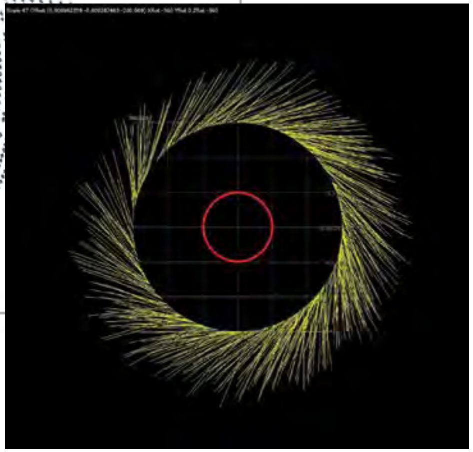


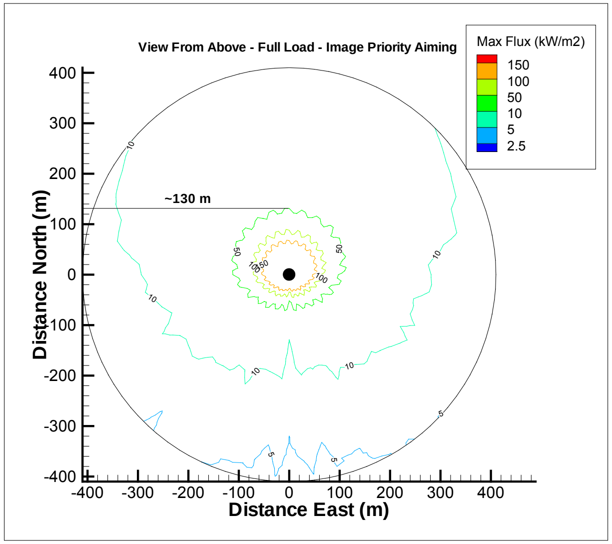
Photo and model of high-flux regions causing solar glare and avian hazards at Ivanpah Solar Electric Generating System

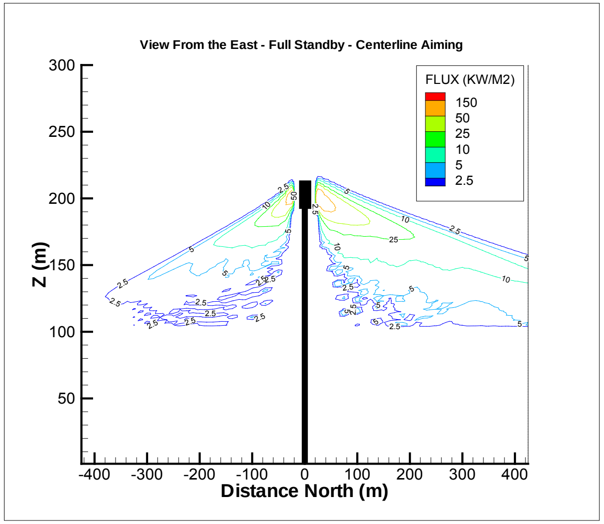
Previous Work

- **Argonne/NREL Study "A Summary Review of Issues Related to Avian Mortality at Utility-Scale Solar Facilities"**
  - o **Preliminary results compare well with previous analyses**
  - o **Various approaches to standby aiming can significantly reduce flux levels and their impact on avian mortality.**
  - o **Future work recommended to determine the impact of alternative aiming strategies which simultaneously minimize impacts to plant operations and avian health.**









Approach

1. Identify metrics for safe solar flux levels

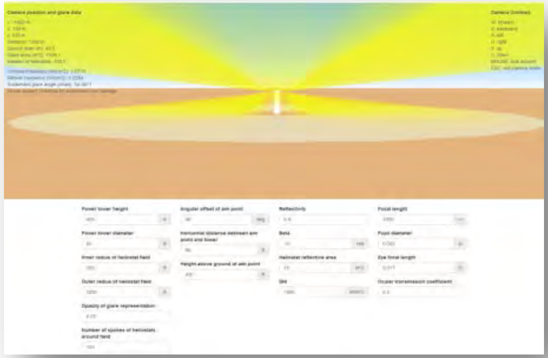
2. Develop tools to model solar flux in air space around power tower
   - o Case studies: Ivanpah and NSTTF at Sandia (for validation)

3. Compare alternative heliostat standby-aiming strategies
   - o Minimize solar flux according to metrics in (1) above
   - o Minimize impact on plant operations

4. Develop user friendly assessment tool for agencies/stakeholders

Ivanpah Solar Electric Generating System

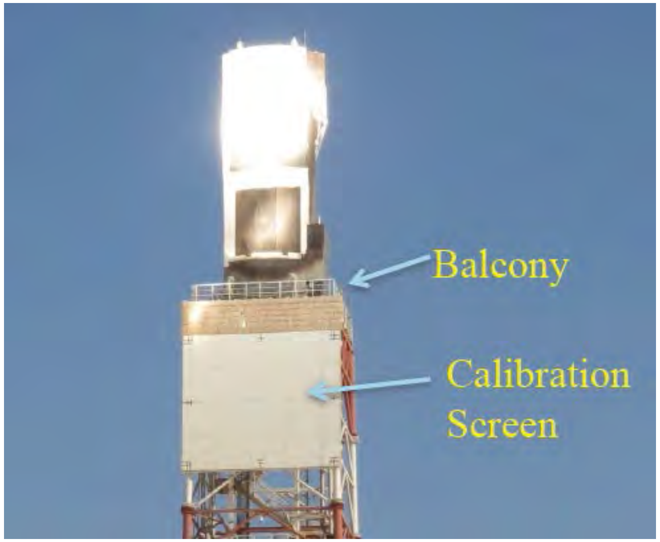
National Solar Thermal Test Facility (NSTTF)

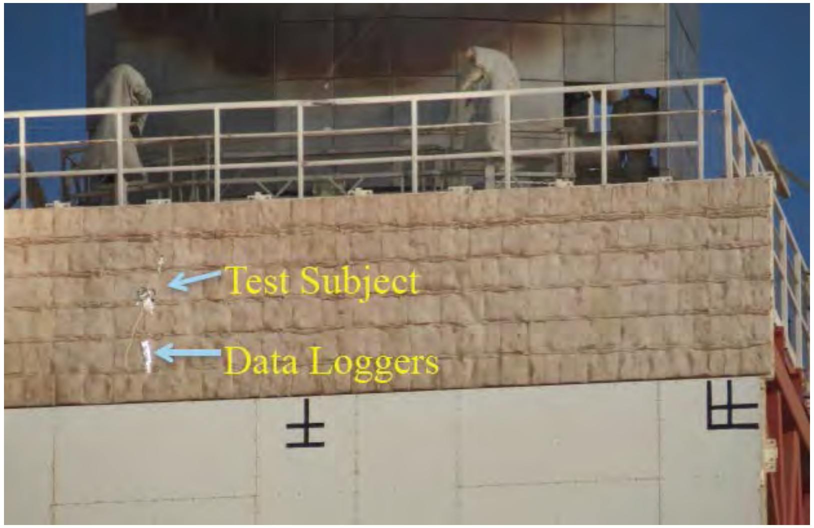


Tower Illuminance Model

Solar Energy Development Center
(Negev Desert, Southern Israel)

- Tests conducted with bird carcasses exposed to different flux levels (Santolo, 2012)
  - “no observable effects on feathers or tissue were found in test birds where solar flux was below 50 kW/m^2 with exposure times of up to 30 seconds.”
  - California Energy Commission analytical study found that “a threshold of safe exposure does not exist above a solar flux density of 4 kW/m^2 for a one-minute exposure”





Crescent Dunes (SolarReserve)
(Tonopah, Nevada)

- **110 MW_e molten-salt power tower**
- **In January 2015, 3,000 heliostats were aimed at standby points above receiver**
  - o 115 bird deaths in 4 hours
  - o SolarReserve spread the aim points to reduce peak flux to < 4 kW/m^2
    - – Reported zero bird fatalities in months following change

Figure 1 – The halo created by the reflected light of 3,000 heliostats which caused the bird mortalities.

Images from http://cleantechnica.com

Ivanpah Solar Electric Generating System

(Ivanpah, California)

- **390 MW_e direct steam power-tower plant (3 towers)**
- **Kagan et al. (2014) found 141 bird fatalities Oct 21 – 24, 2013**
    - 33% caused by solar flux
    - 67% caused by collisions or predation
- **H.T. Harvey and Associates found 703 bird fatalities in first year at ISEGS**
    - Study estimated 3500 bird fatalities accounting for search efficiency and scavengers removing carcasses
- **ISEGS has since implemented new heliostat aiming strategies and bird deterrents**

Cause	Number of Detections				
	Winter	Spring	Summer	Fall	Total
Singed	27	100	42	147	316
Collision	14	15	10	45	84
Other*	5	5	2	3	15
Unknown	51	82	61	94	288
Total	**97**	**202**	**115**	**289**	**703**

* Includes detections in ACC buildings without evidence of singeing or collision effects.

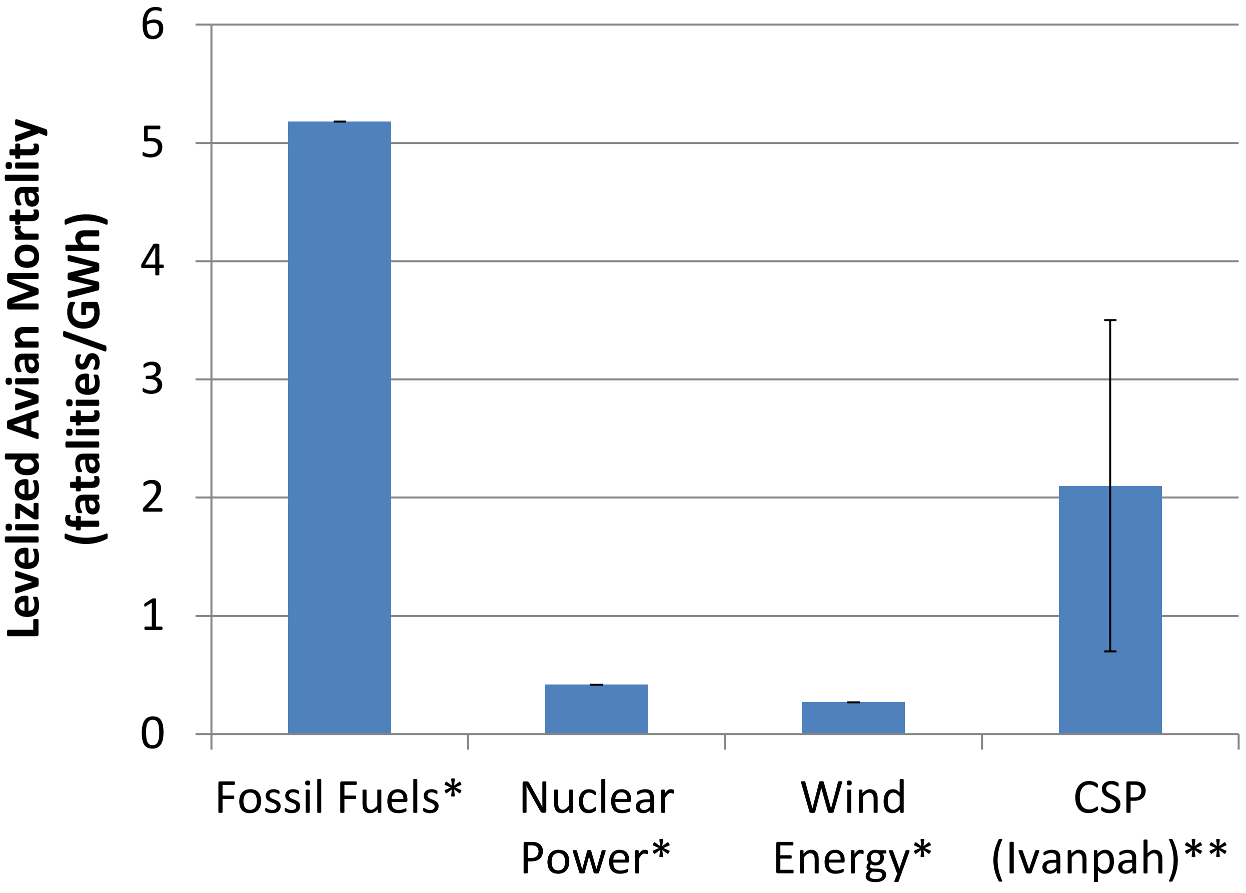
H.T. Harvey and Associates, 2013 - 2014

Gemasolar Thermosolar Plant

(Andalusia, Spain)

- 20 MW_e molten-salt power tower plant
- 14-month study revealed no avian fatalities in vicinity of tower (Dept. of Zoology, U. Granada)

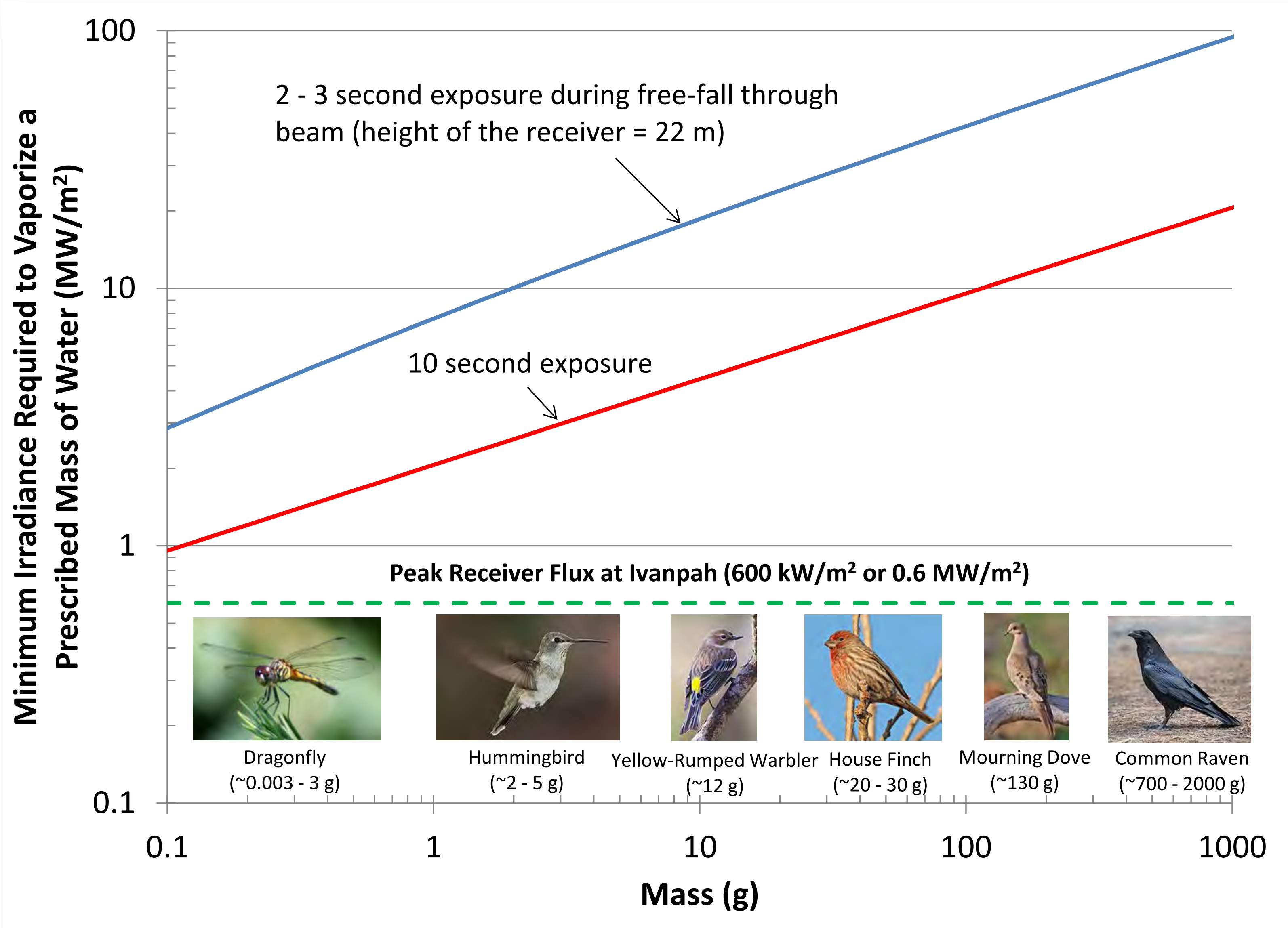
Levelized Avian Mortality for Energy (LAME)



*Sovacool (2009)

**During first year of operation at Ivanpah (2013 – 2014) before mitigation measures and deterrents were implemented

Feasibility of Bird Vaporization



Deterrents

- **Acoustic**
  - Painful or predatory sounds
- **Visual**
  - Intense lights and decoys
- **Tactile**
  - Bird spikes, anti-perching devices
- **Chemosensory**
  - Grape-flavored powder drinks (methyl anthranilate)

Conclusions from prior studies

- The large number of "streamers," or smoke plumes, observed and attributed to vaporization of birds is likely caused by insects flying into the concentrated flux
- Complete vaporization of birds flying into concentrated solar flux is highly improbable
- Safe irradiance levels for birds have been reported to range from 4 kW/m^2 to 50 kW/m^2
- Mitigation measures and bird deterrents can and are being used

Flux Hazard Analysis

- Create computer model of baseline power tower design (Ivanpah Unit #2) in SolarPILOT / SolTrace.
  - Heliostat geometry, positions and tower height from NRG.
- Create computer model of National Solar Thermal Test Facility in SolarPILOT / SolTrace.
  - Validate model using flux measurement tools

Flux Hazard Analysis

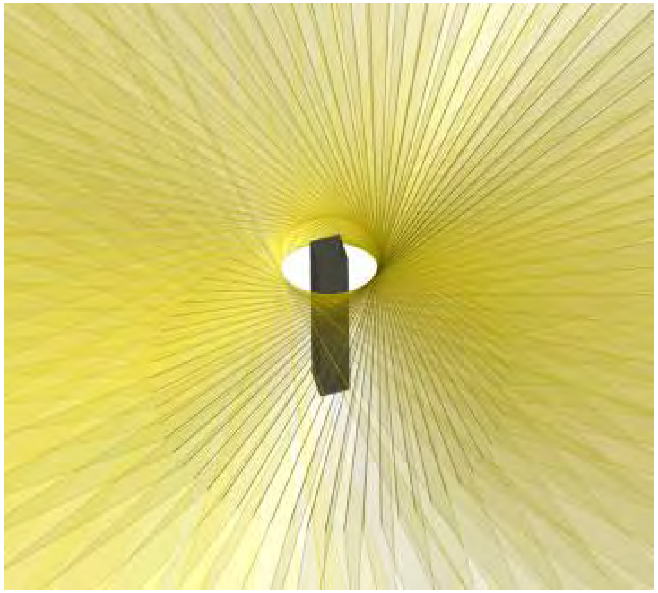
- Obtain/establish relevant information/parametric data from industry/stakeholder workshop
  - Baseline/novel aiming strategies.
  - Heliostat control capabilities (slew rates, aiming algorithms/capabilities)
  - Metrics for safe solar flux levels (I_{haz}, $V > I_{haz}$)
  - Performance metrics

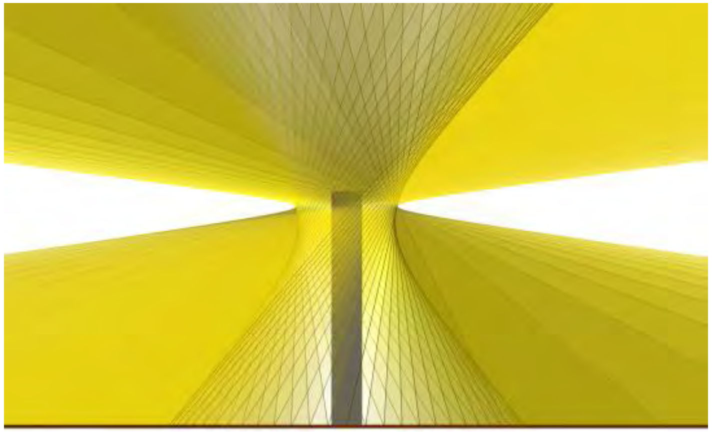
Flux Hazard Analysis

- Apply methodology to Ivanpah and NSTTF fields for analyzing baseline and alternative cases for standby conditions.
  - Generate volumetric flux maps for standby aim-point strategies for representative times and days of the year.
  - For representative flight paths through the volume, perform worse case thermal analysis to determine whether surface (feather) temperature exceeds 160^{o} C along given flight path.
  - Consider number of flight paths exceeding 160^{o}C or the total time of exceedance as metrics to determine the effectiveness of different stand-by aiming strategies.

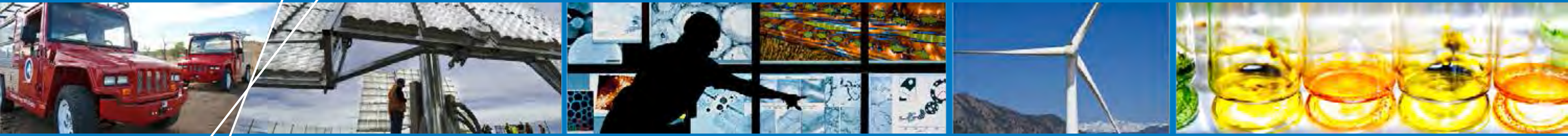
Flux Hazard Analysis

- Evaluate successful aiming strategies for impact on annual performance
  - Quantify time from standby to operational for representative days of the year and for both baseline and alternative standby aiming strategies.
  - Quantify annual performance impact of alternative vs baseline cases with the goal of achieving zero loss of annual energy delivered.
- Provide both input and output data from methodology for validation of the enhanced Tower Illuminance Model (TIM)





Wind Energy/Wildlife Interactions: Overview of the Challenges and Current Efforts to Address Them

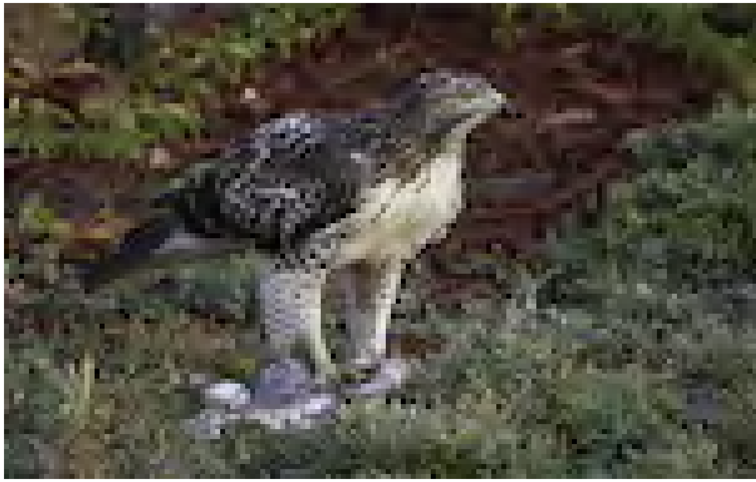


Elise DeGeorge, NREL

May 11, 2016

Outline

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions



Red-tailed hawk eating a rabbit.
Photo by Dennis Schroeder, NREL 22325

Outline

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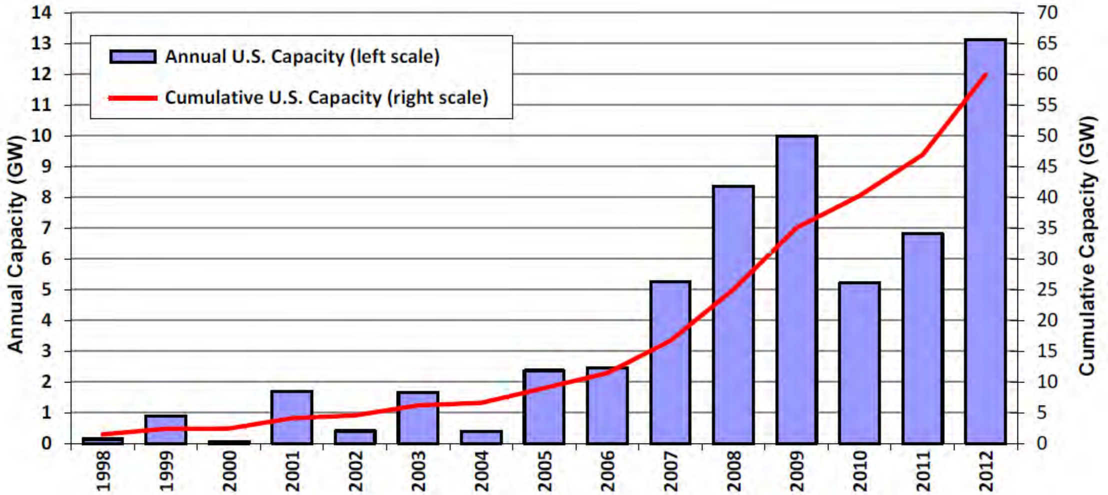
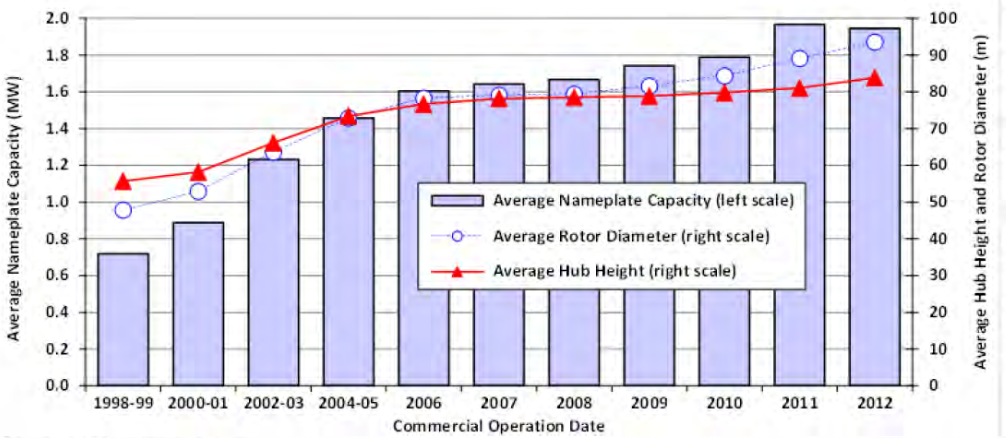
Photo by J. Lucas, Purdue University

Wind Installed Capacity over Time



Source: AWEA project database

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

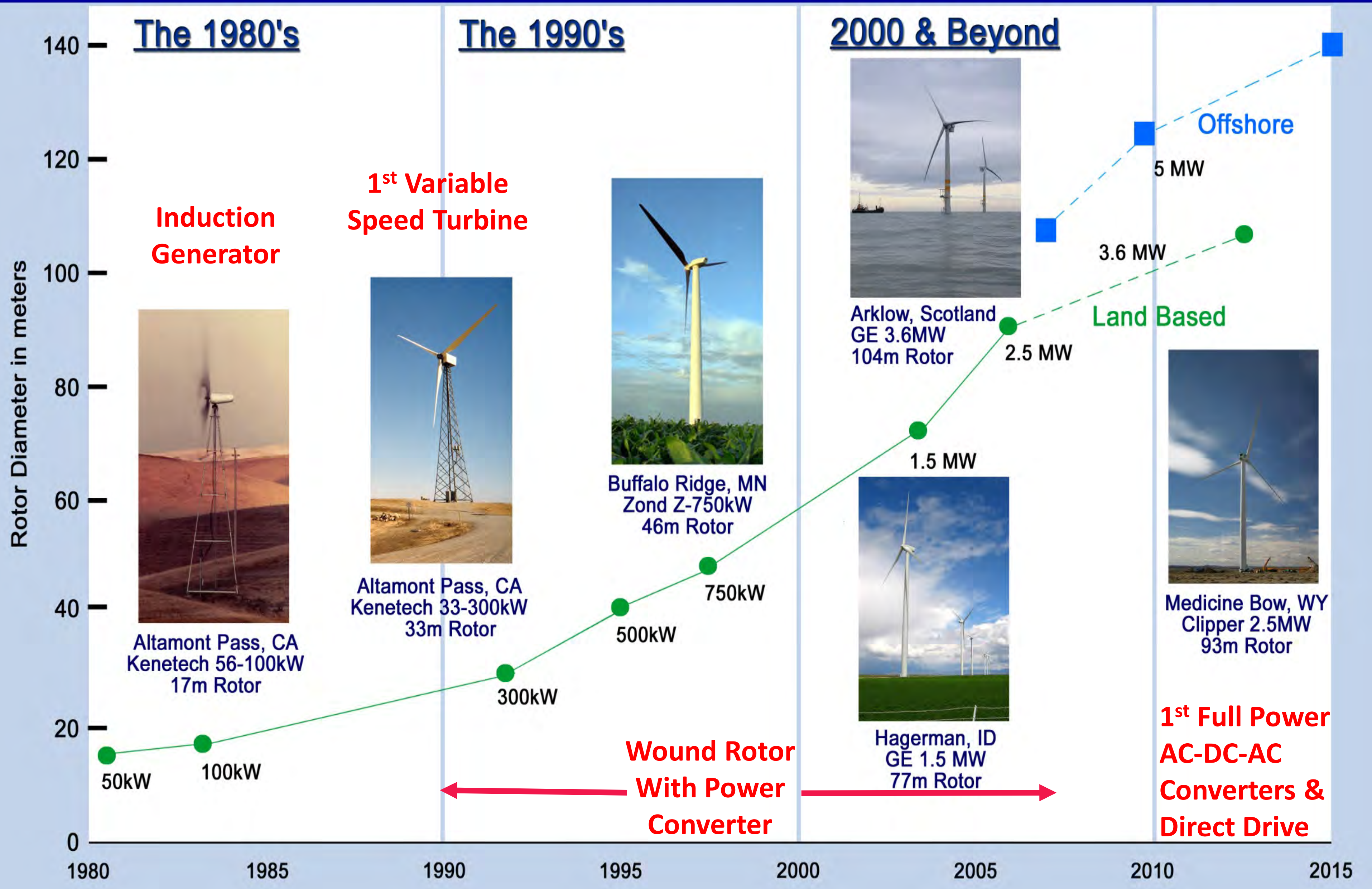


Source: AWEA project database

Figure 15. Average Turbine Nameplate Capacity, Rotor Diameter, and Hub Height Installed during Period (only turbines larger than 100 kW)

Source: 2012 Wind Technologies Market Report

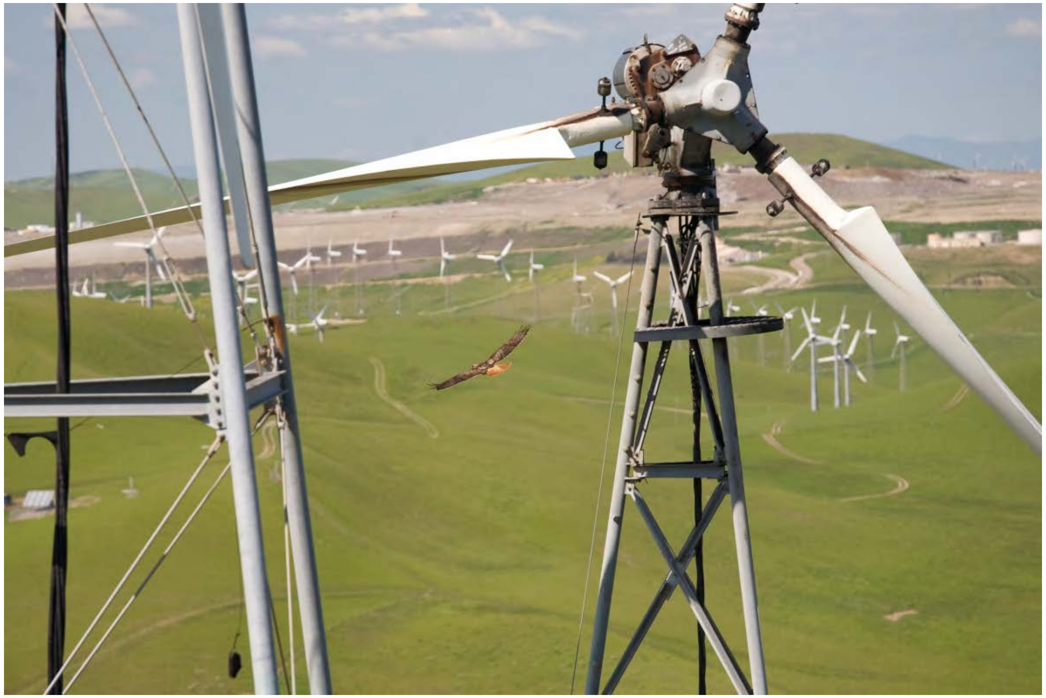
Evolution of U.S. Commercial Wind Technology



Wind Turbines May Impact Wildlife & Habitats

The discussion of wind turbine impact on wildlife began at the Altamont Wind Resource Area, California, in the late 1980s and early 1990s

Junction Hill Top Wind Farm, Iowa. Five GE 1.6-megawatt (MW) turbines. *Photo by Tom Wind, NREL 26494*



Altamont Pass Wind Resource Area, California.
Kenetech 56-100 kilowatt (kW) turbines.
Photo by Shawn Smallwood, NREL 17329

Real or Perceived Wildlife Impacts can be a Challenge for Development

- Misinformation on potential of impacts is rampant
- Impacts are species- and habitat-specific
- Impacts are site-specific; micrositing is critical to reducing these impacts.

Combination of 221 Mitsubishi Heavy Industries 1-MW turbines and 53 GE 1.5-MW turbines at the Cedar Creek Wind Farm in Grover, Colorado. *Photo by Dennis Schroeder, NREL 30593*

Eight Nordex N60, 1,300-kW wind turbines in Garrett, Pennsylvania. *Photo by Green Mountain Energy* Company, *NREL 09699*

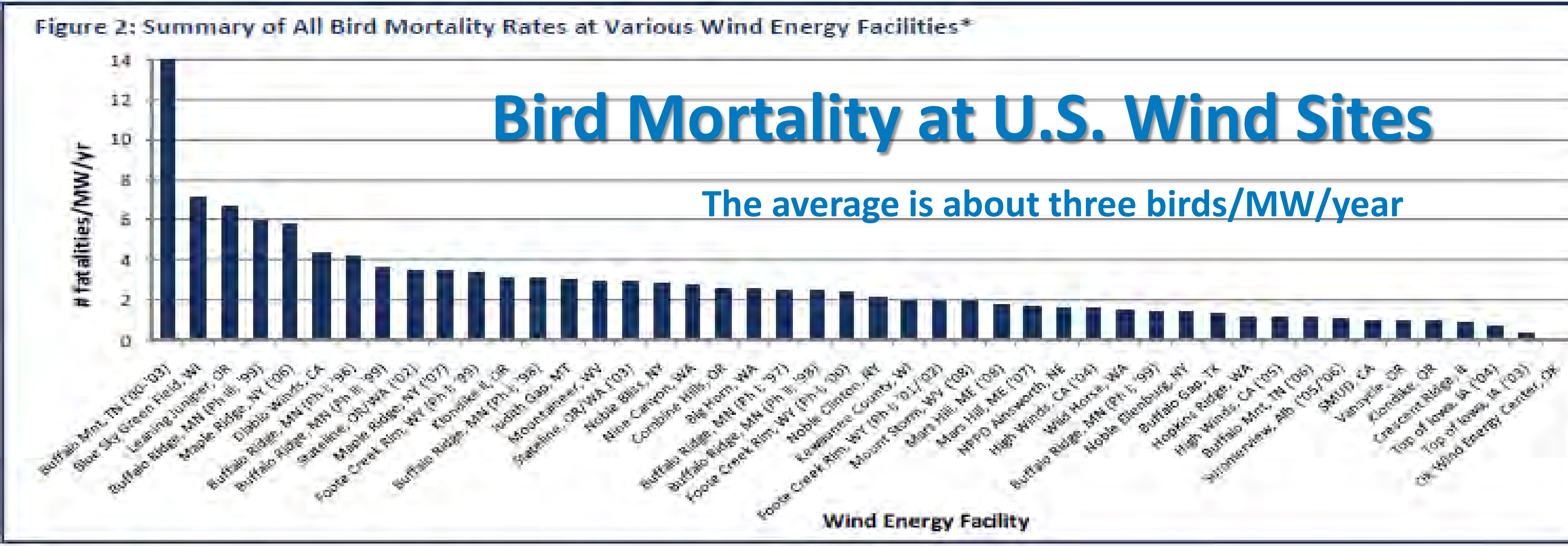


Figure 2: Summary of All Bird Mortality Rates at Various Wind Energy Facilities*
Bird Mortality at U.S. Wind Sites
The average is about three birds/MW/year
fatalities/MW/yr
14
12
10
8
6
4
2
0
Wind Energy Facility

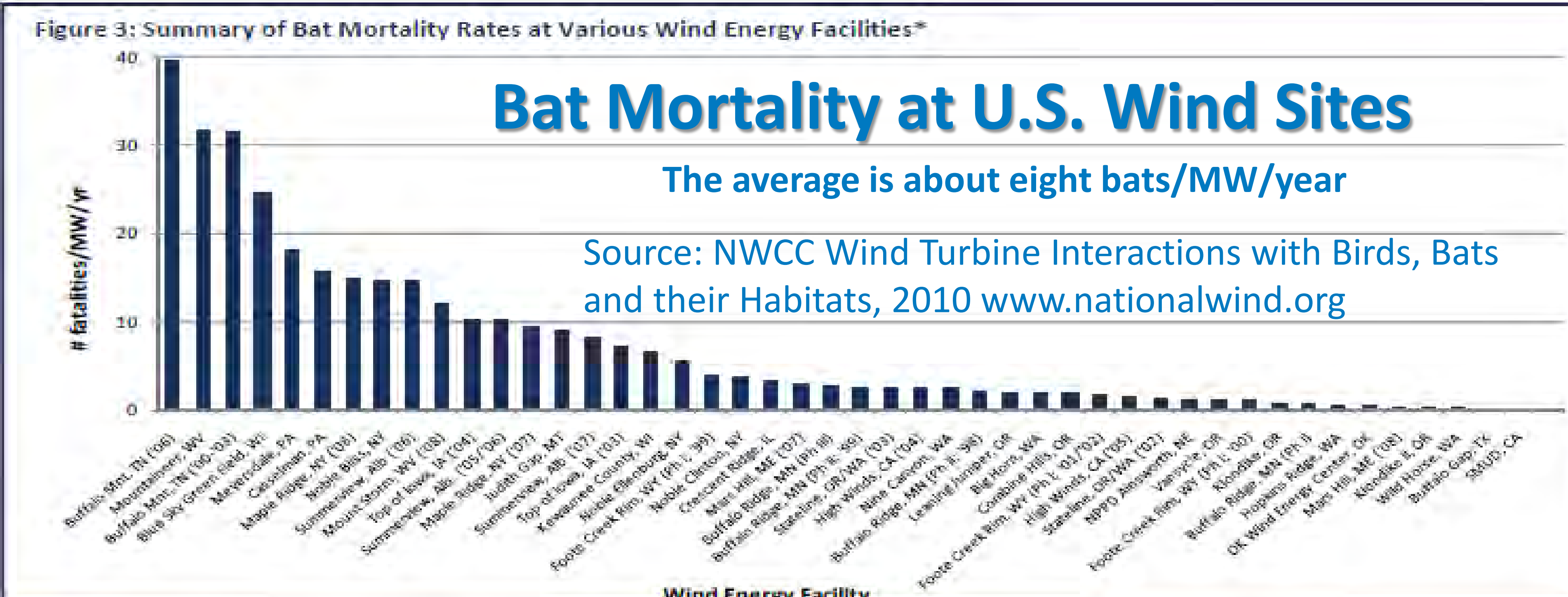


Figure 3: Summary of Bat Mortality Rates at Various Wind Energy Facilities*
Bat Mortality at U.S. Wind Sites
The average is about eight bats/MW/year
Source: NWCC Wind Turbine Interactions with Birds, Bats and their Habitats, 2010 www.nationalwind.org
fatalities/MW/yr
40
30
20
10
0
Wind Energy Facility

U.S. Fish and Wildlife Service Statutory Authority for Wind Permitting Guidelines

- **Endangered Species Act:**
  - Directs the Service to identify and protect threatened and endangered species and their critical habitat
  - Must provide a means to protect the species' ecosystems.
- **Migratory Bird Treaty Act:**
  - Based on a strict liability statute
  - Does not require proof of intent, knowledge, or negligence to be deemed a violation
  - Does include actions resulting in the 'taking' or possession of a protected species, in the absence of a USFWS permit or regulatory authorization, is deemed a violation.
- **Bald and Golden Eagle Protection Act:**
  - Provides additional legal protection for bald and golden eagles. First enacted in 1940/ golden eagle added in 1962

Whooping Crane. *Photo by Karin Sinclair, NREL 27961*

Bald Eagle. *NREL 01101*

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Challenges to Wildlife Related to Wind Energy

Wildlife challenges include:

- Habitat and species that are likely to be impacted vary by
  - Climate
  - Topography
  - Location
- No single solution
- Impacts expected to increase as more turbines are installed across the country—but these can be managed.

Ways of addressing the challenges:

- Identify-near-term research needs
- Use a multipronged approach
- Involve multiple stakeholders
- Garner support for collaborative field research, methods/metrics refinement, tools, mitigation strategies, and deterrent development/testing
- Disseminate information.

Challenges: Key Issues Being Addressed

Impacts of wind turbines on wildlife include:

- Bats (mortality)
- Raptors (mortality)
- Nocturnal migration (mortality)
- Prairie birds (habitat – displacement; genetic diversity)
- Cumulative (population impacts).

Tools to avoid problematic sites:

- Federal (e.g. Wind Energy Guidelines)
- State guidelines
- Pre versus post construction validation
- Mapping of migratory pathways
- Presiting assessments
- Risk assessments
- Literature archive
- Peer review (promote transparency)

Sage Grouse. *NREL 20649*

Avian Strike Probability Versus Turbine Size

Altamont Scale

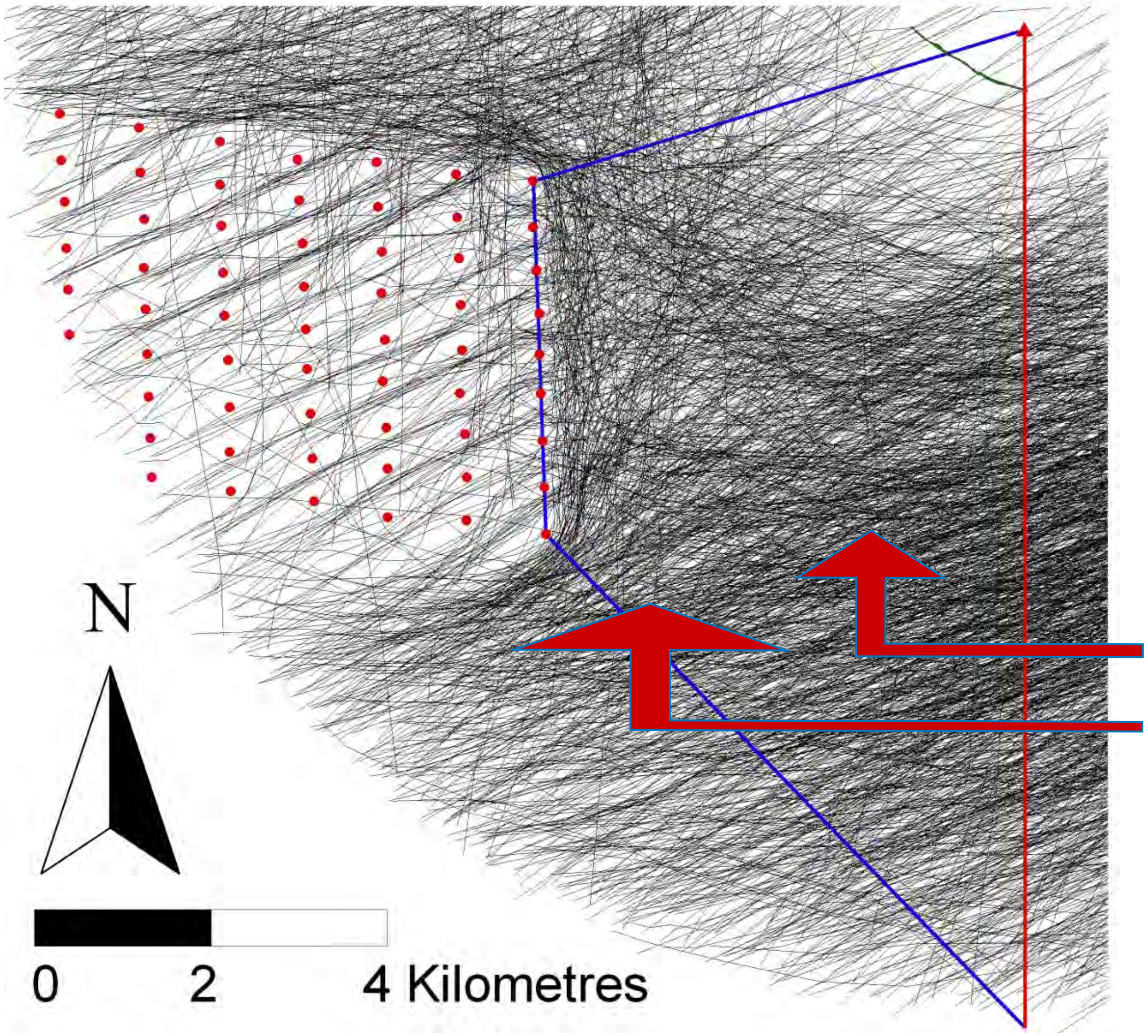
15-meter (m) diameter RSA and 100 kW

Next-Generation Scale

93-m diameter RSA and 2.5 MW

Avoidance Behavior can be Significant

Radar tracks of migrating birds through the Nysted Offshore Windfarm for operation in 2003

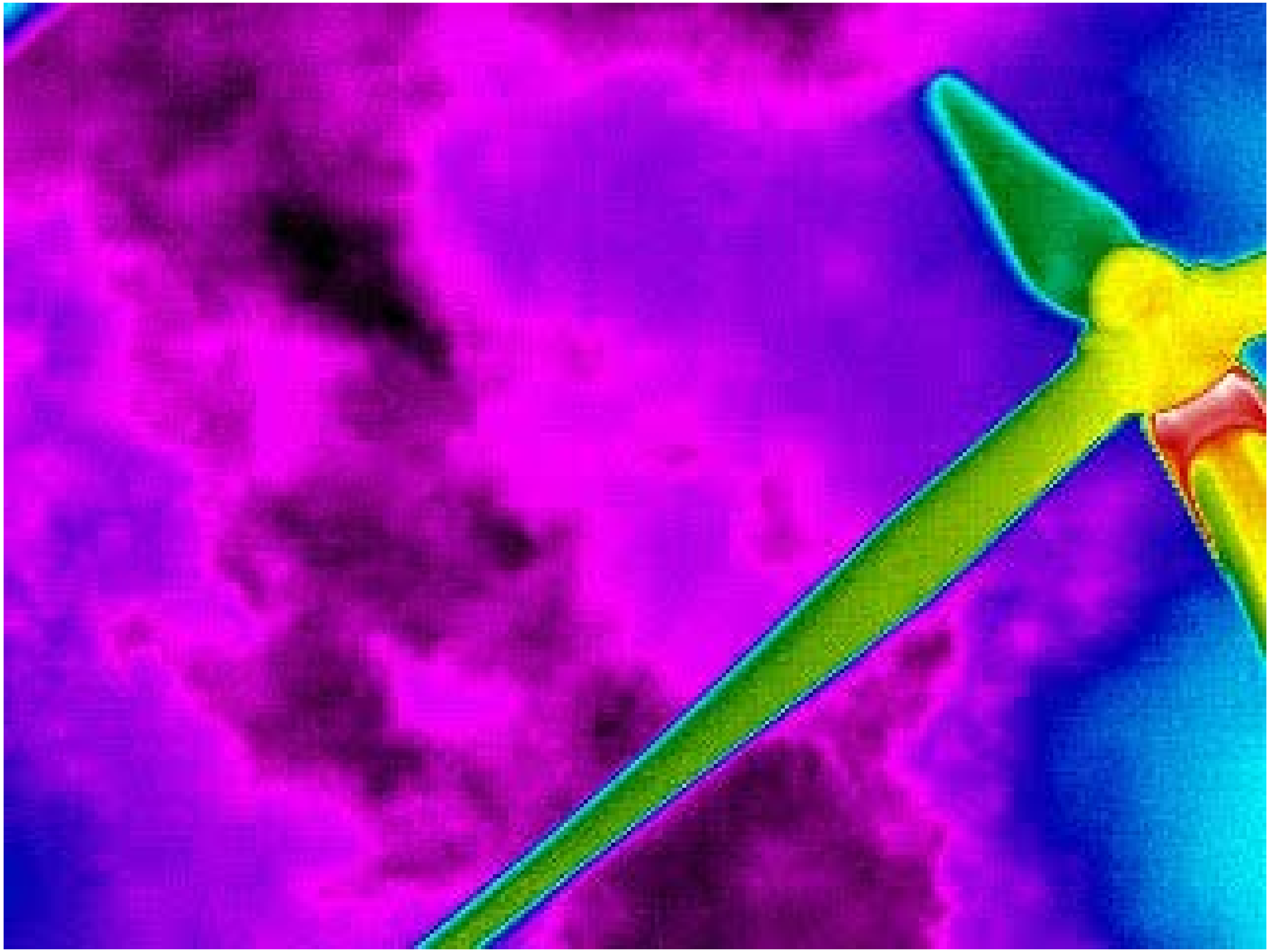


Response distance:

day = c. 3,000 meters (m)

night = c. 1,000 m

Bats Interactions: Curiosity?



Infrared Image of a Bat Flying Through a Wind Turbine Rotor

Video by Jason Horn, Boston University

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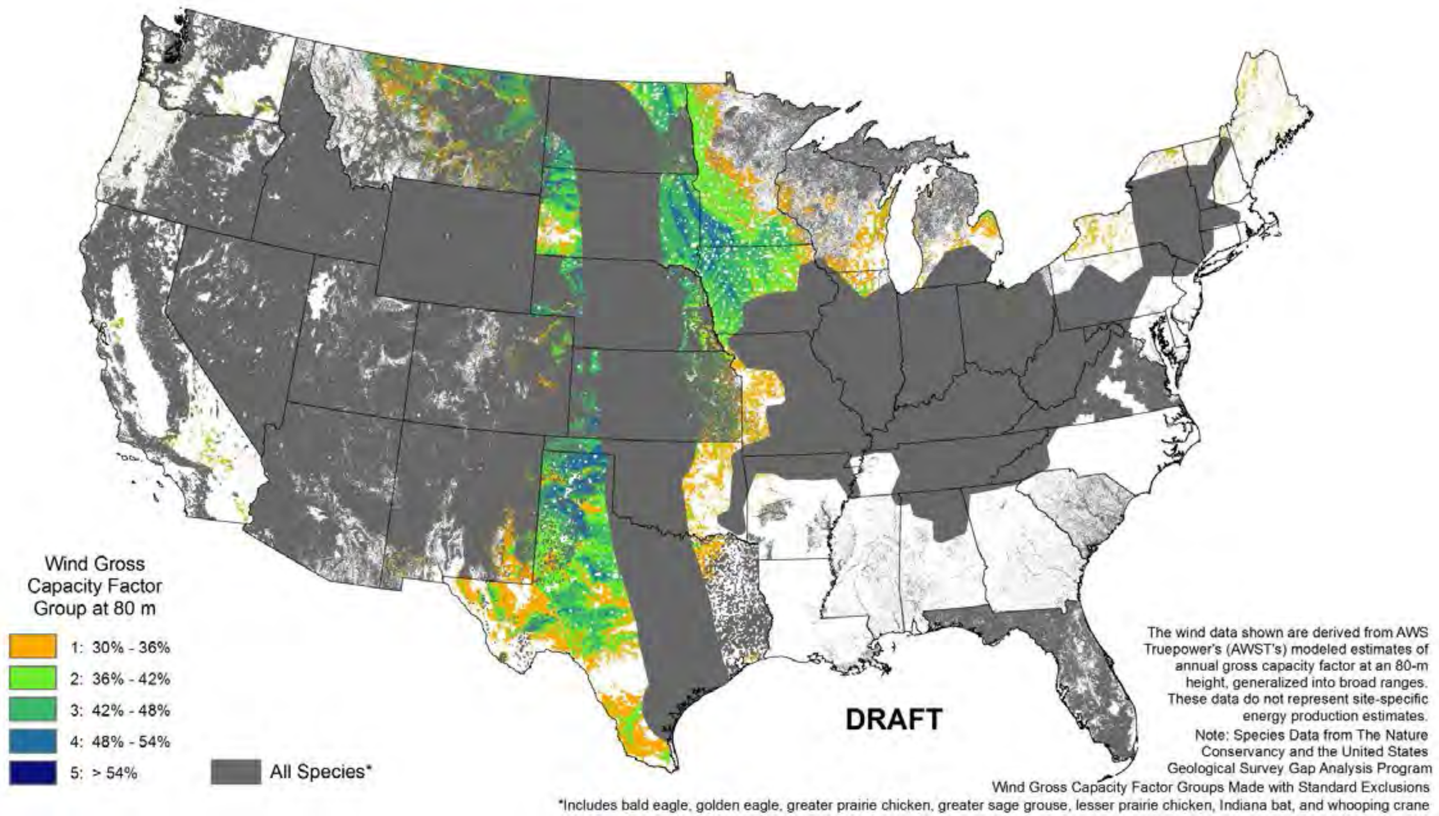
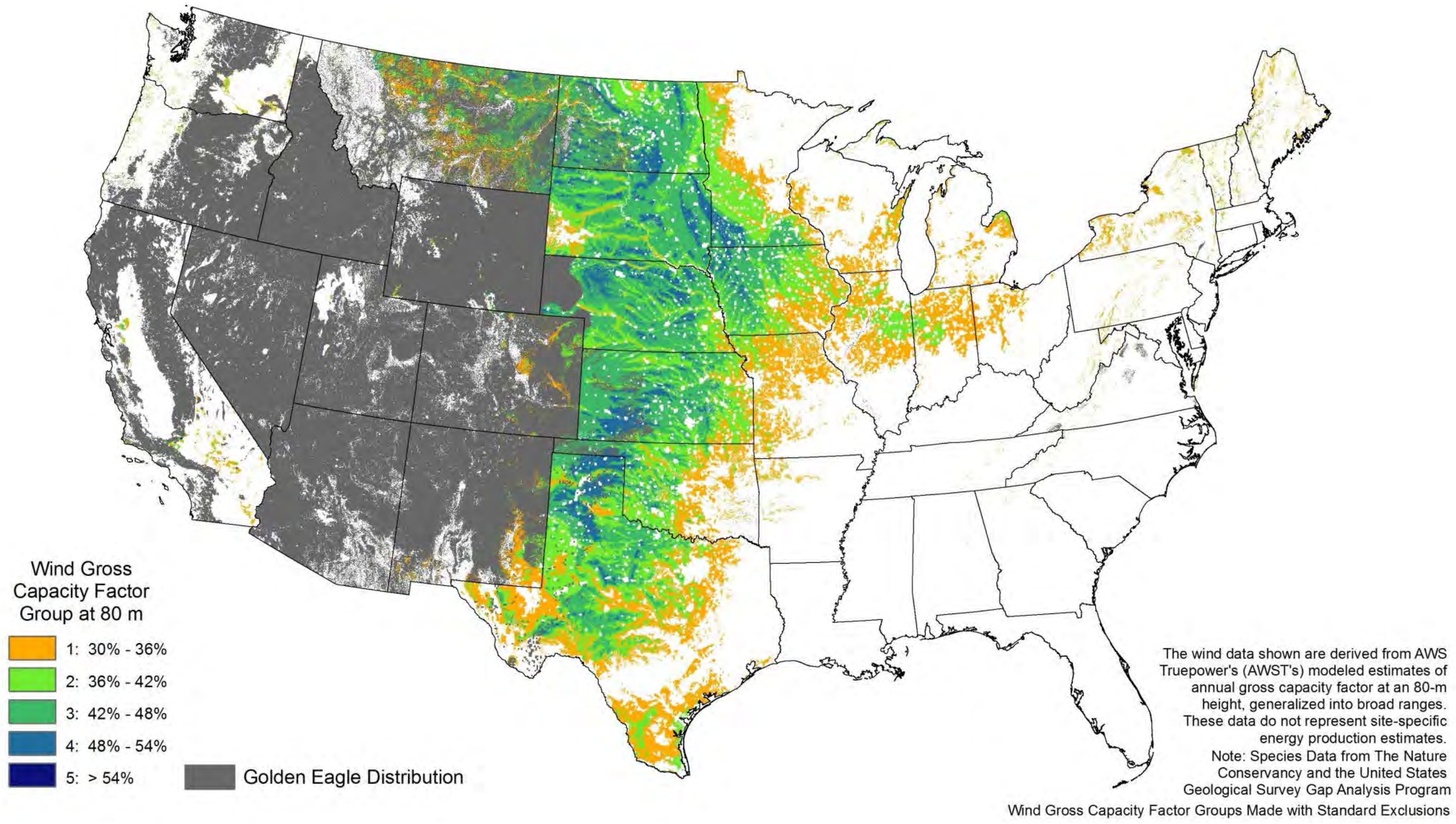
Key Species Habitat Distribution: Seven Species



Areas in grey indicate where wildlife species live, breed, and migrate. These areas are *not* no-build zones, but are of special concern for developers that could increase costs and time, or lead to project delays or cancellation.

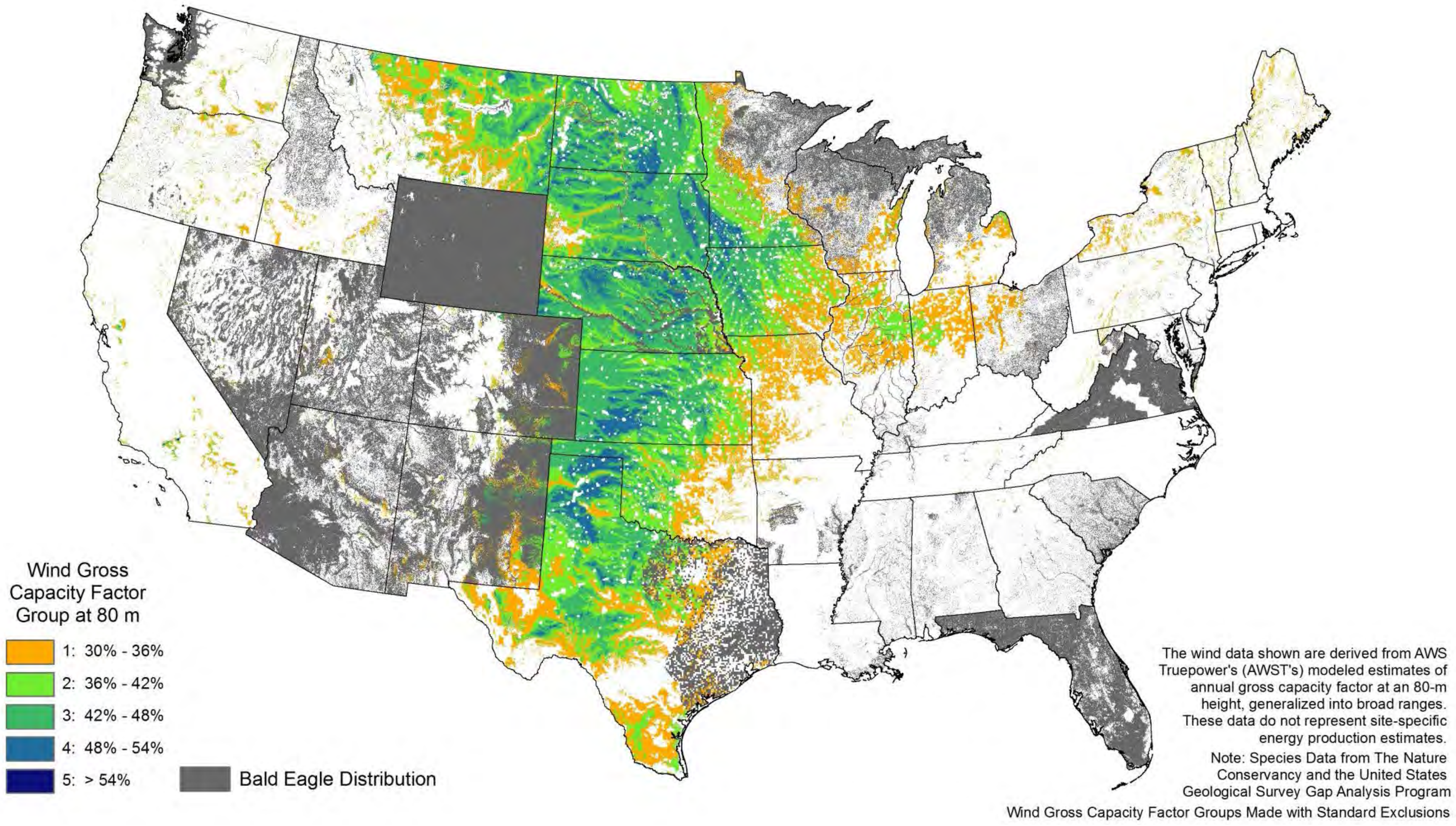
Wildlife distribution can impact local areas very differently. On a national scale, 44%–53% of land could be affected.

Key Species Habitat Distribution: Golden Eagles



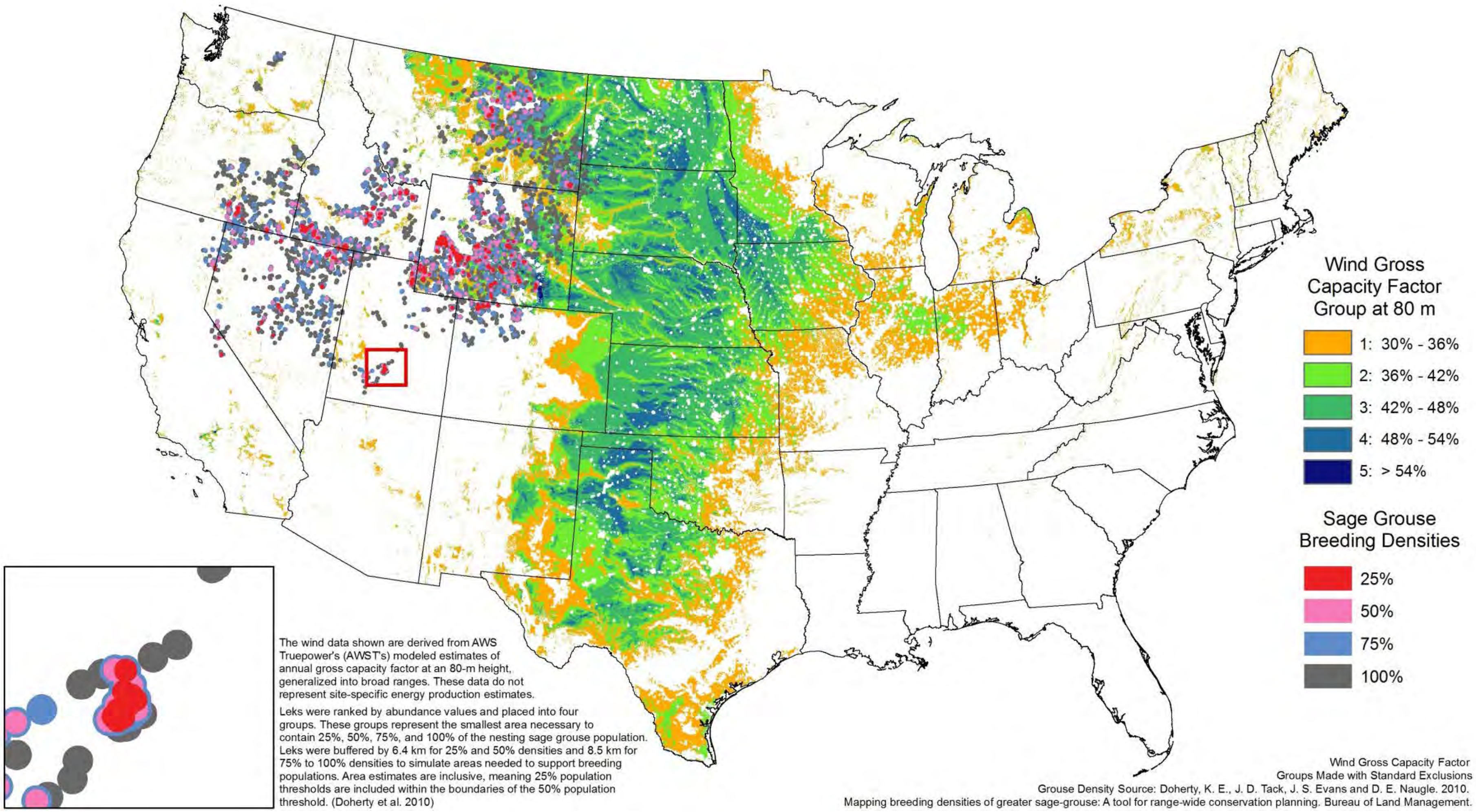
Golden eagle habitat: areas requiring additional consideration

Key Species Habitat Distribution: Bald Eagles



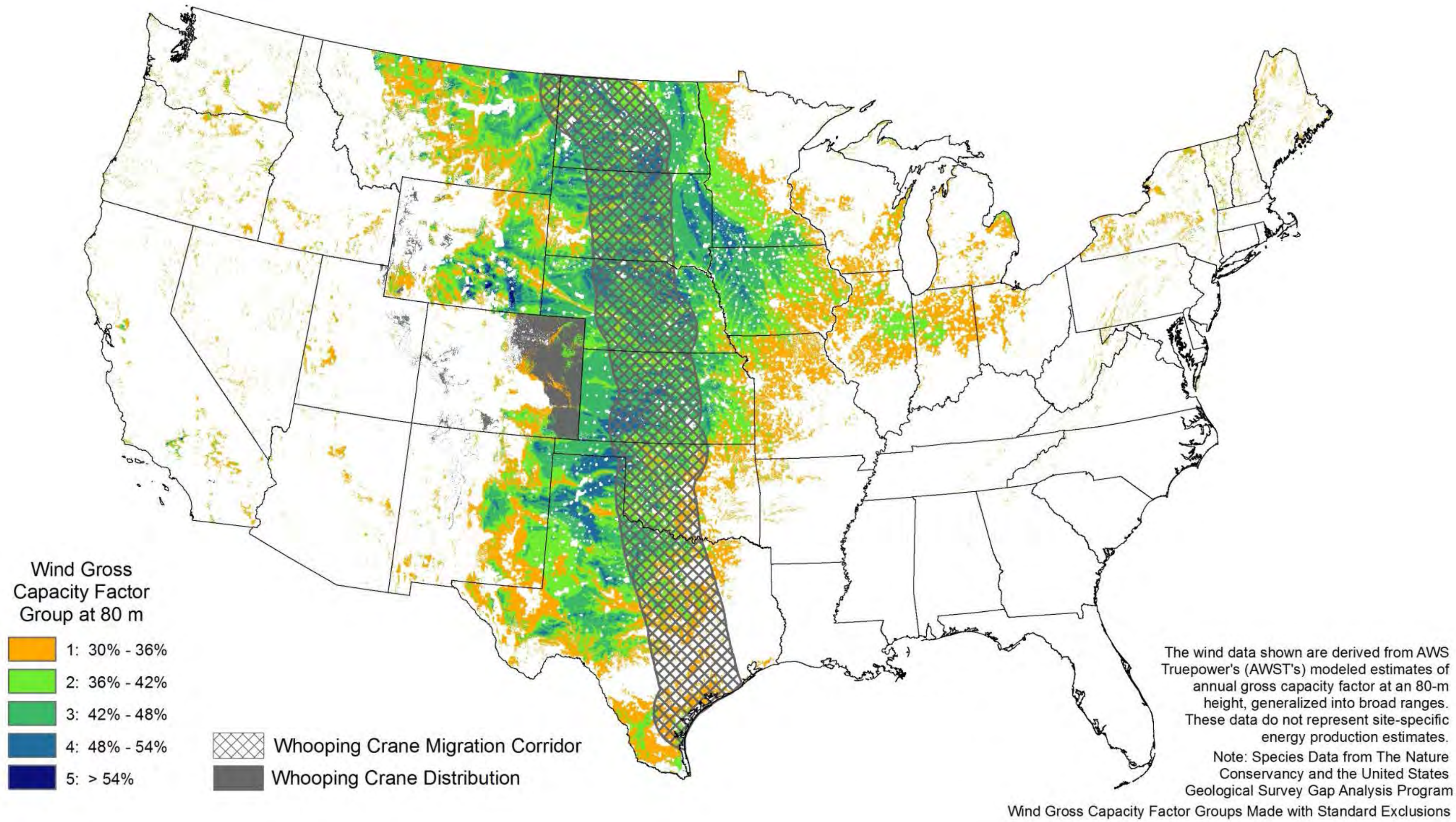
Bald eagle habitat: areas requiring additional consideration

Key Species Habitat Distribution: Sage Grouse



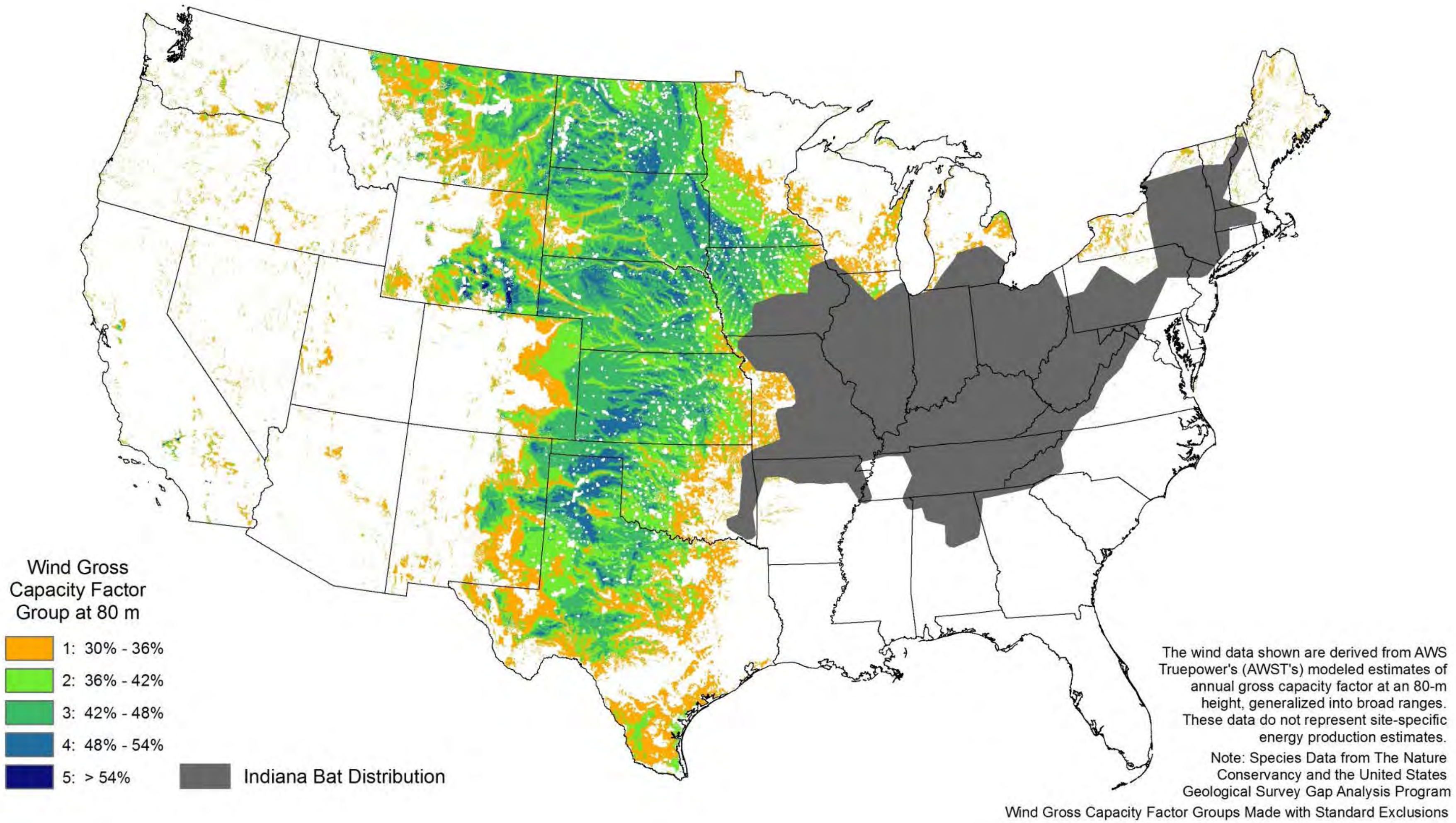
Sage grouse habitat and breeding sites: areas requiring additional consideration

Key Species Habitat Distribution: Whooping Crane



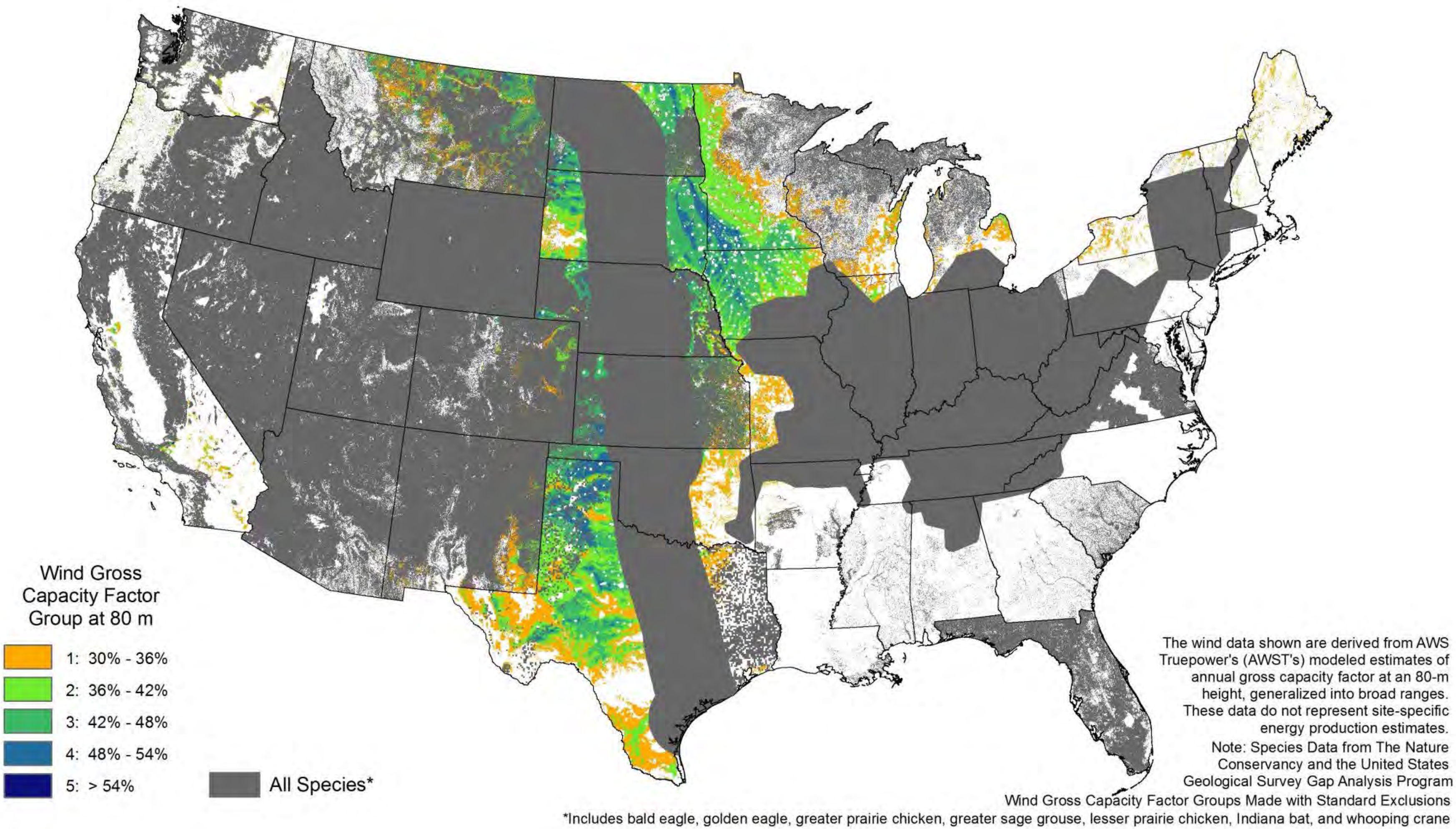
Whooping crane habitat and migratory corridor: areas requiring additional consideration

Key Species Habitat Distribution: Indiana Bat



Indiana bat habitat distribution: areas requiring additional consideration

Key Species Habitat Distribution: Combined



Combined wildlife impacts: areas requiring additional consideration

Outline

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions

Mitigation Research

Mitigation research focuses on:

- Deterrent development
- Correlating wind speed to utilization
- Correlating weather patterns to fatality patterns
- Offsite compensation
- Micrositing
- Turbine size
- Blade visibility
- Seasonal shutdowns
- Habitat manipulation
- Artificial roosts.

Greater Prairie Chicken. *Photo by Mark Herse, Kansas State University, NREL 27970*

Technology/Model Research

Technology/modeling research is focused on:

- Radar validation
- Thermal imaging cameras
- Near-infrared cameras
- Stable isotopes
- Predictive models.

Infrared camera. *Photo by Dennis Schroeder, NREL 20338*

Testing Detection Systems at the NWTC

Houdini in flight during FY15. GPS data logger can be seen on his right foot and UHF tracker can be seen on his left.

Testing of detection systems using Auburn University's golden and bald eagles

Importance of Convening Interdisciplinary Panel of Experts for Prioritizing Research

The National Renewable Energy Laboratory
together with
The Department of Energy's Wind and Water Power Technologies Office
are pleased to invite you to the
Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop

Land-based wind energy deployment is challenged by the lack of accepted solutions for reducing eagle fatalities at wind energy projects. Therefore, there is an expressed need for tools to reduce these fatalities and to facilitate permitting under the Bald and Golden Eagle Protection Act. For this workshop, we will be engaging experts from a wide range of fields to comprehensively assess the current state of technologies, key gaps, promising emerging technology solutions, novel ideas, and research and development needs.

Please join us...
The National Renewable Energy Laboratory
Research Support Facility
15013 Denver West Parkway
Golden, Colorado

Tuesday December 8th, 2015	Full day
Wednesday December 9th, 2015	Half day

CONTACTS

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RSVP *required*.
Please provide a response **no later than September 21, 2015** to bethany.straw@nrel.gov.

NREL | NATIONAL WIND TECHNOLOGY CENTER

- Bringing people of different focus areas/expertise to the table to understand and prioritize solutions
- Outcome as it relates to wind energy and eagle impacts: need to understand fundamental behavior and physiology of species of concern

Recommendations from Physiology and Behavior Specialists

- Understand: population and habitat associations, threats, annual cycle, demography, flight behavior, diet, etc..
- Risk is when turbines intersect with a species basic needs (e.g. with eagles it is food, updraft and nesting sites)

Photo provided by T. Katzner

Golden eagle copulation call

For auditory deterrent research, one expert recommends the following:

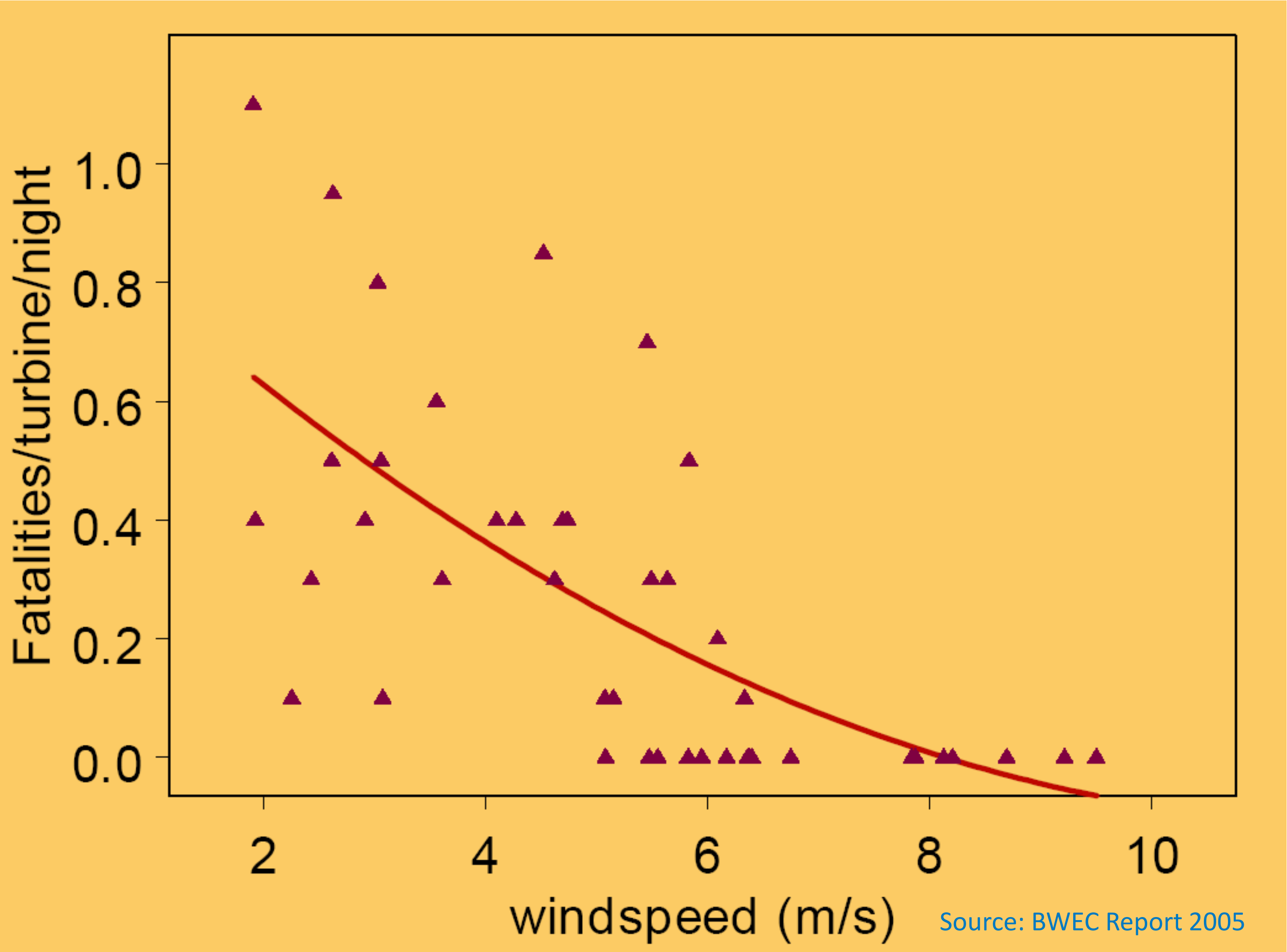
- Measure the auditory system of these birds
- Use this information to build a library of sounds that might be stressful (annoying)
- Use heart monitors to give us an index of stress (estimated by an increase in heart rate)
- Give a variety of different sounds to estimate stress induced by the sounds

Test birds over different time intervals (hours to weeks) to estimate the rate of adaptation to these sounds

Properties of the Vocal System Provide Clues about Properties of the Auditory System

Source: As presented by Jeff Lucas, Purdue University at Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop, December 2015

BWEC Study Results



Research Conducted from Settlement Agreements

Duke Energy at Top of the World Windfarm in Casper, Wyoming

- Onsite wildlife specialists during daylight hours
- Working with FWS on an eagle trapping and tracking project
- GPS help to understand eagle migration movements
- Advancing IdentiFlight camera system
- Opportunities for R&D when faced with unsupported requirements

An aerial view of Duke's Top of the World wind farm, located in Casper, Wyo.
Photo courtesy of Duke Energy Renewables

Source: http://nawindpower.com/online/issues/NAW1604/FEAT_01_Duke-s-Avian-Mitigation-Techniques-Take-Flight-What-s-Working-And-Why.html

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Outline

- Historical overview and statutory authority
- Challenges to wildlife
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Collaboratives are Often Beneficial for Advancing the Knowledge Base

Benefits of collaboratives include:

- Access to third party, unbiased research
- Accepted experts within collaborative
- Agreement on study design
- The ability to develop relationships (trust)
- A safe forum for discussion
- The ability to engage early and often
- Transparency/credibility
- Leveraging of funds
- Project access
- Access to interim results
- Accepted results
- A model for future interactions.

705-MW project in Tehachapi Pass Wind Resource Area, California.

Photo by David Hicks, NREL 18455

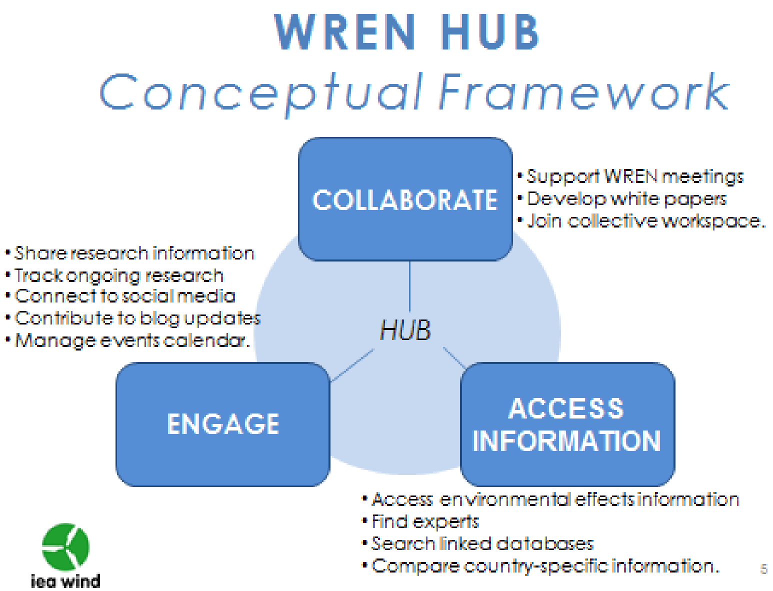
Current collaboratives

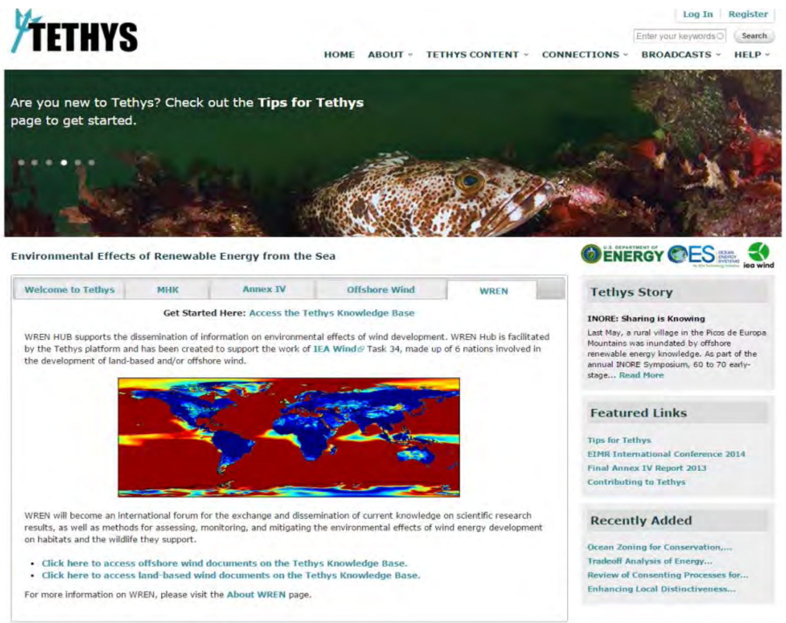
Current collaboratives include:

- The National Wind Coordinating Collaborative (NWCC). Includes federal, state, utilities, nongovernmental organizations (NGOs), and wind industry
  - Grassland Shrub Steppe Species Collaborative. Includes federal, state, NGOs, and wind industry
  - Sage Grouse Collaborative. Includes federal, state, NGOs, and wind industry
- Bats and Wind Energy Cooperative (BWEC). Includes federal, state, NGOs, and wind industry
- American Wind Wildlife Institute (AWWI). Includes industry and NGOs
- International Energy Agency Wind Task 34. Includes nine member countries.

More on International Energy Agency Wind Task 34

- Working Together to Resolve Environmental Effects of Wind Energy, known as **WREN**
- October 2012–2016; extension under discussion
- Current member countries: Ireland, Netherlands, Norway, Spain, Switzerland, United Kingdom, United States, France, and Sweden.





Primary products:

- WREN Hub/Tethys (http://tethys.pnnl.gov/)
- White papers: Adaptive management, individual impacts to population effects, green versus green, cumulative impacts, transboundary issues
- Webinars: on land/offshore, birds/bats/marine mammals, tools http://tethys.pnnl.gov/environmental-webinars?content=wind

Outline

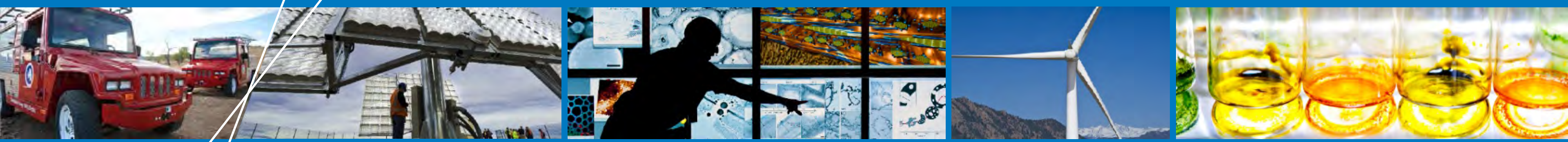
- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions

Conclusions

- Wind-wildlife impact concerns are complicated
- Micrositing is key to avoiding, minimizing, and mitigating impacts; some locations may just not be appropriate for wind development
- Research and development of tools is ongoing and benefits from interdisciplinary approaches
- Collaboratives provide opportunities to leverage resources to find solutions for common challenges.

Grand Ridge Wind Energy Center. GE 1.5-MW turbines in Lasalle County, Illinois. *Photo by Invenergy, LLC, NREL 16040.*

QUESTIONS?



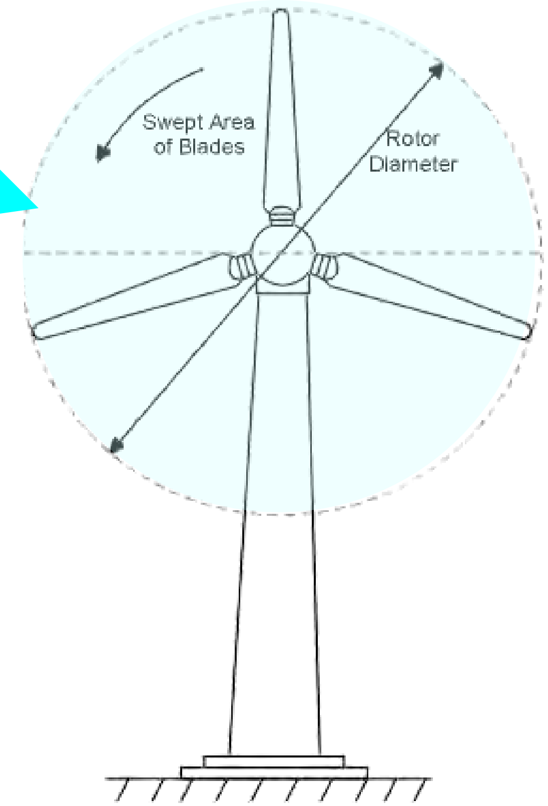
Turbine Power Basics

Power in the Wind = ½ρAV³

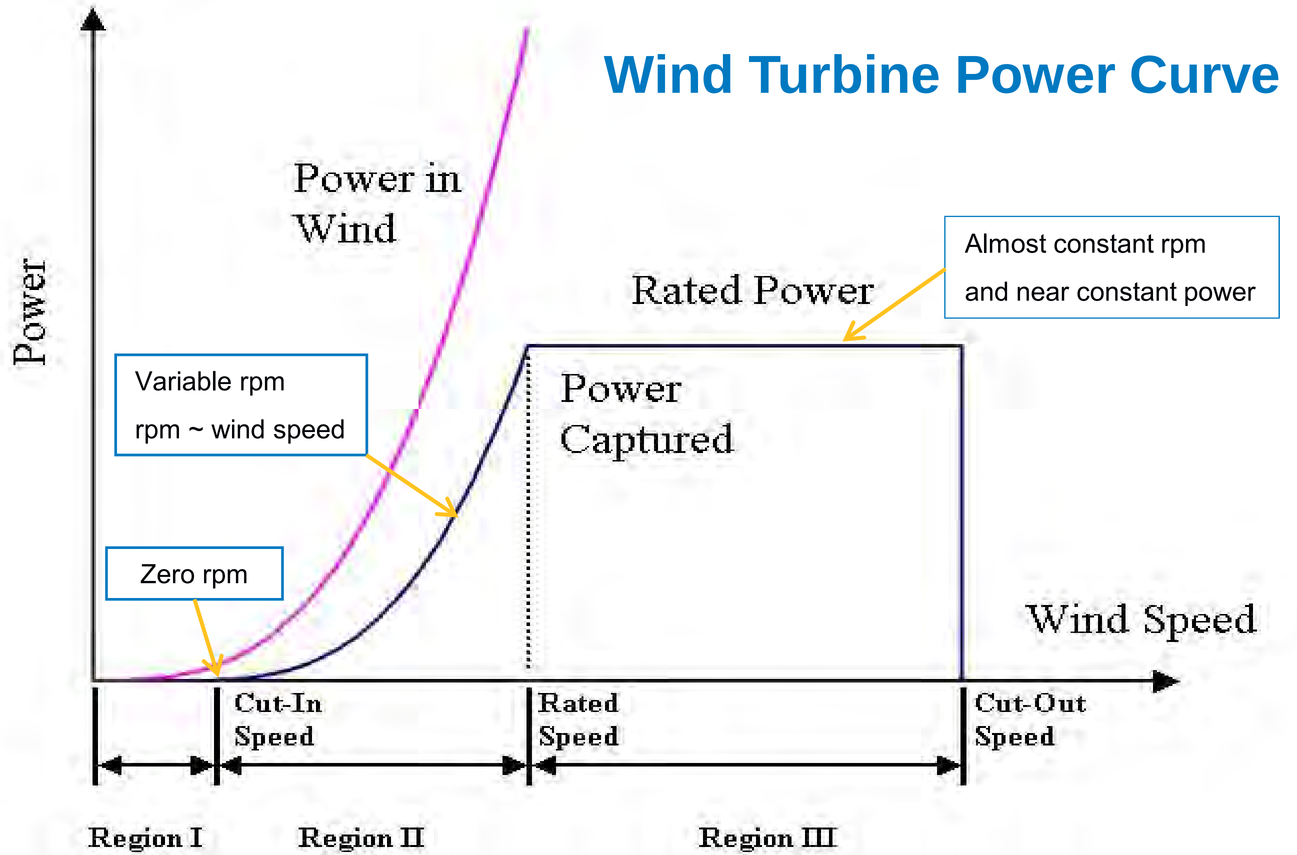
A - Area of the circle swept by the rotor

ρ = Air density

V = Wind Velocity



Wind Turbine Power Curve



NWCC

Formed in 1994, founding members included NREL and DOE, the American Wind Energy Association, National Audubon Society, Electric Power Research Institute, and Union of Concerned Scientists. Membership currently exceeds 1,500 people.

Major features of the NWCC include:

- Multistakeholder
- Facilitated; ground rules for engagement
- Coordinated field research
- Information dissemination (e.g., website; coordination of report preparation and publication; presentations at meetings)
- Biennial Research Meeting (X in December 2014)

Recent research activities were initiated under the Grassland Shrub Steppe Species Collaborative, and include:

- Grassland Community Collaborative (Prairie-Chicken research)
- Sage Grouse Collaborative (Sage Grouse research)

http://www.nationalwind.org/

BWEC

Formed in 2004, founding members included the American Wind Energy Association, Bat Conservation International, USFWS, and NREL, with DOE and the U.S. Geological Survey later. Major features of the BWEC include:

- Objective, science-based
- International expertise tapped
- Organizational structure includes an oversight committee, technical committee, and science committee
- Coordination of field research (e.g., operational curtailment, acoustic deterrent, other)
- Information dissemination (e.g., website; coordination of report preparation and publication; presentations at meetings)
- Frequent science meeting.

http://www.batsandwind.org/

Source: Arnett, et al. 2008. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities

AWWI

Formed in 2008, board members consist of 50% industry and 50% NGOs.

Primary activities include:

- Research
- Data repository

Wind-Wildlife Research Information System

- Landscape tools

Landscape Assessment Tool

- Mitigation strategies for eagle take

Through the use of expert elicitation, AWWI has facilitated the development of two models to predict numerical effects of compensatory mitigation on golden eagle survival and reproduction through: lead abatement and vehicle collision reduction strategies.

- Education

http://www.awwi.org/

Golden Eagle with a transmitter on its back.
Photo by Randy Flament, NREL 23585

Candidate Avian Risk Metrics

Hypothesis: "Mortality risk increases with flight time in the rotor zone (yellow zone), if the turbine is operating"

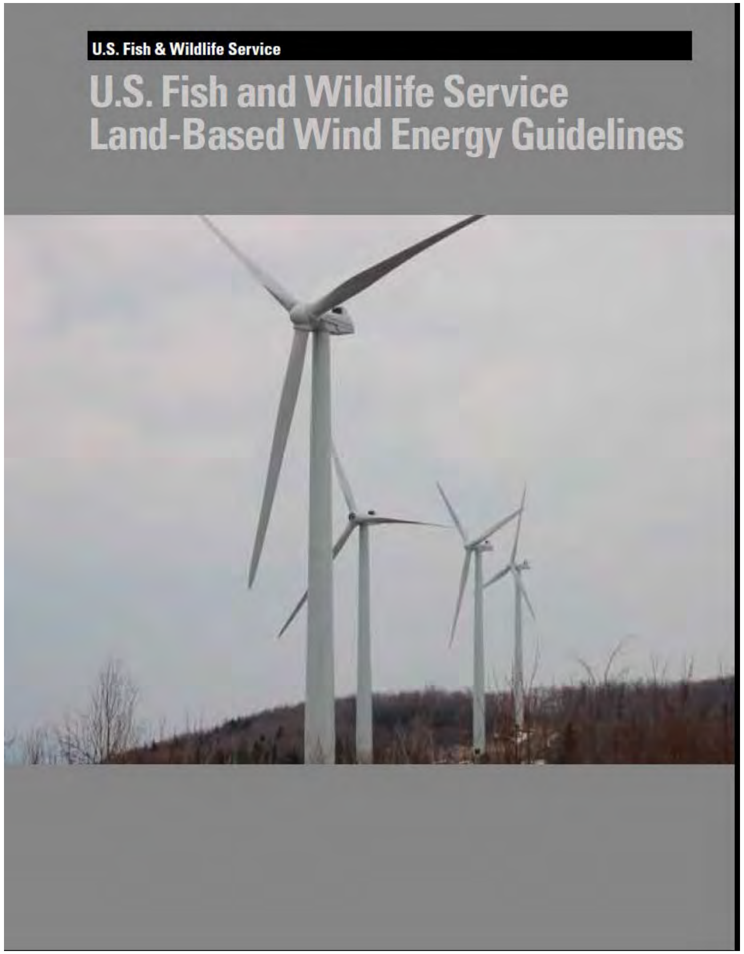
A Candidate Preconstruction Relative Risk Metric:

Species Relative Risk = (Flight Hours in Rotor Zone with Wind in Operating Range)/(Plant Swept Area x Hours with Wind in Operating Range)

A Candidate Postconstruction Fatality Metric:

Species Risk = Fatalities/(Swept Area x Turbine Operation Hours)

The USFWS Land-based Wind Energy Guidelines



Released March 2012

Provide a Tiered Approach, including:

- Tier 1 – Preliminary site evaluation (landscape-scale screening of possible project sites)
- Tier 2 – Site characterization (broad characterization of one or more potential project sites)
- Tier 3 – Field studies to document site wildlife and habitat and predict project impacts
- Tier 4 – Postconstruction studies to estimate impacts
- Tier 5 – Other postconstruction studies and research.

USFWS Guidelines: Developer and Service Roles

TIER	*Project Developer/Operator Role*	*Service Role*
Tier 1: Preliminary site evaluation	• Landscape level assessment of habitat for species of concern • Request data sources for existing information and literature	• Provide lists of data sources and references, if requested
Tier 2: Site characterization	• Assess potential presence of species of concern, including species of habitat fragmentation concern, likely to be on site • Assess potential presence of plant communities present on site that may provide habitat for species of concern • Assess potential presence of critical congregation areas for species of concern • One or more reconnaissance level site visit by biologist • Communicate results of site visits and other assessments with the Service • Provide general information about the size and location of the project to the Service	• Provide species lists, for species of concern, including species of habitat fragmentation concern, for general area, if available • Provide information regarding plant communities of concern, if available • Respond to information provided about findings of biologist from site visit • Identify initial concerns about site(s) based on available information • Inform lead federal agencies of communications with wind project developers
Tier 3: Field studies and impact prediction	• Discuss extent and design of field studies to conduct with the Service • Conduct biological studies • Communicate results of all studies to Service field office in a timely manner • Evaluate risk to species of concern from project construction and operation • Identify ways to mitigate potential direct and indirect impacts of building and operating the project	• Respond to requests to discuss field studies • Advise project proponent about studies to conduct and methods for conducting them • Communicate with project proponent(s) about results of field studies and risk assessments • Communicate with project proponents(s) ways to mitigate potential impacts of building and operating the project • Inform lead federal agencies of communications with wind project developers
Tier 4: Post construction studies to estimate impacts	• Discuss extent and design of post-construction studies to conduct with the Service • Conduct post-construction studies to assess fatalities and habitat-related impacts • Communicate results of all studies to Service field office in a timely manner • If necessary, discuss potential mitigation strategies with Service • Maintain appropriate records of data collected from studies	• Advise project operator on study design, including duration of studies to collect adequate information • Communicate with project operator about results of studies • Advise project operator of potential mitigation strategies, when appropriate

USFWS Eagle Conservation Plan Guidance (April 2013)

- To facilitate issuance of programmatic eagle take permits for wind energy facilities the USFWS finalized the Eagle Conservation Plan Guidance- Module 1- Land-based Wind Energy Version 2
- This Guidance provides a framework for developing and evaluating Advanced Conservation Practices, which is the framework for detect and deter technologies

Photo by T. Katzner

Power and Size of Turbines Over Time

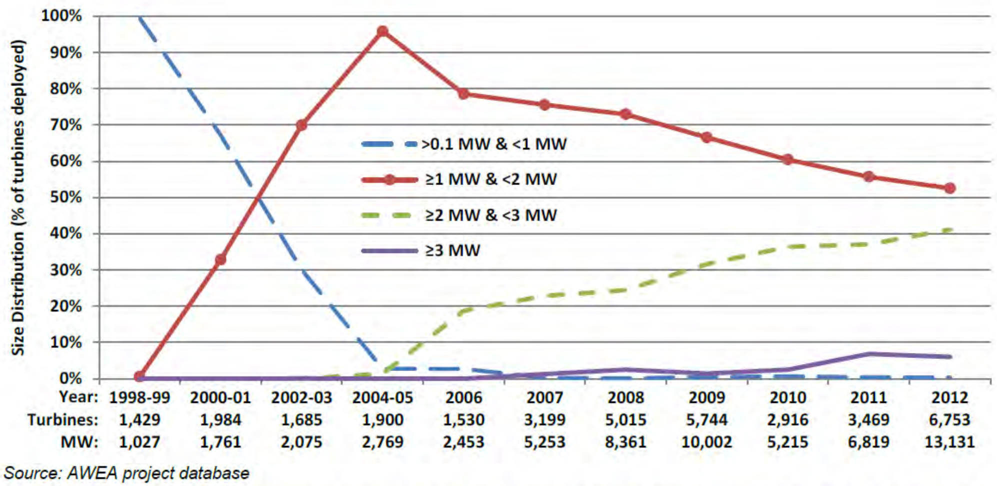
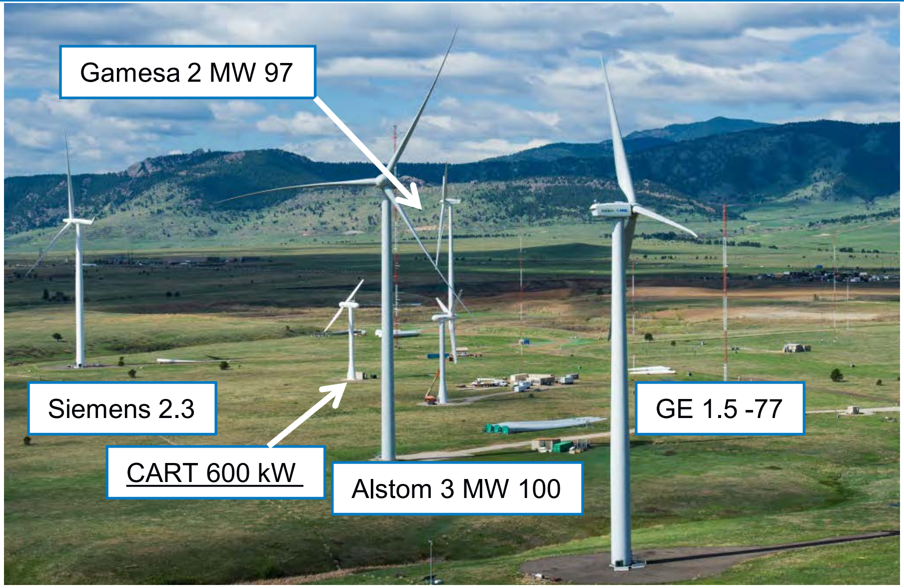


Figure 16. Size Distribution of Number of Turbines (>100 kW) Deployed in Each Period

Source: 2012 Wind Technologies Market Report

Representative Wind Turbine Specifications



National Wind Technology Center – NREL Pic 25898


Danish National Wind Test Center – Photo by R. Thresher

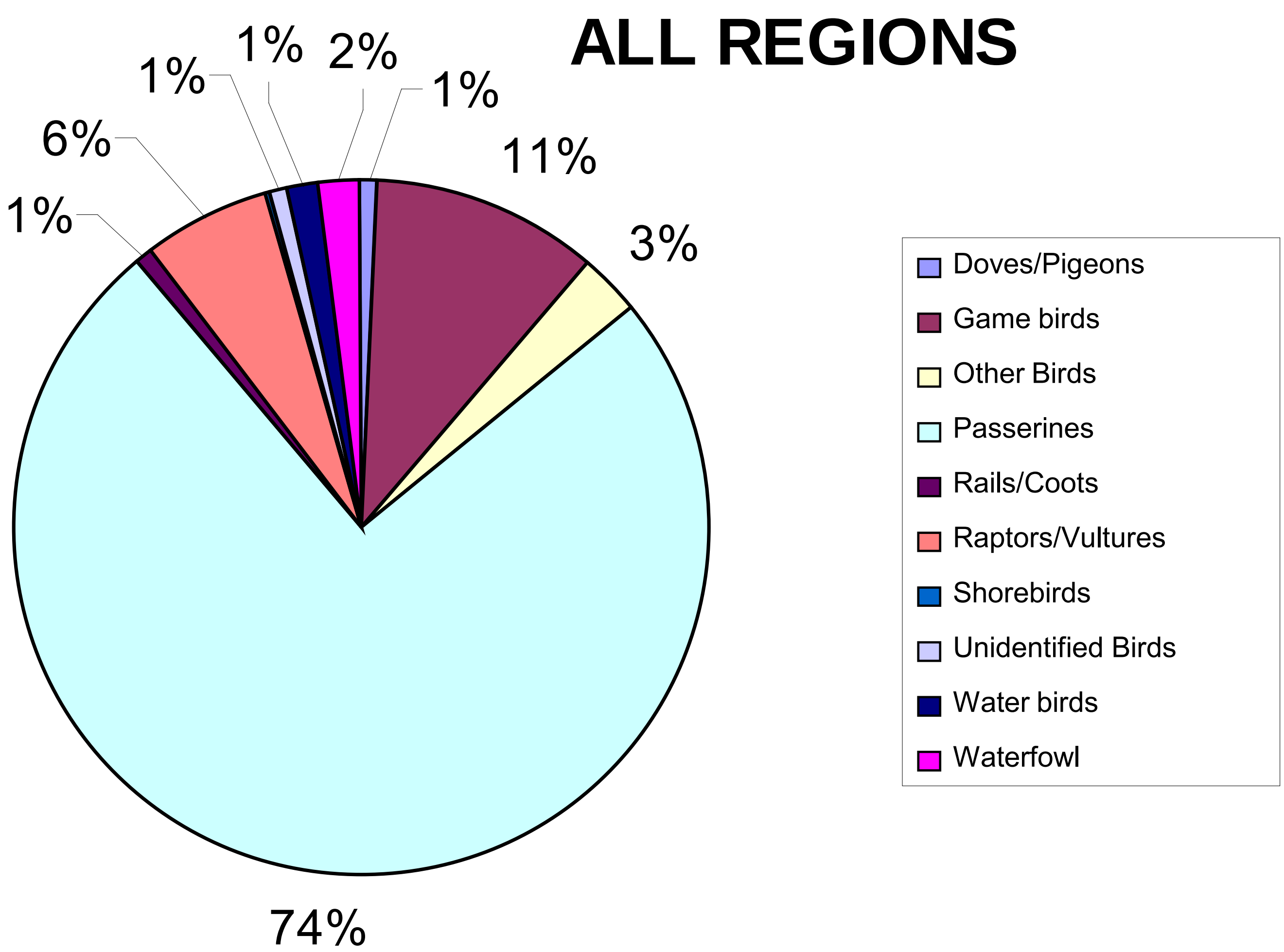
Turbine	Power MW	Rotor Size m	Rotor Area m^2	Rotor Speed rpm	Tower Height m	Cut in Wind Speed m/s
GE 1.5 se	1.5	70.5	3904	12-22.4	54.7 – 64.7	4
GE 1.5 sl	1.5	77	4657	11-20.4	61.4 - 100	3.5
GE 1.5 sle	1.5	77	4657	11-20.4	61.4 - 100	3.5
GE 1.5 xle	1.5	82.5	5346	10.1-18.7	58.7 - 100	3.5
GE 1.6 or 1.7	1.6 – 1.7	100	7854	?	80 -96	?
GE 2.5 100	2.5	103	8333	?	75-100	3
GE 3.2 103	3.2	103	8333	?	70-98	?
Siemens SWT 2.3	2.3	100	7854	6-16	80 or Site specific	3-4
Siemens Offshore SWT 6.0 154	6	154	18,600	5-11	Site Specific	3-5

U.S. Department of Energy Wind Program's Mission

- Reduce challenges to project development to accelerate deployment of appropriate wind energy
- Support achievement of 20% wind energy by 2030
- Accelerate wind energy capacity growth/ development of domestic energy options (Energy Policy Act of 2005).

Northwind 100, 100-kW wind turbine; Hempstead, New York.
Photo by Town of Hempstead, NREL 28963

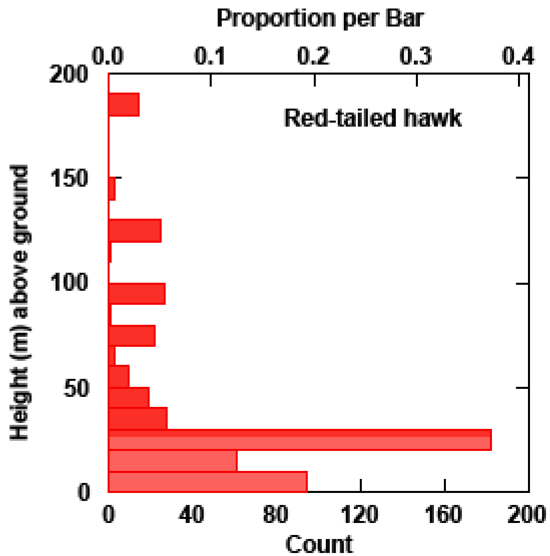
Research: Species Composition of Bird Fatalities



Proportion of fatalities at sites reporting fatalities by species, for all regions where studies have been conducted (the Pacific Northwest, Midwest, Rocky Mountains, and East).
Source: Strickland and Morrison, February 26, 2008.
http://www.fws.gov/habitatconservation/windpower/Past_Meeting_Presentations/Morrison_Strickland.pdf

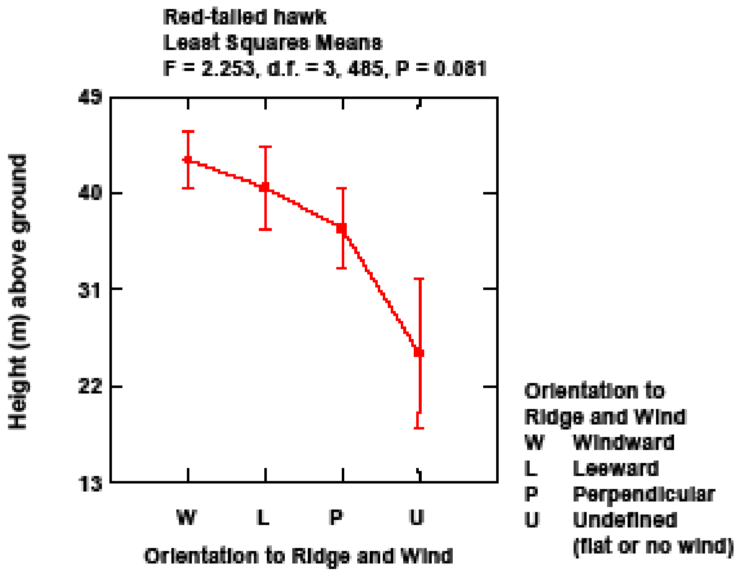
Red-Tailed Hawk Flight Observations in Altamont Pass

Height Histogram



Distribution of flight heights above ground level amount red-tailed hawks observed during behavioral observation sessions during 2003 and 2004 in the Altamont Pass Wind Resource Area.

Height versus Orientation



Mean flight heights of red-tailed hawk over aspect of ridge relative to oncoming winds.

Source: K. Smallwood and L. Neher, CEC-500-2005-005, December 2004

Highlights of One Interaction Study in Altamont Pass

Raptor Fatalities and Sightings

	Fatalities	Sightings	Rel. Risk F/S
Burrowing Owl	38	56	0.68
American Kestrel	22	429	0.05
Red-Tailed Hawk	100	1,780	0.06
Golden Eagle	10	401	0.02
Northern Harrier	2	114	0.02
Prairie Falcon	1	63	0.02
Turkey Vulture	0	756	0
Common Raven	0	792	0

From: *Bird Risk Behaviors and Fatalities at the Altamont Pass WRA*, Carl G. Thelander, et al

Sage Grouse Research

These are preliminary results and are not for distribution or citation.

Annual Report

A Study of the Impacts of a Wind Energy Development on Female Greater Sage-Grouse in Southeastern Wyoming

January 27, 2014

Presented to:
National Wind Coordinating Collaborative Sage-Grouse Research Collaborative Oversight Committee

Internal Document – Not for Distribution

Ecology of Male Greater Sage-Grouse in Relation to Wind Energy in Wyoming

Research Team: Power Company of Wyoming and University of Missouri

Sage Grouse. *NREL 20649*

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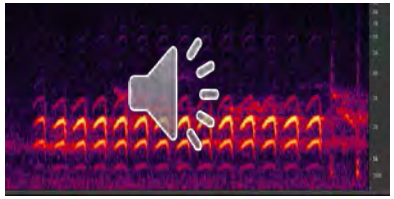
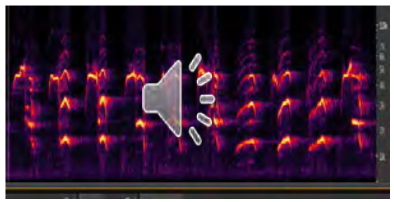
Properties of the Vocal System Provide Clues about Properties of the Auditory System

White breasted nuthatch



Golden eagle copulation call



Golden eagle skonk call

Bald eagle chatter call

Examples of amplitude modulation and frequency spectrums

Source: As presented by Jeff Lucas, Purdue University at Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop, December 2015

Breakout Session 1 (Day 1)

Stakeholder Concerns, Additional Relevant Data Sources, and Additional Research underway

Breakout Group 1

Other things CWG should undertake?

- Greater stakeholder involvement
  - CWG & ASWG
  - FACA?
  - Use industry as a resource
  - Review of the Science Plan
- Outline next steps beyond the Science Plan
  - Implementation

New Information

- New solar project in Pahrump, NV
  - Panel spacing may diffuse the lake effect
- Widen the scope beyond AZ, CA, and NV
- USGS-FWS OFR on standardized monitoring

Group 2 (Day 2)

What other tasks should the CWG Undertake (1 of 2)

- Focusing on the science is the correct approach. Monitoring should be informed by research. Don't monitor for sake of monitoring. Interrelationship between monitoring and research.
- Consider costs when determining monitoring requirements (Danielle, Jeremiah)
- Monitoring should be designed to answer specific questions.
- Monitoring Guidelines due out in June. Will be publically available. Different from the CWG Science Plan.
- Monitoring procedures are a research question.
- Determine level of overall mortality
- Look at causation.
- Get data to focus the research
- Science plan should have priorities as a product
- What is the low hanging fruit?
- Leverage information and existing data

What other tasks should the CWG Undertake (1 of 2)

- Site specific monitoring vs understanding where projects should go
- What are we siting for? Any specific species? (Songbirds, migratory birds, etc.) E.g. wind now focuses on bats and raptors.
- Good model is San Juaquin Valley Least Conflict Plan (goes beyond science)
- What features in the landscape influence avian presence and behavior
- Keep in mind Technology specific effects
- Keep visibility on ongoing research efforts, common database? AWWI web site has extensive list of studies. When should studies be released?
- General research studies vs project data. CEC posts project data after review.
- Lots of folks want data/information, but many studies are still underway
- CWG and ASWG access to raw data? What questions can be answered?

Any ongoing or planned research or data collection efforts that are relevant to developing the science plan

- ASWG Research Panel looking at rough methodologies to answer ASWG questions
- ASWG Research Panel asked to sequence the research

Breakout Group 3

Stakeholder Concerns, Additional Relevant Data Sources, and Additional Research underway

Group 3

- Dan Boff, DOE
- Kirk LaGory
- Amy Fesnock,
- Bill Werner
- Katie Umekubo
- Chuck Griffin
- Juliette Falkner
- Karyn Coppinger
- Brian Boroski, H.T. Harvey
- Matt Hutchinson

Other things CWG should undertake?

- Need to specify focus on causation of mortality
- Look at sublethal effects (e.g., decreased reproduction, carrying capacity, etc.)
- Scope should go beyond regulatory requirements

Data and models

- Use of existing monitoring data: What does it tell us? What would we do differently?
- Making data available to the public. Data quality issues.
- Need to develop a toolkit

Relevant studies

- Genetic studies to examine population of origin
- Golden eagle research related to populations
- Look at rare and common species to provide bookends
- Condor Issue (vol 118): several papers population concerns related to renewable energy issues
- Draft article submitted to JWM, modeling estimates related to searcher efficiencies for rare species
- Draft paper looking at direct and indirect effects for solar, wind, and transmission

Conceptual Understanding of Avian-Solar Interactions

Lee Walston

Argonne National Laboratory

May 10-11, 2016

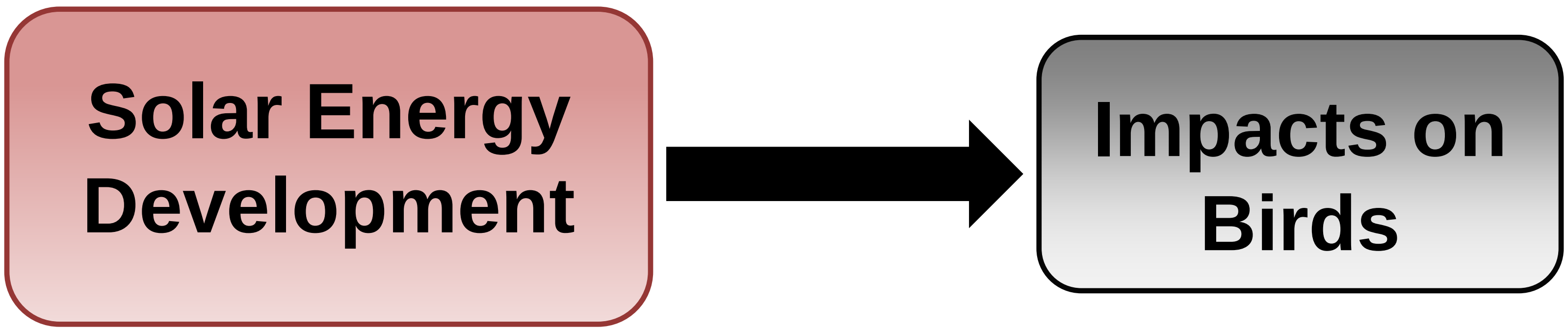
Sacramento, California

Why Develop a Conceptual Model?

- Illustrate important processes
  - Direct & indirect effects
  - Interactions and cumulative effects
- Synthesize current understanding of avian-solar interactions
  - Foster a common understanding
- Identify information gaps and research priorities
- Starting point for the avian-solar science plan

Avian-Solar Conceptual Model

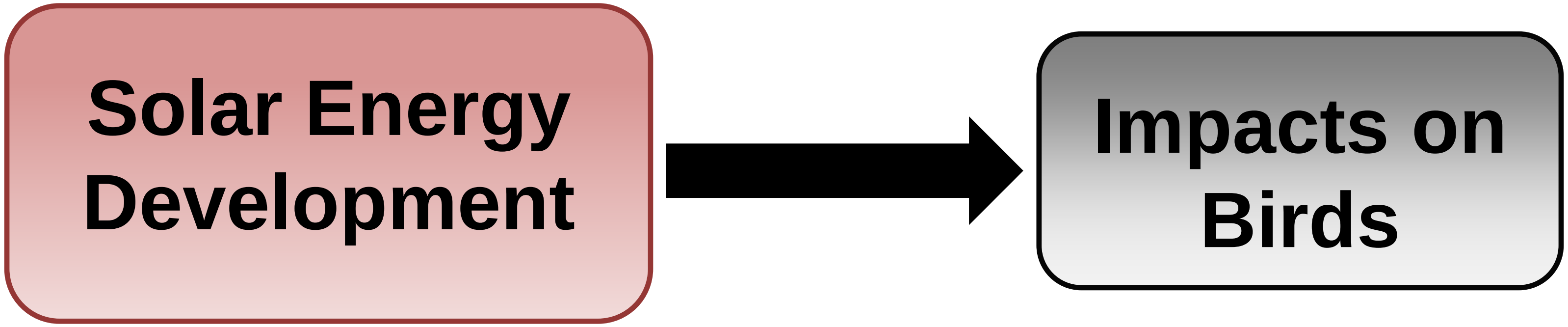
- Simple vs. Complex



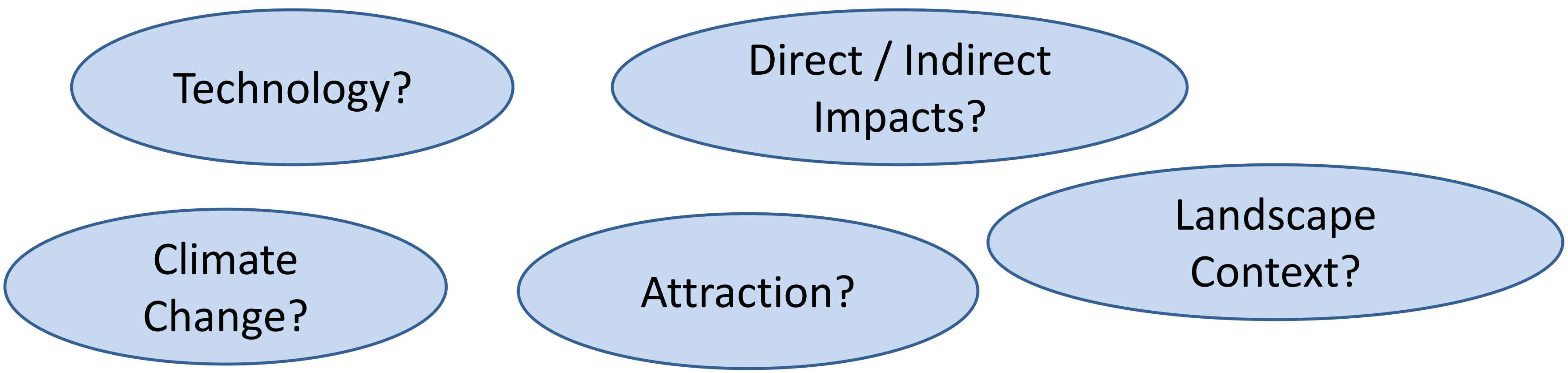
- Two main focal points

Avian-Solar Conceptual Model

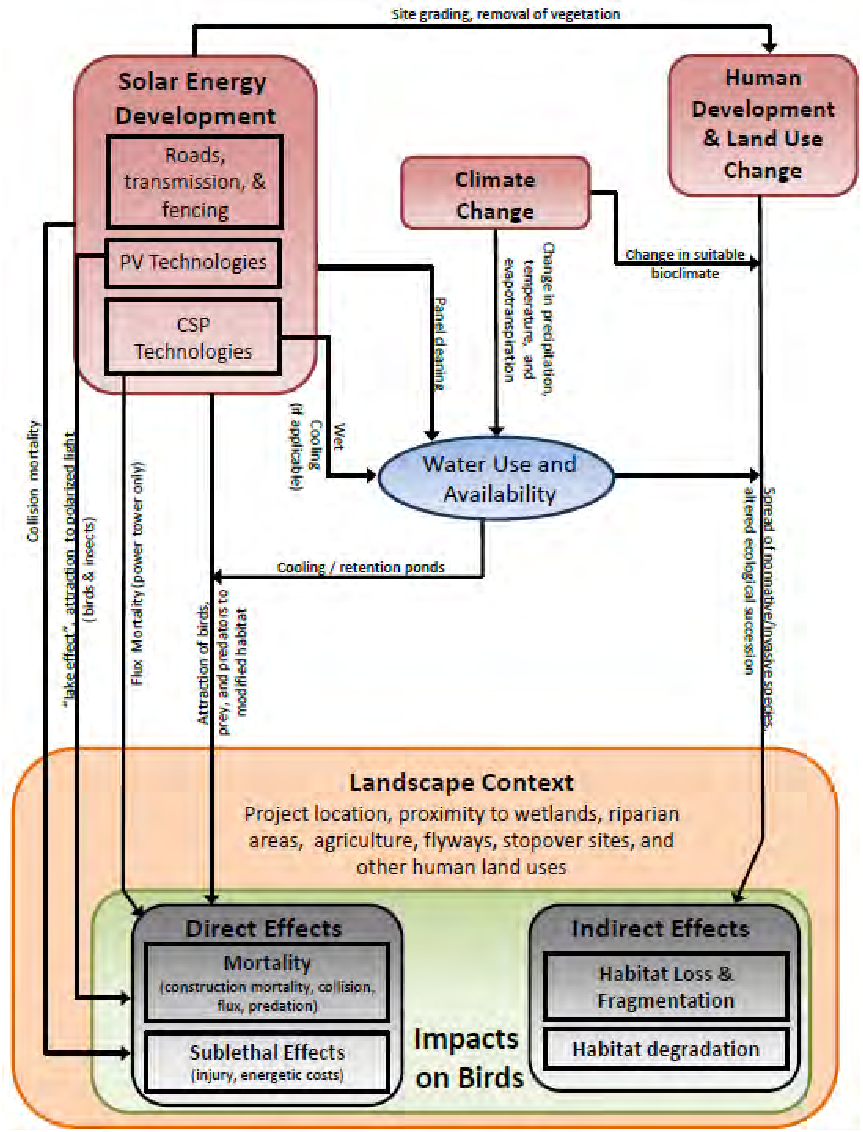
- Simple vs. Complex



- Impacting factors, pathways, and interactions



Avian-Solar Conceptual Model



Avian-Solar Conceptual Model

Climate Change

Human Development & Land Use Change

Solar Energy Development

Roads, transmission, & fencing

PV Technologies

CSP Technologies

Indirect Effects

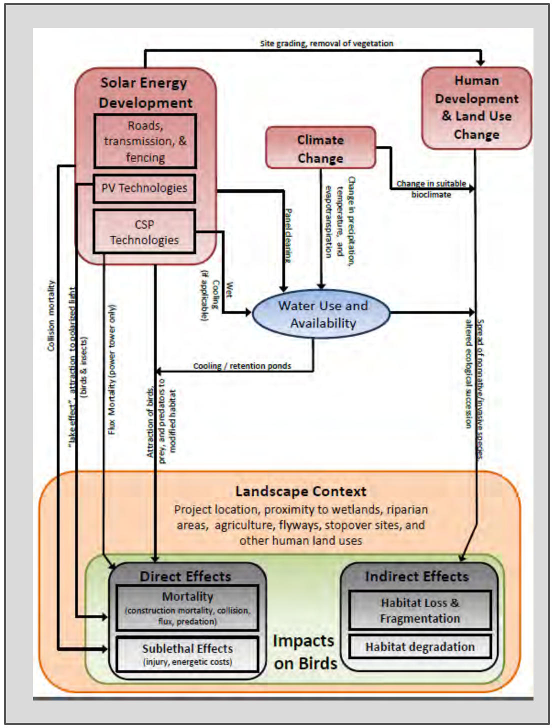
- Habitat loss & fragmentation
- Habitat degradation

Change in suitable climate

Habitat loss

Spread of nonnative / invasive species

Altered ecological succession



Avian-Solar Conceptual Model

Climate Change

Human Development & Land Use Change

Solar Energy Development
- Roads, transmission, & fencing
- PV Technologies
- CSP Technologies

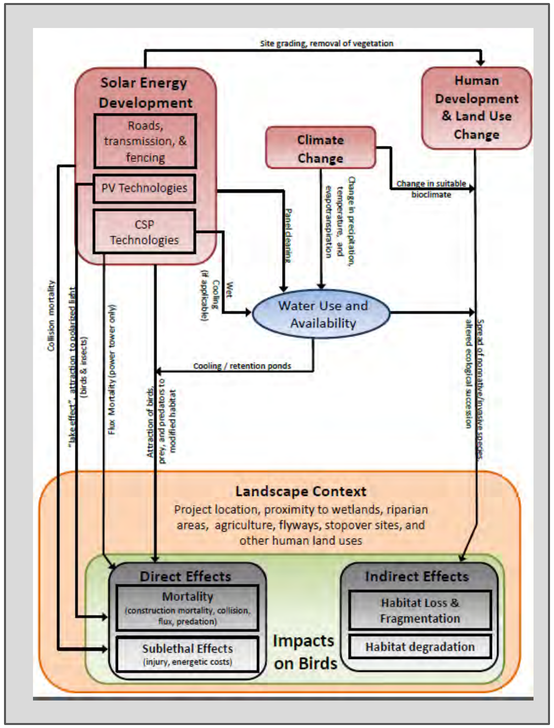
Direct Effects

- Mortality
- Sublethal Effects

Construction mortality, collision, flux, predation

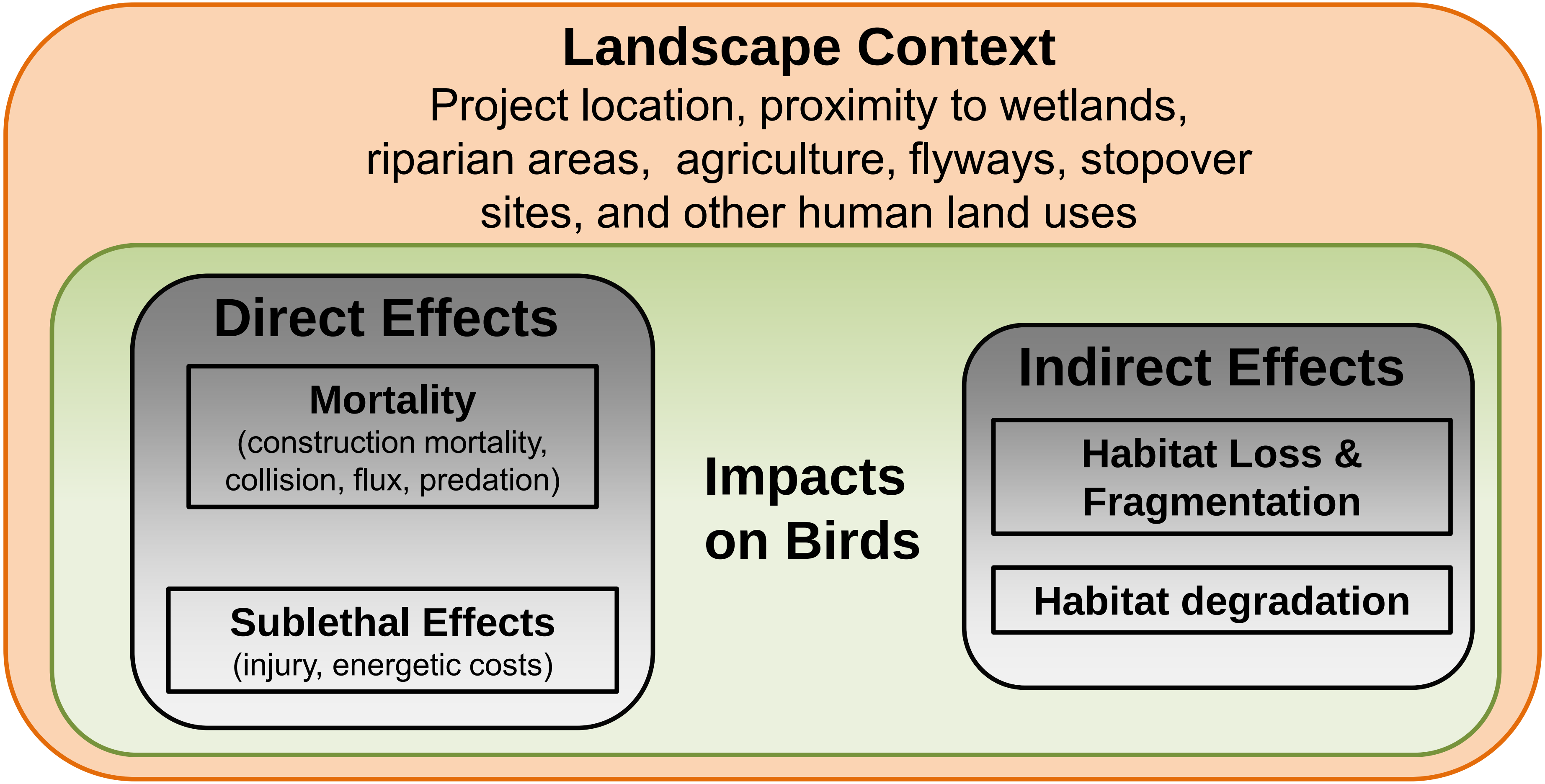
Attraction of birds, prey, and predators

Technological considerations & project design (e.g., water)



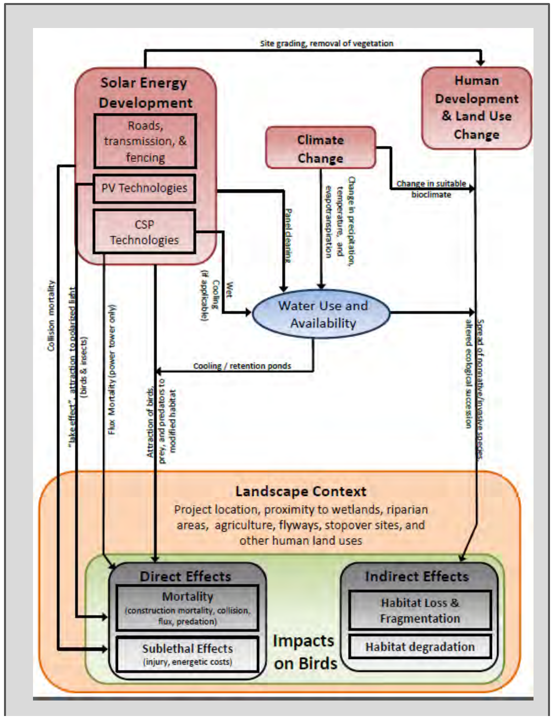
Avian-Solar Conceptual Model

- Location matters



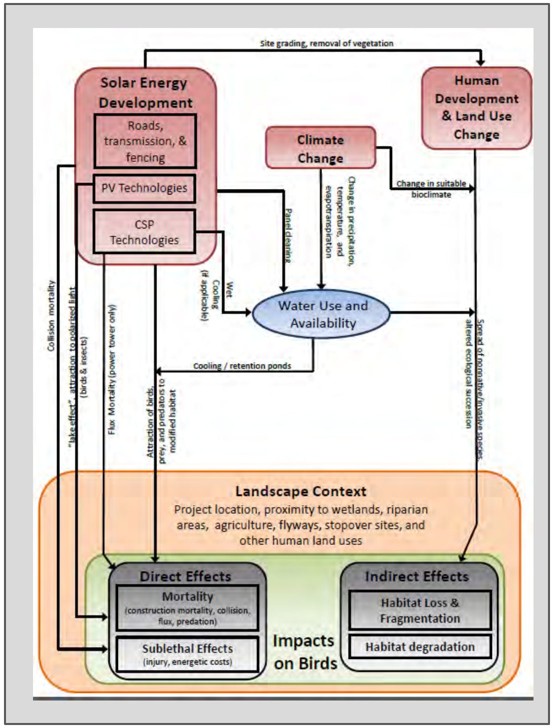
Avian-Solar Conceptual Model

- Focus on processes and interactions the CWG may be most concerned about
- Supporting text to be provided in the science plan
- The diagram illustrates *potential* impacts that could occur
  - Projects sited on previously disturbed lands may have less impact
  - Projects with minimal water requirements (and no ponds) may have less impact



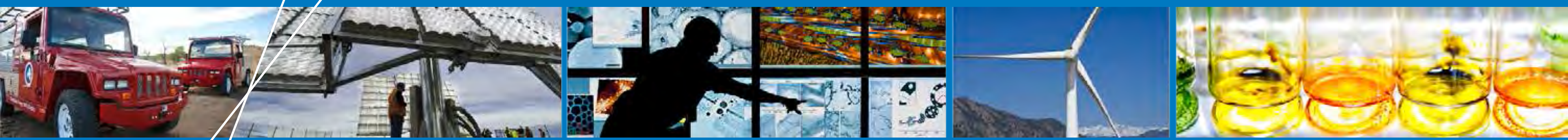
Avian-Solar Conceptual Model

- To inform selection and prioritization of the CWG management questions
  - Are any processes more important for agency decision making?
  - What are the information gaps?
  - Which information gaps should be addressed first?
- Future versions of the model may illustrate important information gaps and CWG priorities
  - Color / thickness of the arrows
  - Additional annotation



Questions?

Agency Management Questions and Related Research Needs



Tony Jimenez

May 11, 2016

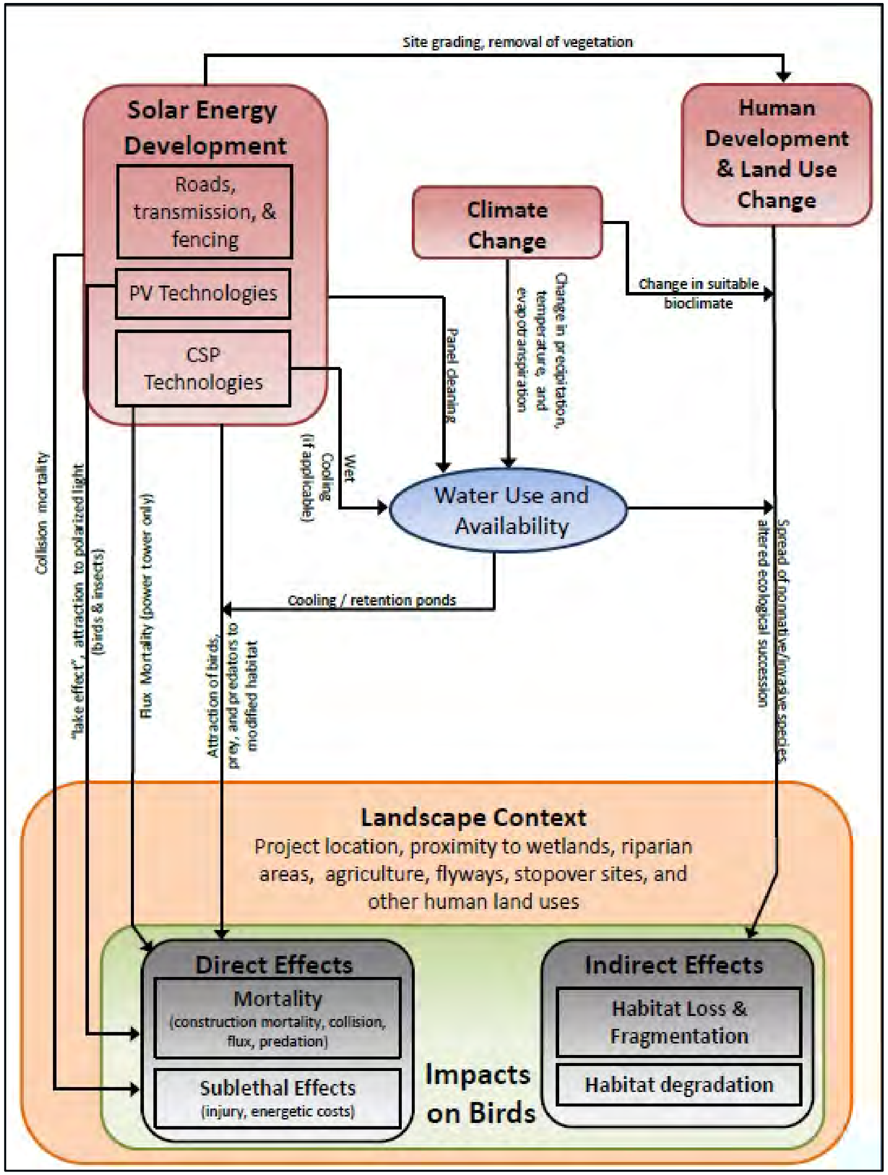
NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Outline

- Avian-Solar Interaction Model
- "Management Question" Defined
- Sample Questions
- Management Question Categories
- Generalized Management Questions
- Research Prioritization
- Discussion


Red-tailed hawk eating a rabbit.
Photo by Dennis Schroeder, NREL 22325

Avian Solar Conceptual Framework



Management Questions Background

- Define what information the agencies need
- Define research needs
- Tied to the conceptual model
- Due to differing missions, different agencies may have different questions
- Received 108 questions
- Questions grouped into seven (7) categories
- Questions consolidated into 14 “generalized questions”

Sampling of Management Questions

- What are the most scientifically rigorous and cost-effective population monitoring tools available for: 1) quickly identifying potential impacts to populations, and 2) determining effectiveness of mitigation strategies at local and regional scales?
- Is higher mortality realized during any particular time of year?
- Are birds being attracted to the site to forage on insects killed by the concentrated solar flux?

Management Questions Categories

1. Landscape Considerations
2. Methods to Evaluate Avian Risk and Impacts
3. Sources of Mortality and Injury
4. Avian Behavior (Attraction/Avoidance)
5. Impacts to Habitat and Other Wildlife That Might Affect Birds
6. Taxonomic and Guild-Specific Impacts
7. Minimization, Mitigation, and Adaptive Management

Generalized Management Questions

1. Landscape Considerations	What are the larger-scale avian movement patterns in the region (including seasonal movements and factors that influence avian movements such as the presence of stopover sites in the landscape)? What are the landscape-level cumulative impacts on regional bird populations or on bird populations migrating through landscapes targeted for solar development? What is the anticipated solar energy build-out for the foreseeable future? (e.g., project size, location, technology type)
2. Methods to Evaluate Avian Risk and Impacts	What are the best methods for monitoring and evaluating avian mortality, specific to each type of solar energy technology? What are the best methods for identifying the bird species that would be most vulnerable during all phases of solar development (pre-construction, construction, and post-construction)?
3. Sources of Mortality and Injury	What are the sources of avian mortality and injury at solar facilities (i.e., project features), and what factors (e.g., location, habitat characteristics, time of year, species) affect frequency of those mortalities and injuries?

Generalized Management Questions

4. Avian Behavior (Attraction / Avoidance)	How do solar facilities affect landscape level movements of birds (i.e., migration and dispersal movements), and what factors (e.g., location, habitat characteristics, time of year, species) affect these movements? How do solar facilities affect local-scale movements/behaviors of birds (i.e., foraging and breeding behaviors), and what factors affect these behaviors?
5. Impacts to Habitat and Other Wildlife That Might Affect Birds	What are the impacts of solar development to other wildlife (such as predators or prey) and habitat that might affect birds?

Generalized Management Questions

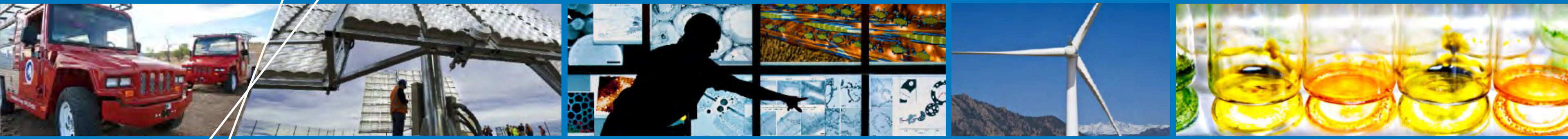
6. Taxonomic and Guild-Specific Impacts	How do solar developments affect different bird taxa or guilds? What are the population effects from solar developments to individual bird species, particularly those of conservation concern? Which population or species-specific impacts are of greatest conservation concern?
7. Minimization, Mitigation, and Adaptive Management	What are the most effective minimization and mitigation methods to reduce or eliminate avian mortality? (e.g., project siting, technology engineering and project design to reduce attractiveness of facilities to birds, construction timing, operational parameters, deterrents, or offset) What off-site mitigation is most effective for off-setting mortalities for affected populations/species?

Research Prioritization

Based upon initial input from CWG members

- **Management:** Questions that are important for informing management decisions (management questions vs. research questions)
- **Timeliness:** Questions that can be answered in 3-5 years
- **Overlap:** Questions shared by multiple agencies

QUESTIONS / DISCUSSION



Day 2 Breakout Group Discussions

Group #1

Conceptual Framework

- Add stranding as another form of mortality
- Add dust suppression as water use

Management Questions (General)

- Research questions cannot be fully addressed through monitoring; require research/study design
- Not all questions can be answered with existing data
- Focus on natural history of taxa most likely to interact with solar facilities (e.g., insectivores).

#1 Landscape Considerations

- Scope concerns with the amount of foreseeable development question.
- Meta-analysis of existing data could address landscape considerations
  - ebird
  - Breeding bird survey

#2 Monitoring Methods

- Consider changes to pre-construction baseline surveys for taxa most likely to be affected ("better" baseline monitoring data)
  - Different seasons
  - Species-specific protocols
  - What taxa are most likely to interact with solar facilities?

#3 Source of Mortality and Injury

- It is possible ("maybe") for existing data and monitoring protocols to help inform sources of mortality and causation.

#4 Behavior

- Existing data/studies that could be used to understand avian behavior:
  - Pre-construction radar study for at least one solar project
  - Raptor telemetry data

#5 Impacts to habitat and other wildlife

- Could use predictive information on ravens, raptors, and desert tortoise.

#6 Population-level effects

- Monitoring data could help address how solar impacts different taxa differently.

#7 Mitigation

- Look at deterrents used in other industries (wind, aviation)
- Connect new approaches to systematic monitoring designs

Climate Change

- Could also be used to determine species of concern.

Criteria

- Budget & duration
- Would the answer to the question affect decisions?

Group 2 (Day 2)

Any Important elements missing or misrepresented in the conceptual framework?

- These were mostly captured in the discussion after Lee’s presentation
- All birds lumped as one. Consider differential impacts to different guilds/species
- Take into account potential benefits and risks? Or relabel “Potential Negative Impacts” which acknowledges that there may be potential benefits.

Can any of the management questions be addressed with existing information/data? What questions would require additional field work?

- Do we have a good understanding of current monitoring protocols? Protocols evolve based on past experience.
- Look at monitoring approaches for uniformity.
- What are the sources of mortality? (Partial).
- How do impacts of development affect different guilds/taxonomies (Partial)
- Most of the questions will need research.
- Some/many effects appear to be location specific. Depend upon landscape and terrain features.
- Use existing data to develop hypothesis and inform the next iteration of research

Additional critical research needs that weren't identified

- Preconstruction monitoring (as research) to establish baseline mortality for areas that will see lots of development.
- How do we gather baseline mortality data? How funded?
- What before/after data already exists?
- Effect of emerging/future/sunsetting technologies? E.g. types of panels, antireflective coatings. tracking/fixed tilt.

What criteria should be considered by the agencies in establishing priorities for future research? Can you rank in terms of importance for guiding future research (e.g. allocation of funds)?

- Prioritize questions that can be answered sooner?
- Cost/difficulty
- Avoid duplication
- Foundationality
- Fills an important gap
- Should different agencies focus on different questions?
- What are the priorities of the individual agencies?
- Scope and applicability
- Unique to solar
- Solicit public comment on criteria & research needs

Other

- No definitive focus yet (as to priorities)
- Need to do background comparisons
- How do we ensure these agreed-upon priorities are carried out by the member agencies (implementation)

Breakout Session 3

Conceptual Framework, Management Questions, Research Needs and Priorities

Group 3

- Dan Boff, DOE
- Kirk LaGory
- Amy Fesnock,
- Bill Werner
- Katie Umekubo
- Chuck Griffin
- Juliette Falkner
- Karyn Coppinger
- Brian Borowski, H.T. Harvey
- Matt Hutchinson

Conceptual Framework

- Suggestions included
  - Place solar impact box within human development to show proper context
  - Solar should show as positive effect on climate change
  - Add season and weather as influencing factors
  - Present as hypothesis driven
  - Include avian behavior as factor
  - Define indirect
  - Factors are not comprehensive list. Add “e.g.,”
  - Water availability and use should be placed within solar box
  - Need to include potential benefits (e.g., use more neutral language regarding change rather than just degradation)

Management Questions

- Many questions have landscape context but not included in landscape bin
- Data are available on solar development projections, but may not have specific information on where these would go
- Monitoring data available on limited questions regarding mortality

Research Needs and Priorities

- What are the fundamental data needs to answer questions?
- Focus on basic processes:
  - Why are birds at site?
  - What are they exposed to?
  - What results in fatality?
- What is net effect on birds

Breakout 4 –

- *Landscape Framework comments*
  - *Broader context would be good beyond just solar.*
  - *Also, put INTO context to ensure it isn't misinterpreted when seen as a standalone document.*
  - *Should be entitled "pathway for potential impacts";*
  - *Suggest that at the core, it begins with the concepts lifecycle/life history perspective*

Breakout 4

- *Management questions comments*
  - *'landscape considerations' is not a management question but rather required background for solving other management questions.*
    - *Importance of background mortality*
  - *Level of pre-construction needed*
    - *BACI versus geospatial*
    - *Understand first what agency's want to see*
  - *Different ways to determine which guilds/species to study, e.g.*
    - *disproportional impacts, water birds, subset example of all guilds, other?*

Breakout 4

- ASWG compared to CWG questions
  - Feather spots…include clearly in CWG
  - *climate change futures with landscape considerations management question*
  - *Standardization - what attributes are needed to determine best methods?*
- *Criteria Ranking*
  - *#1 Fundamental need – recommend adding this*
  - *#2 Management*
  - *#3 Overlap*
  - *#4 Timeliness*

Multiagency Avian-Solar Collaborative Working Group: Stakeholder Workshop

Next Steps

May 10-11, 2016

Sacramento, California

Stakeholder Input Wanted

- All handouts and presentations will be available on the CWG webpage: http://blmsolar.anl.gov/program/avian-solar/
- Stakeholders can comment during this meeting and/or in writing following the workshop by **June 1, 2016**
- Agencies are seeking input from stakeholders on all matters relevant to the CWG objectives:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG
  - Level and mode of future stakeholder engagement

Draft Avian-Solar Science Plan

- Revise draft elements incorporating stakeholder comments
  - Summary of available data
  - Conceptual framework
  - Management questions
- Develop additional elements
  - Prioritization of management questions
  - Implementation plan
  - Comparative cost data
- Draft plan released for stakeholder review mid summer

Future Stakeholder Engagement

- A stakeholder webinar will be hosted to present and take comments on the draft avian-solar science plan (late summer 2016)

- For more information:
  - Subscribe for email updates: send request to rollins@anl.gov
  - CWG webpage: http://blmsolar.anl.gov/program/avian-solar/

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RESEARCH ARTICLE

Defining population structure for the Mojave desert tortoise

Bridgette E. Hagerty · C. Richard Tracy

Received: 19 August 2009 / Accepted: 20 February 2010 / Published online: 6 April 2010

Abstract We used highly variable microsatellite markers to identify population structure, movement, and biological boundaries for populations of the desert tortoise, *Gopherus agassizii*, in the Mojave and Colorado Deserts of the southwestern United States. The Mojave desert tortoise (listed as "threatened" by the U.S. Fish and Wildlife Service) has a large geographic range, long generation time, low population densities, and little above-ground activity. Additionally, the dispersal patterns of individual tortoises are virtually unknown, making indirect methods to assess movement among populations valuable. Using Bayesian assignment tests, we detected hierarchical structuring within the Mojave desert tortoise. Three basal groups were identified, and these corresponded to the mitochondrial DNA haplotypes reported in 1989. Additional population structure was evident within each basal unit, and this structure corresponds with major geographic barriers. Our analyses suggest that gene flow among populations was historically high because levels of population differentiation were low across the range. Geographic distance explained a large proportion of variation in genetic distance (68%), which pinpoints that dispersal is limited only on a regional scale. In light of these new analyses of the genetic population structure of the Mojave desert tortoise, we make new recommendations for the number and locations of recovery units for conservation of this species.

Keywords Desert tortoise · *Gopherus agassizii* · Population structure · Microsatellites · Mojave Desert · Conservation unit

Electronic supplementary material The online version of this article (doi:10.1007/s10592-010-0073-0) contains supplementary material, which is available to authorized users.

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Introduction

Important inferences about dispersal and gene flow among populations can be made from analyses of genetic population structure (Johnson and Gaines 1990; Bohonak 1999; Ross 2001), including inferences about contemporary and historical movements and assessments of the physical, ecological, and biological factors influencing those movements (Manel et al. 2003; Waples and Gaggiotti 2006; Storfer et al. 2007). Here, we characterize the genetic population structure of the Mojave desert tortoise (*Gopherus agassizii*) to infer patterns of gene flow and dispersal of individuals among populations.

The Mojave population of the desert tortoise, which is listed as threatened under the U.S. Endangered Species Act of 1973, is located north and west of the Colorado River and occurs in the Mojave and Colorado Deserts (U.S. Fish and Wildlife Service (USFWS) 1994). Ecosystems inhabited by the Mojave desert tortoise are heterogeneous in climate, geology, topography, and vegetation associations, and suitable habitats are relatively continuous from southwestern Utah to southwestern California (Rowlands et al. 1982; Germano et al. 1994; Berry et al. 2006). Pronounced population declines have been associated with several threats mainly attributed to increased human impacts due to urban development in the southwestern deserts (USFWS 1994; Lovich and Bainbridge 1999; Edwards et al. 2004; Tracy et al. 2004).

Desert tortoises, particularly hatchlings and juveniles, spend the majority of their time in retreats below ground (Nagy and Medica 1986; Morafka 1994; Hillard 1996; Wilson et al. 1999a, b; Tracy et al. 2004), making the study of population dynamics very difficult from field data alone. As long-lived reptiles (generation time is likely 25 years or more; USFWS 1994), which spend a majority of their life sequestered in burrows, desert tortoises are an ideal candidate to infer population processes from genetic data.

Our first objective was to characterize the population structure of the Mojave desert tortoise using highly variable genetic markers. Specifically, we inferred population structure in the Mojave desert tortoise by comparing two genetic assignment approaches that use a Bayesian statistical framework to delineate genotype clusters without the need to infer gene flow with a priori subjective groupings. Bayesian methods can be used to identify structure within populations that have dispersal patterns differing from a simple island or stepping stone model, such as models with hierarchical levels of structure (Evanno et al. 2005). Genetic data exhibit a time lag associated with effective population size and population substructure, and this lag can be magnified with species that have long generation times (Keyghobadi 2007). Therefore, any detectable genetic structure in desert tortoises most likely represents natural movement patterns existing prior to human influences in the Mojave Desert (USFWS 1994; Lovich and Bainbridge 1999).

We predicted that tortoises should exhibit a population genetic structure based upon limitations to dispersal at a regional scale, but that local levels of historic gene flow would be high. Indeed, several chelonian species display limited dispersal on a larger geographic scale (e.g., Cunningham et al. 2002; Paquette et al. 2007; Howeth et al. 2008), but the gopher tortoise (*Gopherus polyphemus)* in the southeastern United States exhibits extreme differentiation due to reduced gene flow caused by natural and anthropogenic habitat fragmentation (Schwartz and Karl 2005). Previous investigations of desert tortoise populations are not sufficient to elucidate putative boundaries of desert tortoise populations due to limitations of sampling design. Therefore, our goal was to identify natural population boundaries on a large geographic scale through systematic sampling of the complete spatial extent of the listed distinct population segment. Although the level of divergence among groups of desert tortoises is unclear, and they are most likely not demographically independent, we will use the term "population" more generally to describe entities that can be distinguished by differences in allele frequencies.

Our second goal was to evaluate the Recovery Units of the 1994 Recovery Plan, and to recommend revisions of boundaries for management units. The desert tortoise has a wide distribution, and its biological distribution largely differs from political boundaries. The Mojave desert tortoise's range traverses four states (Utah, Arizona, Nevada, and California), and that range is currently divided into six recovery units (a management unit associated with a species' recovery plan; USFWS 1994). The original recovery units reflected the best available scientific evidence at the time of its listing as a threatened species (USFWS 1994). The units were delineated to capture and preserve the considerable diversity in morphology (Weinstein and Berry 1987), ecology (Germano et al. 1994), and genetics (Lamb et al. 1989; Rainboth et al. 1989).

According to the new formal policy adopted by the U.S. Fish and Wildlife Service, recovery units should be geographically identifiable and essential to the recovery of the Mojave population of the desert tortoise (National Marine Fisheries Service (NMFS) 2006). Each unit should contain elements necessary to conserve genetic or demographic robustness, or elements required for the long-term sustainability of the whole distinct population segment, subpopulation, or species (NMFS 2006). Preserving genetic and ecological diversity among populations continues to be a primary objective in desert tortoise conservation. Currently, the U.S. Fish and Wildlife Service is revising the Recovery Plan for the Mojave desert tortoise, including delineating recovery units. We provide new data and analyses that can be used to evaluate and revise those recovery units.

Methods and materials

Sample collection and genotyping

Whole blood was collected from 748 desert tortoises between 2004 and 2006 throughout the Mojave and Colorado Deserts (Fig. 1). Samples were grouped subjectively into 25 sampling locations each considered to be distinct geographic areas (Table 1). We collected samples along randomly placed transects during routine population monitoring conducted by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service (USFWS) 2006). Additional samples were collected from transects (4–12 km) placed to cover otherwise poorly sampled areas of the range that were not included in population monitoring (Hagerty 2008). Transect selection differed based upon land ownership and density of tortoises, and samples were evenly distributed across the range of the species.

Blood samples were dried onto filter paper dots and stored until DNA could be isolated. Total genomic DNA

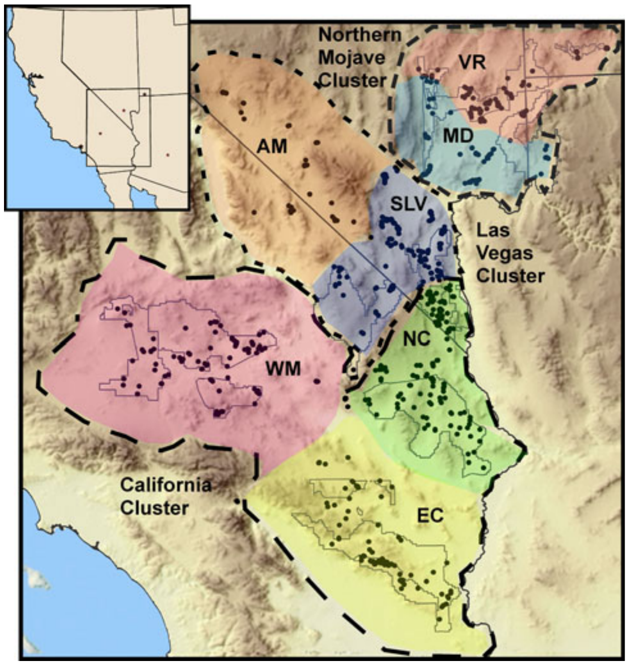

Fig. 1 Map showing the population structure of the Mojave desert tortoise and the associated major topographic features. Each *black* dot indicates a location where a blood sample was collected. The three basal clusters that were identified using STRUCTURE are marked as *dotted lines*. The smallest hatching is the Las Vegas Cluster, medium hatching is the Northern Mojave cluster, and the largest hatching is the California cluster. The *colors* within each basal cluster indicate the seven finer-scale clusters designated as follows: Virgin River (VR) = *red*, Muddy Mountains (MD) = *light blue*, Amargosa Desert (AM) = *orange*, South Las Vegas (SLV) = *dark blue*, Northern Colorado (NC) = *green*, Eastern Colorado (EC) = *yellow*, and Western Mojave (WM) = *pink*. The Piute and Eldorado clusters, which were not detected in all analyses, are not shown on this map. The *stars* in the inset indicate some major cities in the southwestern United States including, St. George, UT, Las Vegas, NV, Barstow, CA, Los Angeles, CA, and Phoenix, AZ

was extracted from up to three filter-paper dots using a dried blood protocol for QIAGEN DNeasy kits (Qiagen 2001). DNA was eluted in a TE buffer, quantified using a Labsystems Fluoroskan Ascent fluorometer, and diluted to concentrations between 5 and 10 ng/μl for amplification with microsatellite primers. DNA was amplified using the polymerase chain reaction (PCR) and individuals were genotyped with 20 microsatellites. Microsatellite primer sets were obtained from previous studies of *G. polyphemus* (GP15, GP30, GP61; Schwartz et al. 2003), the Sonoran population of *G. agassizii* (GOAG3, GOAG4, GOAG7; Edwards et al. 2003), and the Mojave population of *G. agassizii* (14 primer sets; Hagerty et al. 2008). All microsatellite loci were amplified in six multiplex PCRs, and two individual PCRs. Conditions for these reactions are described in Hagerty et al. 2008. Multiplex 1 ($T_a = 57°C$) contained primers GOAG7 and GOAG3. Multiplex 2 ($T_a = 55°C$) contained primers GP61, GP30, and GP15. The multiplex reactions for the remaining loci were completed as described in Hagerty et al. (2008). GOAG4 ($T_a = 55°C$) and GOA17 ($T_a = 61°C$) were amplified individually.

All amplified microsatellite segments underwent a multicolor fluorescence-based DNA fragment size analysis in five separate panels using a fully automated ABI 3730 DNA sequencer. We amplified microsatellites and completed fragment analysis in collaboration with the Nevada Genomics Center (http://www.ag.unr.edu/Genomics/). All alleles were scored with GeneMapper 5.0 (Applied Biosystems, Inc.).

Descriptive population genetic analyses

We calculated descriptive statistics, including gene diversity and number of alleles per locus (GENEPOP 1.2; Raymond and Rousset 1995) and tested for linkage disequilibrium for each pair of loci and for deviation from Hardy–Weinberg expectations (HWE; FSTAT 2.9.3.2; Goudet 2001). An estimate of F_{IS} was calculated for each locus and across loci for each sampling location to test for significant heterozygote deficits. We tested for statistical significance at the 0.05 level and controlled for multiple testing using the Bonferroni correction (Rice 1989). We also performed a test for null alleles (MICROCHECKER 2.2.3; van Oosterhout et al. 2004), using the combined probability of expected heterozygote classes to test for statistical significance at the 0.05 level.

Identifying populations

We investigated the genetic population structure of the desert tortoise in the Mojave and Colorado Deserts using two Bayesian clustering models. STRUCTURE (2.1; Pritchard et al. 2000; Falush et al. 2003) was used to infer the number of genotype clusters without a priori knowledge about potential population clusters. GENELAND (2.0; Guillot et al. 2005b) is similar to STRUCTURE, but also incorporates spatial data for each individual into the analysis.

STRUCTURE procedures and parameters

STRUCTURE uses a Bayesian approach to define the number of genotype clusters (K) based upon the probability of particular multilocus genotypes given the allele frequencies. The most likely number of genotype clusters is determined as the number of distinct groups in linkage equilibrium and HWE (i.e., characterizing a randomly mating population). Genotype cluster of origin and allele frequencies of each cluster are estimated using a Markov Chain Monte Carlo (MCMC) re-sampling algorithm over a

Table 1 Summary geographic and genetic information for each sampling location for Mojave desert tortoises

Recovery unit	Sampling location	State	Site abbr.	N	Gene diversity (±) SD		Allelic richness (±) SD		F_{IS}
Upper Virgin River	Red Cliffs Desert Reserve	UT	RC	33	0.712	0.207	6.413	2.668	0.072
Northeastern Mojave	Beaver Dam Slope	UT, NV	BD	12	0.656	0.263	5.568	2.644	0.079
	Mormon Mesa	NV	MM	43	0.687	0.238	6.114	2.737	0.011
	Gold Butte	NV	GB	17	0.643	0.279	5.593	2.624	**0.142**
	Muddy Mountains	NV	MD	30	0.750	0.241	7.357	3.380	**0.075**
	Coyote Springs	NV	CS	26	0.723	0.235	7.078	3.445	0.061
	NE Las Vegas Valley	NV	NEL	20	0.744	0.267	7.416	3.423	−0.003
	NW Las Vegas Valley	NV	NWL	21	0.756	0.215	7.589	3.197	0.061
	Amargosa Desert	NV	AM	18	0.742	0.215	6.999	3.156	0.036
	Pahrump Valley	NV	PA	27	0.765	0.215	7.499	3.199	0.059
	South I-15 (Goodsprings, Jean Dry Lake)	NV	SI	29	0.786	0.169	7.442	3.022	0.035
	SW Las Vegas Valley	NV	SWL	28	0.780	0.209	7.993	3.816	0.038
	SE Las Vegas Valley	NV	SEL	12	0.799	0.173	7.606	3.105	0.047
	Eldorado Valley	NV	EL	49	0.780	0.198	7.406	3.041	**0.069**
Eastern Mojave	Piute Valley	NV	PI	80	0.779	0.209	7.920	3.172	**0.061**
	Shadow Valley	CA	SH	17	0.768	0.188	7.253	3.149	0.051
	Ivanpah Valley	CA	IV	16	0.788	0.206	7.655	3.182	0.039
	W Providence Mountains	CA	WP	14	0.780	0.195	7.970	3.515	0.027
Northern Colorado	Chemehuevi Valley	CA	CM	59	0.739	0.232	7.517	3.345	**0.058**
	E Providence Mountains	CA	EP	38	0.746	0.222	7.556	3.204	**0.06**
Eastern Colorado	Chuckwalla Valley	CA	CK	56	0.721	0.253	7.078	3.359	0.044
	Pinto Mountains	CA	PM	25	0.724	0.257	7.288	3.574	0.056
Western Mojave	Ord-Rodman	CA	OR	14	0.737	0.239	7.048	3.392	0.072
	Superior-Cronese	CA	SC	45	0.725	0.234	7.024	3.423	0.026
	Fremont-Kramer	CA	FK	19	0.721	0.237	6.916	3.047	0.098
			Overall		0.742	0.040	8.352	3.354	0.053

1994 Recovery Unit, state, site abbreviation, sample size (N), mean gene diversity (±1 st. deviation), mean allelic richness (±1 st. deviation), and F_{IS} (significant values after Bonferroni correction of $P < 0.0001$ are in *bold*)

range of possible clusters (K). We used an admixture model, which allows for multiple genetic sources of individuals, with correlated gene frequencies (Falush et al. 2003). We used a uniform prior, making assignment to each K equally likely. We specified a 750,000 MCMC burn-in period followed by ten 750,000 MCMC replicates per K, from $K = 1$ to $K = 10$, to approximate the posterior allelic distributions against which individual genotypes were compared and assigned to a cluster (Pritchard et al. 2000). We ran initial simulations which suggested that $K > 10$ were unlikely.

For each value of K, we computed the mean estimated natural log of the probability of data or $\ln P(D)$ across the 10 independent MCMC replicates. The smallest value of K that adequately explains the structure in the data is taken to be the most likely solution (Pritchard et al. 2000). We also calculated the second-order rate of change in the posterior probability (ΔK) (Evanno et al. 2005). Additionally, we used the value of the admixture parameter (α) and the pattern of assignment to clusters to estimate the true number of genotype clusters (Evanno et al. 2005).

The ΔK statistic can identify the uppermost level of structuring among potential populations in a hierarchy (Evanno et al. 2005), thus we used additional STRUCTURE simulations with the same parameter values described above to detect any potential substructuring within the main clusters identified by the initial model simulations. We used the individual assignments from the number of clusters identified using ΔK to create data sets ($N = K$), and we searched for additional hierarchical structuring within each basal cluster (Evanno et al. 2005; Rowe and Beebee 2007). We continued to analyze subsequent clusters until the model did not support additional subdivision.

To account for potential bias in the number of populations inferred from STRUCTURE (McRae et al. 2005), we reduced the number of genotypes in locations that had more than 30 sampled individuals. We completed an ad hoc bootstrap analysis with 10 replicates by randomly selecting 30 individuals from each location. Locations with fewer than 30 individuals remained unchanged in the analyses. Procedures as described above were completed for each replicate. Hierarchical analyses were also completed with reduced data sets.

GENELAND procedures and parameters

GENELAND implements a Bayesian clustering algorithm similar to STRUCTURE and uses an MCMC re-sampling method to estimate unknown parameters including the number of genotype clusters. GENELAND additionally incorporates spatial data (geo-referenced coordinates) for each individual (Guillot et al. 2005a, b). This model assumes that populations are spatially organized as a set of non-overlapping polygons with no gaps (Guillot et al. 2005a, b). Unlike STRUCTURE, GENELAND treats the number of genotype clusters as an additional parameter (Guillot et al. 2005a).

Four individuals were removed from GENELAND analyses because we did not have reliable spatial coordinates for them. In our simulations, we used spatial and genetic data (Dirichelet model of allele frequencies) as a priori information. We included uncertainty (1 km) into the spatial coordinates for each individual to account for any measurement error, movement of individuals, and the potential for observed locations to reflect the true locations inaccurately (Guillot et al. 2005a). The first set of MCMC chains was used to determine the modal number of inferred populations (Guillot et al. 2005a). The MCMC algorithm was repeated 10 times, allowing K to vary among simulations, using the following parameters: (1) minimum number of populations equal to one, (2) initial number of populations equal to two, (3) maximum number of populations was 15, (4) 500,000 MCMC iterations, (5) thinning equal to 10, (6) maximum number of nuclei in the Poisson-Voronoi tessellation equal to 300 (default), and (7) maximum rate of Poisson process equal to 100 (default). After the modal number of populations (K) was estimated from the initial ten simulations, the previously inferred value of K was used as the initial and maximum number of populations in five additional runs with the same model parameters. Mean assignment probabilities were calculated for each individual from the five runs. During post-processing, we used 200 pixels along the X-axis and Y-axis and a burn-in of 1,000 MCMC cycles. The model identified the modal population of each individual and the probability of assignment of each individual to the modal population. Hierarchical clustering was evaluated using this model with the same method described for STRUCTURE.

Statistics for inferred populations

We determined population differentiation among all sampling locations and among the populations inferred from the two Bayesian models. We calculated pair-wise F_{ST} values (Weir and Cockerham 1984) and tested for pair-wise genetic differences among clusters and sampling locations (not assuming HWE) using a randomization procedure (FSTAT 2.9.3.2; Goudet 2001). Statistical significance at the 0.05 level was evaluated after the Bonferonni correction for multiple comparisons (Rice 1989). An analysis of molecular variance (AMOVA; Excoffier et al. 1992) was also conducted to test the significance of the inferred population structure (Arlequin 3.1; Schneider et al. 2000). A frequency-based assignment approach (DOH; Paetkau et al. 1995) was used to evaluate the hypothesis of genotype clusters provided by the Bayesian approaches. A Mantel test was used to test for correlation between pair-wise genetic distance ($F_{ST}/(1 - F_{ST})$; Rousset 1997) and geographic distance matrices (Isolation by Distance web service; IBDWS; Jensen et al. Jensen et al. 2005). We calculated a geographic distance matrix with pair-wise Euclidean distances between the centroids of all sampling locations (ArcGIS 9.2, ESRI, Redlands, USA).

Sex-biased dispersal

We investigated the potential for sex-biased dispersal in the Mojave desert tortoise using assignment indices (Mossman and Waser 1999; GENALEX 6.3; Peakall and Smouse 2006). Negative AI_c values indicate that an individual is more likely than average to be a recent migrant, and we tested for differences in the mean AI_c values between males and females using a Mann–Whitney U-test. We tested for this pattern in the total population using 619 individuals that had complete genotypes and known sex, as well as among sampling locations.

Results

Descriptive population genetic analyses

Average gene diversity (0.742 ± 0.040) and allelic richness (8.352 ± 3.354) indicated that the Mojave desert tortoise exhibits high levels of genetic diversity (Table 1). The pairs of microsatellites did not exhibit significant linkage disequilibrium among locations or in any particular group after the Bonferroni correction ($P < 0.000011$ after 95,000 permutations). Six of the 25 sampling locations (GB, MD, EL, PI, CM, EP) had significant F_{IS} values after the Bonferroni correction ($P < 0.0001$), indicating that these sampling locations are not in HWE (Table 1).

However, these significant values were influenced by two loci (GOA 6 and GP 61; Hagerty 2008). Each sampling location did not represent a discrete randomly mating population, which would create conditions outside of HWE. Although multiple populations (6-9) indicated signs of the presence of null alleles at GOA6, GOA9, GOA12, and GP 61, this evidence did not occur consistently across all tested locations. Therefore, we did not remove any microsatellites from subsequent analyses.

Identifying populations

Bayesian clustering without spatial information (STRUCTURE)

ln$P(D)$ across 10 independent runs of the complete data set reached a plateau after $K = 9$ (Table 2), indicating that nine clusters are more appropriate than 10 or more clusters despite a slight increase in the posterior probability. The proportion of admixture (α) also was lowest and reached a plateau at $K = 9$ (Table 2). However, the largest increase in the likelihood that a model was a good fit and the largest ΔK occurred between $K = 1$ and $K = 2$ (Table 2). Several independent runs of STRUCTURE for $K = 1$ never converged, thus, it may be inappropriate to compare STRUCTURE results for $K = 1$ with results using other values of K. When we removed $K = 1$ from analysis to find the best fit to the data, $K = 3$ became the most probable configuration. The ΔK for $K = 3$ was at least two times higher than ΔK for subsequent values of K (Table 2). A large reduction in the admixture parameter (α) also occurred between $K = 2$ and $K = 3$ (Table 2). Multimodality in the model fit prohibited clear interpretation of our data set. At least two local maxima were reached in different independent MCMC simulations when $4 < K < 9$ (not shown).

Table 2 Mean ln$P(D)$ ($\pm$1 st. deviation)

K	Mean ln$P(D)$	SD ln$P(D)$	Mean $L'(K)$	Mean $L''(K)$	ΔK	α
1	−64113.	8.37				
2	−60625.	1.39	3487.1	2572.35	**1845.73**	0.187
3	−59918.	2.73	707.06	557.65	**204.28**	0.078
4	−59769.	578.13	149.41	523.2	0.91	0.054
5	−59242.	4.33	527.45	309.63	71.46	0.049
6	−59011	72.55	230.66	144.23	1.99	0.046
7	−58776	77.10	234.65	158.84	2.06	0.045
8	−58595	20.94	180.75	83.62	3.99	0.043
9	−58482	6.79	113.59	98.23	14.46	0.041
10	−58461	20.44	21.94			0.041

The second order rate of change calculations for ΔK, and the admixture parameter (α) when K was fixed to $K = 1$ through $K = 10$ in STRUCTURE

Bold values indicate the highest ΔK

We chose $K = 3$ as the basal, most parsimonious number of genotype clusters due to the high ΔK and the occurrence of multimodality when $K > 3$ (Table 2). We interpreted this level of clustering to represent the uppermost level of clustering across the landscape. Proportional membership for each sampling location to one of the three clusters was high and ranged from 62 to 97%. Cluster 1 (Northern Mojave or NM) encompassed seven sampling locations in Utah and Nevada (RC, BD, MM, GB, MD, CS, NEL; Table 3). Cluster 2 (Las Vegas or LV) included individuals from nine sampling locations in Nevada and along the Nevada/California border (NWL, AM, PA, SH, IV, SI, SWL, SEL, EL; Table 3). Cluster 3 (California or CA) contained individuals from nine sampling locations in California and in Piute Valley, Nevada (PI, CM, EP, WP, CK, PM, OR, SC, FK; Table 3).

Hierarchical sub-structuring could explain the discrepancy between ΔK and the peak mean ln$P(D)$. Each basal cluster had an additional level of structuring, ranging from two to four additional clusters (Table 3). The additional clusters that were identified in the hierarchical analyses aligned exactly with the clusters identified by the model when $K = 9$ (Fig. 2), indicating that some additional level of structure exists within the Mojave desert tortoise. The mean proportional membership of sampling locations to each of the nine clusters from the complete analysis was variable (Fig. 2). Although several geographic locations were clearly assigned to a particular cluster, others were split among clusters (Fig. 2). When $K = 2$ was chosen as the most basal number of clusters and used to investigate sub-structuring, the resulting clusters were identical (not shown). Additional sub-structuring was not present in any of the nine genotype clusters when they were analyzed separately (not shown).

When we randomly sampled individuals to distribute sampling effort more evenly among locations ($N \leq 30$ per location), ln$P(D)$ peaked when $K = 6$. The reduction in the number of genotype clusters when $K = 6$ resulted in no subdivision of the "California" cluster, whereas when we used all of our data (regardless of the uniformity of sample size), the "California" cluster was split into additional clusters (Fig. 2). ΔK with the reduced dataset was also highest when $K = 3$, and these three basal clusters were identical to those identified with the full data set. With the reduced data set, the resulting number of individuals assigned to each of these three basal clusters was similar ($N_1 = 165$, $N_2 = 212$, $N_3 = 208$). The reduction in sample size also reduced the total number of genotype clusters identified in hierarchical clustering analyses to seven. However, the seven genotype clusters identified using

Table 3 Mean ln$P(D)$ and ΔK for each of the three basal clusters identified with STRUCTURE

Basal cluster	K	Mean ln$P(D)$	ΔK	Description of hierarchical clusters
Northern Mojave	1	−13456.4		Cluster 1 (Virgin River): RC, BD, MM
	2[a]	−13191.9	16.9	Cluster 2 (Muddy Mountains): GB, MD, CS, NEL
	3	−13219.1	9.0	
	4	−13359.0	7.3	
	5	−14842.2	4.2	
	6	−14295.2	2.6	
	7	−14497.5	1.7	
Las Vegas	1	−17997.5		Cluster 1 (Amargosa Desert): AM, PA, SH
	2	−17925.7	1.8	Cluster 2 (Southern Las Vegas): NWL, IV, SI, SWL
	3[a]	−17807.7	43.1	
	4	−18187.4	3.2	Cluster 3 (Eldorado): EL, SEL
	5	−18006.1	2.9	
	6	−18235.4	2.5	
	7	−18905.2	2.4	
	8	−19387.3	1.6	
	9	−19454.3	2.1	
	10	−19686.9	1.4	
California	1	−28618.9		Cluster 1 (Piute Valley): PI, WP
	2	−28184.7	44.7	Cluster 2 (Northern Colorado): CM, EP
	3	−27885.3	38.1	Cluster 3 (Eastern Colorado): CK, PM
	4[a]	−27683.7	55.7	Cluster 4 (Western Mojave): OR, SC, FK
	5	−27753.1	19.1	
	6	−28166.4	2.0	
	7	−28822.3	2.2	
	8	−28965.1	1.7	

Additional analyses were used to detect hierarchical clustering within the Mojave desert tortoise

Abbreviations for location names are provided in Table 1

[a] Indicates the K with the highest mean ln$P(D)$ and ΔK

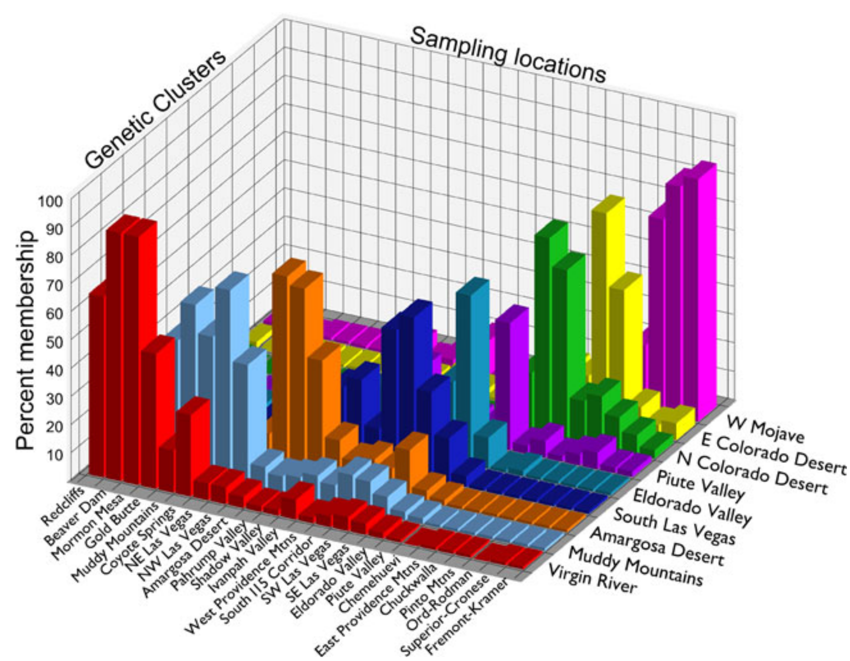

Fig. 2 Mean proportional membership of individuals in the 25 sampling locations to one of nine genotype clusters that we identified for the Mojave desert tortoise with STRUCTURE. The locations along the X-axis and Y-axis are organized to follow a north to south and east to west gradient

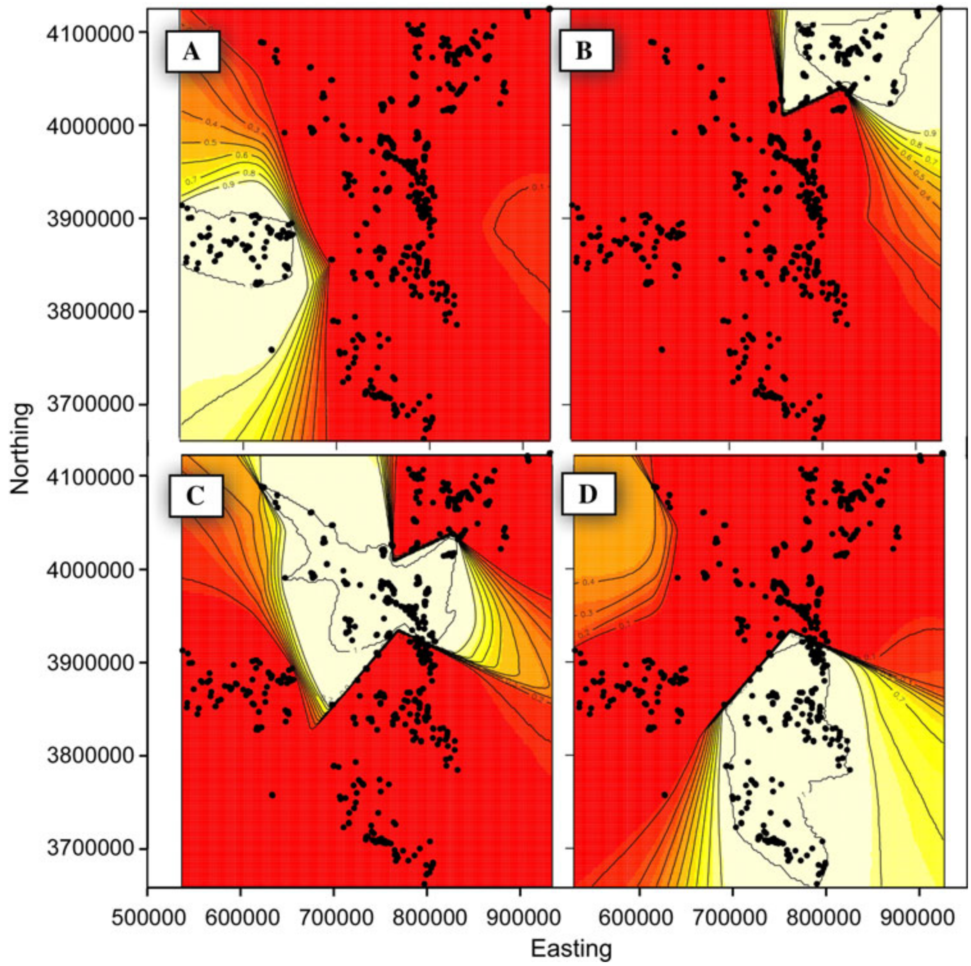

Fig. 3 Map of the posterior probability of membership to four genotype clusters identified using GENELAND. Each *black point* corresponds to a desert tortoise location, equivalent to the locations shown in Fig. 1. The *lighter shading* and associated *contour lines* represent increasing probability of membership. The clusters shows are **a** Western Mojave Desert (WM); **b** Virgin River (VR); **c** Las Vegas (LV); and **d** Colorado Desert (CO)

hierarchical analyses did not match the clusters identified from the best fit model with the reduced dataset ($K = 6$ using $\ln P(D)$). The sub-structuring for cluster 1 (NM) remained unchanged (two clusters). However, cluster 2 (LV) was only subdivided into two clusters, which removed the Eldorado Valley cluster (not shown). Cluster 3 (CA) was subdivided into three clusters, which removed the Piute Valley cluster (not shown).

Table 4 Pair-wise F_{ST} values for the nine inferred genotype clusters of Mojave desert tortoises

	VR	MD	AM	SLV	EL	PI	NCO	ECO	WM
VR	–								
MD	0.025	–							
AM	0.044	0.016	–						
SLV	0.048	0.019	0.012	–					
EL	0.067	0.038	0.023	0.014	–				
PI	0.087	0.057	0.041	0.029	0.020	–			
NCO	0.114	0.082	0.062	0.051	0.040	0.011	–		
ECO	0.132	0.097	0.086	0.066	0.057	0.028	0.026	–	
WM	0.125	0.082	0.071	0.057	0.052	0.032	0.032	0.031	–

Population differentiation among clusters was significant using an adjusted *P*-value ($P < 0.00139$) after 720 permutations

Cluster IDs are: *VR* Virgin River, *MD* Muddy Mountains, *AM* Amargosa Desert, *SLV* South Las Vegas Valley, *EL* Eldorado Valley, *PI* Piute Valley, NCO Northern Colorado Desert, *ECO* Eastern Colorado Desert, *WM* Western Mojave Desert

Bayesian clustering with spatial information (GENELAND)

When we analyzed the complete data set with GENELAND, the modal number of genotype clusters was most frequently four, though $K = 3$ was chosen twice out of 10 simulations. Two of the four genotype clusters were similar to those resulting from analyses using STRUCTURE when $K = 3$. The Northern Mojave cluster and the Las Vegas Cluster were delineated with similar boundaries to those identified without spatial information in the STRUCTURE analyses (Fig. 3). The California cluster, identified by STRUCTURE, was split into two clusters in the GENELAND analyses (Fig. 3). The West Mojave was separated from the remainder of the California sampling locations (Eastern Colorado sites, Northern Colorado sites; Fig. 3).

Assignment of individuals to these clusters was consistently greater than 90%. When the model was constrained to $K = 3$, a majority of independent simulations (4 out of 5) identified the same three clusters identified by STRUCTURE. Hierarchical structuring was not detected in the NM or LV cluster; however, the Eastern and Northern Colorado separated as hierarchical clusters within the CA cluster in subsequent analyses.

Statistics for inferred populations

The Bayesian clustering methods did not provide consistent, definitive delineations for population structure. Therefore, we tested multiple configurations of genotype clusters using an analysis of molecular variance (AMOVA). We compared $K = 3$, $K = 7$, and $K = 9$ from STRUCTURE and $K = 4$ from GENELAND. For $K = 3$, the amount of variation explained by differences among genotype clusters was low (4.94%), and most genetic variation was explained by differences within sampling locations (88.46%). These percentages were similar for all configurations. All variance components, including the among-population portion, contributed significantly to the genetic variation among clusters ($P < 0.05$ when compared to 1023 permutations of the data).

Pair-wise F_{ST} values among sampling locations ranged from 0.003 (Chemehuevi—East Providence Mountains) to 0.162 (Beaver Dam Slope—Pinto Mountains; Supplemental Table 1; Hagerty 2008). Almost all pair-wise comparisons for population differentiation were significant after Bonferroni correction ($P < 0.000167$ after 6000 permutations), except for a few adjacent locations (Supplemental Table 1; Hagerty 2008). When locations were combined to correspond to the 7 or 9 inferred genotype clusters from STRUCTURE, pair-wise F_{ST} values ranged from 0.012 (Amargosa—South Las Vegas) to 0.132 (Virgin River—Eastern Colorado) and followed a pattern similar to comparisons among all sampling locations (Table 4). Each pair-wise comparison for genetic differentiation was statistically significant after Bonferroni correction ($P < 0.001389$ after 720 permutations).

Self-assignment of individuals to sampling locations using a frequency-based assignment test was variable (7.14–89.1%). However, the percentage of self-assignment improved dramatically when sampling locations were clustered to resemble the nine inferred populations (64.7% for Amargosa Desert–92.4% for Western Mojave). Additionally, no random assignments occurred in any of the seven or nine populations after 10,000 re-sampling events.

Isolation by distance was evident across the range of the Mojave desert tortoise. Genetic and geographic distances among sampling locations were correlated strongly ($Z = 4392.398$, $r = 0.824$, $P < 0.0001$).

Evidence for sex-biased dispersal?

We did not detect evidence of sex-biased dispersal among Mojave desert tortoises. Although the sample mean AI_c for females (-0.140 ± 0.143) was more negative than for males (0.097 ± 0.120), the means were not statistically different (Mann–Whitney U-test, $U = 44035$, $P = 0.305$). The same pattern occurred when we examined individual sampling locations.

Discussion

Identifying populations for the Mojave desert tortoise

Three basal populations of the Mojave desert tortoise are identifiable using Bayesian assignment tests, and these populations follow a north to south gradient (Fig. 1). The Northern Mojave cluster ranges as far north as St. George, UT, and has localized transitional zones between Mormon Mesa and Coyote Springs (through Moapa Valley) and across the Muddy and Virgin Rivers. This area is topographically diverse and represents a mosaic of habitats for tortoises, which are interspersed between mountain peaks taller than 1,000 m. The transition between the Northern Mojave and Las Vegas clusters is apparent as a gradual change in allele frequencies across several mountain ranges that extend north to south (Hagerty 2008). Prior to extensive urban development, Las Vegas Valley, which constitutes a majority of the Las Vegas cluster, provided a continuous tract of tortoise habitat with open corridors to the northwest and south (Britten et al. 1997). A transition zone between the Las Vegas and California clusters was apparent across Searchlight Pass, a connection point for the Eldorado, Newberry, and Highland mountain ranges. This low pass (1500 m) separates Eldorado and Piute Valleys near the Nevada/California border. Other mountain ranges, such as the New York and Providence ranges, and low elevation areas like Death Valley separate the Las Vegas and California clusters. The California cluster contains most of the Mojave and Colorado Deserts in California. The habitat in this cluster is relatively continuous, but the changes in vegetation are substantial.

The basal genotype clusters identified here closely resemble the distribution of mtDNA haplotypes found previously (Lamb et al. 1989), yet these haplotypes had very few restriction-length differences in comparison to the Sonoran and Sinaoloan haplotypes (Lamb et al. 1989). Less than 0.5% nucleotide differences were found among Mojave haplotypes, which were identified in representative individuals from each of the six recovery units (Lamb et al. 1989). Recent mtDNA sequencing also corroborated this low divergence rate among Mojave haplotypes (Edwards

2003; Murphy et al. 2007). Two major mtDNA lineages were identified (Murphy et al. 2007), and these lineages correspond to the California Cluster and a combination of the Las Vegas and Northern Mojave Cluster in this study. The combination of microsatellite and mtDNA evidence supports the existence of population structure at the landscape scale. Inferences from our study were made without presuming underlying population structure, and our data complement the distribution of known mtDNA haplotypes (Lamb et al. 1989; Murphy et al. 2007).

Previous studies using simulated and real data sets successfully identified fine scale structure in complex systems using hierarchical clustering methods (Evanno et al. 2005; Rowe and Beebee 2007). When we separated and analyzed the basal clusters (either 2 or 3), we identified population structure at a finer geographic scale within each cluster (Fig. 1), and this substructure was also apparent when the entire data set was analyzed. A majority of these finer-scale delineations were robust even when individuals were randomly removed from the sample as a means to create an equal sample size among sites across the range. However, intense sampling did appear to increase the chance that the models identified additional, likely spurious, clusters. When the sample size was reduced, Eldorado and Piute Valleys, which were deemed to be distinct using the full data set, were no longer separated as distinct genotype clusters (particularly in the hierarchical analyses). Therefore, we are skeptical that those two clusters are anything more than artifacts of sampling design. Potential effects of sampling intensity on model output from STRUCTURE have been reported elsewhere (McRae et al. 2005). Thus, it is critically important to balance sampling effort in studies intended to identify population boundaries, and interpretation of results from Bayesian clustering methods must be scrutinized carefully to avoid spurious interpretations.

Despite morphological, ecological, and behavioral differences among tortoises in the region surrounding St. George, UT (e.g., Red Cliffs Desert Reserve; Woodbury and Hardy 1948, Esque 1994; USFWS 1994), we found no evidence within the microsatellite data that individuals from this area are distinct from those along the southern face of the Beaver Dam Mountains, or further south into Nevada (Mormon Mesa). We detected four genetically distinguishable clusters in the Northeastern Mojave Desert, and this result is consistent with genetic and morphometric analyses that revealed biological variation that was previously not seen in southern Nevada (Britten et al. 1997). The four newly observed genotype clusters were the Virgin River cluster, the Muddy Mountains cluster, the Southern Las Vegas cluster (including Eldorado Valley), and the Amargosa cluster (Fig. 1). The Amargosa Desert and Pahrump Valley were not considered in previous analyses because they were not well-sampled (Britten et al. 1997).

Habitat differences driven by variation in climate (predominantly rainfall) as well as correlated behavioral and life history differences were used previously to distinguish among tortoises in different regions within the California cluster (Peterson 1994; USFWS 1994; Peterson 1996; Henen et al. 1998; Lovich et al. 1999; Wallis et al. 1999; Tracy et al. 2004). We further subdivided the California cluster into the Northern Colorado, Eastern Colorado, and Western Mojave (Fig. 1). The Northern and Eastern Colorado clusters are separated by the Baker Sink, which is a low-elevation, and frequently very hot, region extending from Saline Valley in California in the north, then south through Death Valley to Cadiz Valley. This area divides the ecological western Mojave Desert that has variable winter–spring precipitation regime and lower elevations from the more eastern Mojave Desert that is subject to more predictable winter and summer monsoon precipitation and has more variable elevations (Germano et al. 1994; Tracy et al. 2004). The Western Mojave cluster is separated from the Eastern Colorado cluster in the Pinto Mountains, and from the Amargosa cluster in the low elevation area near Death Valley. The Western Mojave cluster was also highlighted as a distinct cluster when spatial data was included as prior information in GENELAND. We assume that the addition of geographic information revealed the likelihood that this cluster is a biological reality, and note that multiple types of analyses are necessary to make informed inferences from population genetic data (Manel et al. 2004; Rowe and Beebee 2007).

Another recent microsatellite study of the Mojave desert tortoise (Murphy et al. 2007) reported very different boundaries of genetic units from those that we detected, despite reporting a similar global F_{ST} value (0.06) and patterns of differentiation. The genotype clusters identified by Murphy et al. (2007) align closely with the current six recovery units described in the 1994 Recovery Plan (USFWS 1994); however, the authors also reported additional substructure within the Western Mojave Recovery Unit (Western, Southern, Central Mojave units). We found no additional hierarchical clustering in the Western Mojave Desert, which is a conspicuous contradiction between these two studies. On the other hand, we detected additional genetic variation in the northern portion of the range, which points to the need for further delineation within the Northeastern Mojave Recovery Unit.

The notable differences between our study and Murphy et al. (2007) are likely attributable to major differences in population sampling design (Hagerty 2008). Specifically, Murphy et al. (2007) sampled tortoises opportunistically (as part of unrelated studies), and a majority of their sampling (73%) was confined to the Western Mojave

Recovery Unit. Although their samples represented each of the original recovery units, there were no samples from Nevada. On the other hand, we sampled more uniformly across the range (incorporating random sampling when possible), accounted for unequal sampling intensity, and adjusted the interpretation of any potential genotype clusters. Careful investigation of population genetic structure requires comprehensive and thorough sampling of all potential populations (Manel et al. 2003; Evanno et al. 2005; Storfer et al. 2007). Skewed sampling has been shown to yield spurious results (McRae et al. 2005), and inferences from our modeling were affected by uneven sample sizes (e.g., potentially spurious clusters in Eldorado Valley and Piute Valley). Thus, we feel that the recovery units that are proposed in Murphy et al. (2007) are likely artifacts of skewed and incomplete sampling.

Although broad and fine scale population structure is present, we detected low genetic differentiation among most sites. Previous simulation studies offer support that Bayesian models can be effective for identifying populations with lower levels of differentiation ($F_{ST} = 0.02$–0.03; Latch et al. 2006). F_{ST} describes the result of cumulative gene flow across generations, yet it does not allow differentiation among hypotheses explaining population dynamics (i.e., reflecting historic or current gene flow; Pearse and Crandall 2004). Our pair-wise F_{ST} values and the other evidence (e.g., AMOVA) support the hypothesis of historically moderate to high levels of localized gene flow, but limited dispersal at a regional scale. Although we do not have current demographic data to show a recent reduction in inter-population movement (e.g., Howeth et al. 2008), habitat fragmentation in the range of the desert tortoise has likely removed all possible paths among previously connected populations.

The pattern of low-to-moderate levels of genetic differentiation among desert tortoise populations could be consistent with isolation-by-distance or an absence of barriers to gene flow (Wright 1943; Kimura and Weiss 1964; Slatkin 1993). Indeed, geographic distance explained 68% of the variation in the correlation between geographic distance and genetic distance among sampled locations. These results are consistent with the lack of major geographic barriers to movement at the landscape scale and the recognized ability of tortoises to move long distances.

The dispersal ecology of this species and other tortoises is not well understood (Morafka 1994; Kazmaier et al. 2002), but individual tortoises have the potential to move long distances to forage or reproduce. Although few long forays (greater than 30 km) have been recorded (Edwards 2003; Edwards et al. 2004), long-distance dispersal events are difficult to detect using direct methods (Koenig et al. 1996; Nathan 2001). The long life spans of tortoises, coupled with annual opportunities for reproduction during non-drought periods, allow individuals potentially to move longer distances over their reproductive lifetime (Edwards et al. 2004; Esque et al. unpublished data). This expanded period of influence and long generation time increases the potential for gene flow to homogenize populations over relatively short distances, causing dispersal distance to be a primary mechanism for any population differentiation. The pattern of assignments in our study did not differ significantly between males and females. Therefore, we were not able to infer sex-biased dispersal, which may be an indication that both sexes disperse in this species. More direct research is required to determine dispersal distances and distinguish among potential mechanisms of dispersal in this species.

Recommendations for recovery units

The 1994 Recovery Plan for the Mojave desert tortoise described recovery units (sensu NMFS 2006) to conserve biological diversity and improve chances of long-term viability (USFWS 1994). Each recovery unit can be managed separately to improve recovery efforts, but all units within the listed the species or population must exhibit signs of recovery before it can be removed from the endangered species list (NMFS 2006). Genotype clusters based upon neutral markers provide an excellent starting point for delineating this type of conservation unit (Palsboll et al. 2007). However, genetic information alone does not necessarily reflect other unique ecological, behavioral, and morphological characteristics or conservation status (Green 2005). Delineating conservation units, including the recovery unit, should not be based solely on population genetics (Paetkau 1999; Taylor and Dizon 1999; Green 2005).

The boundaries of recovery units for the Mojave desert tortoise should be revised to reflect the fine-scale genetic structure identified in this investigation and complementary demographic, ecological, and behavioral information. Across the range, we recommend delineating seven recovery units based on genetic data alone. Additionally, we recommend the retention of the current Upper Virgin River Recovery Unit. The genetic data presented here do not support this delineation; however, other unique features of these tortoises warrant protection. The tortoises located near St. George, Utah represent the northern-most extent of the distribution of this species and have different activity and habitat use patterns (Woodbury and Hardy 1948; Esque 1994; USFWS 1994). Beyond genetic data, each of the recommended recovery units for the Mojave desert tortoise contains a portion of the regional variation in survival rates, causes of mortality, and reproductive output (e.g., Nagy and Medica 1986; Peterson 1994, 1996; Henen et al. 1998; Mueller et al. 1998; Wallis et al. 1999; Tracy et al. 2004), as well as, landscape and local differences in geography, vegetation, and physiognomy. The recommended changes to delineations should be treated as new hypotheses that can be tested with additional data, including estimates of dispersal rates among proposed genotype clusters, and biotic interactions (e.g., host-pathogen relationships) within the ecologically different areas of the range of the Mojave desert tortoise (Palsboll et al. 2007).

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Landscape limits gene flow and drives population structure in Agassiz's desert tortoise (*Gopherus agassizii*)

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Distance, environmental heterogeneity and local adaptation can strongly influence population structure and connectivity. Understanding how these factors shape the genomic landscape of threatened species is a major goal in conservation genomics and wildlife management. Herein, we use thousands (6,859) of single nucleotide polymorphism markers and spatial data from hundreds of individuals ($n = 646$) to re-evaluate the population structure of Agassiz's desert tortoise (*Gopherus agassizii*). Analyses resolve from 4 to 8 spatially well-defined clusters across the range. Western, central, and southern populations within the Western Mojave recovery unit are consistent throughout, while analyses sometimes merge other recovery units depending on the level of clustering. Causal modeling consistently associates genetic connectivity with least-cost distance, based on multiple landscape features associated with tortoise habitat, better than geographic distance. Some features include elevation, soil depth, rock volume, precipitation, and vegetation coverage, suggesting that physical, climatic, and biotic landscape features have played a strong evolutionary role restricting gene flow between populations. Further, 12 highly differentiated outlier loci have associated functions that may be involved with neurogenesis, wound healing, lipid metabolism, and possibly vitellogenesis. Together, these findings have important implications for recovery programs, such as translocations, population augmentation, reproduction in captivity and the identification of ecologically important genes, opening new venues for conservation genomics in desert tortoises.

A major goal in conservation genetics involves understanding how landscape features inf uence population connectivity and structure[1,2]. Heterogeneous environments, geographic distance and life-history traits, such as longevity, mating behavior, and potential for dispersal, can af ect rates of gene fo w across a species' range. Agassiz's desert tortoises (*Gopherus agassizii*) are long-lived, have low-motility, and inhabit one of the most arid environments in North America[3,4]. Populations of *G. agassizii* have been assessed genetically[5–10] since the species was prioritized for conservation[11,12]. One focus has been the redefni tion and delineation of recovery units, originally proposed in the *Desert Tortoise Recovery Plan*[12], based on clustering methods from population genetic data. While some patterns of population genetic structure have been resolved consistently, marked dif erences in experimental design, numbers of samples, and sampling strategies fostered inconsistent results, in particular with respect to the resolution of the Western Mojave recovery unit[9,10,12].

Previous studies have recognized the importance of isolation-by-distance (IBD) as a factor modulating genetic connectivity among desert tortoises[9,10,13,14]. IBD is an evolutionary process by which genetic dif erences between

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individuals and/or populations increase with geographic distance[15,16]. The main biological assumption is that many organisms have limited dispersal leading to geographically restricted mating. While geographic distance is an important part the landscape, it is insensitive to the environment, which can be an important source of divergence[17,18]. Isolation-by-environment (IBE) and isolation-by-resistance (IBR) are two ways in which the effects of landscape heterogeneity can be measured with respect to genetic connectivity. Because IBR can conflate both IBE and IBD in empirical data[17], it can be desirable to explicitly test for IBE, together with IBR and IBD, to untangle multiple competing patterns. A means to accomplish this is to treat IBD as the null hypothesis, against which multiple IBE and IBR models can be tested. While IBE models use overall environmental distances, IBR uses environmental friction or resistance as a proxy for probability of dispersal, where lower resistance leads to higher dispersal[16]. Environmental friction can be quantified by the least-cost distance (LCD), which is the path between two points that accumulates less friction and resistance-distance (RD), which uses circuit-theory to simultaneously weigh many possible routes across a landscape[18].

Landscape genetics models on *G. agassizii* have reported stronger support for IBD than for IBR[13,14]. However, at a fine spatial scale (<100 km^2), Latch *et al.*[14] found weak population structure and weak influence of natural (e.g., slope) and anthropogenic (e.g., roads) factors on genetic connectivity in one population in the central Mojave Desert. Over a broader scale, Hagerty *et al.*[13] used habitat suitability scores from a model of the distribution of desert tortoises[19] to quantify landscape friction with LCD and RD. Their results suggested distance due to barriers, such as mountains and deep valleys, are major landscape features limiting gene flow. However, their barrier model was not better than the null IBD expectation[13]. Moreover, these landscape genetic studies have relied on Mantel tests to identify explanatory variables, a method which has been heavily critiqued[20–22]. After comparing a suite of popular methods for assessing spatial correlation, Shirk *et al.*[23] suggested that linear mixed-effect models using maximum-likelihood population effects[24] and reciprocal causal modeling[16,25] were among the most consistent methods; these have not been applied yet for desert tortoises. Furthermore, previous studies on tortoises have relied on at most 20 selectively-neutral microsatellite markers, which inform only about random, stochastic changes in allele frequencies. Genome-wide single nucleotide polymorphisms (SNPs), alternatively, are generally more abundant and can potentially inform about adaptive processes acting upon specific alleles[26,27].

The genome era promises to resolve many conservation genetics issues associated with breadth of data, marker evolution (e.g., neutral vs. selected sites) and scalability[27]. For instance, thousands of selectively neutral markers can accurately estimate effective population sizes (minimum number of genetically viable individuals) and migration rates (frequency of inter-individual gene exchange), both of which are evolutionary measures critical for assessing conservation status. Further, genomic sites under selection can identify adaptations associated with geographic features, adding potential links to the environment[27,28]. Landscape genomics extends the amalgamation of population genetics and landscape ecology (landscape genetics) on two fronts: (1) access to thousands of putatively independent markers across the genome, which should increase analytical accuracy; and (2) access to genetic data that may be subject to evolutionary forces other than drift, such as natural selection and linkage[29]. The distribution of genetic variation across landscapes can reflect intricate interactions between the environment and evolutionary processes affecting population structure and adaptation to local conditions[30].

The recently published genome of *G. agassizii* provides a unique resource to study the genomic basis of desert adaptations, and factors related to health, disease, and longevity[31]. Likewise, such data can facilitate population genomic analyses by serving as a reference for mapping variants that can be linked to functional regions. Reduced-representation-sequencing approaches, such as double-digest restriction-site associated sequencing (ddRAD-seq), are rapid, reliable, and cost-effective for generating thousands of SNPs across the genome for hundreds of individuals[32]. These approaches may significantly advance evolutionary and conservation analyses for many species[28,33].

Herein, we report an analysis of ddRAD-seq data comprising thousands of markers for hundreds of Agassiz's desert tortoises. Our aim is to comprehensively re-assess population structure throughout the species' range and provide an understanding of how landscape features influence genetic connectivity. We also seek to associate outlier loci with the functions of neighboring genes and model their distribution in an attempt to better understand local adaptation using reverse ecology. Lastly, we anticipate that our results will better inform wildlife management decisions for recovering declining desert tortoise populations[34].

Materials and Methods

Sampling. We evaluated 538 samples of *G. agassizii* from the Marine Air Ground Task Force Training Command, Marine Corps Air Ground Combat Center, Twentynine Palms, California. These samples came mainly from 23 locations in the southern Mojave region. In addition, we used archival DNA samples employed in Murphy *et al.*[9] ($n = 494$), which came from hand-captured tortoises whose blood was salvaged from other research projects[7,35–37]. For these, samples were collected at 31 locations across the Mojave and Colorado deserts (electronic Supplementary File S1), except for Nevada and the Beaver Dam Slope in Utah[9] (Fig. 1). In total, 1032 samples were processed. In the field, animal-handling procedures followed federal and state protocols which adhered to U.S. Fish and Wildlife Service guidelines. Samples were collected under research permits from the California Department of Fish and Game and U.S. Fish and Wildlife Service (TE-06556, TE-17730, BO 8-8-11-F-65R), and complied with the Animal Care and Use Committee of the U.S. Geological Survey and the Animal Research Committee at the University of California, Los Angeles.

Laboratory procedures and next-generation sequencing. Total genomic DNA was isolated from 50–100 µl of whole blood in 750 µl lysis buffer (50 mM Tris pH 8.0; 50 mM EDTA; 25 mM Sucrose; 100 mM NaCl; 1% SDS) by overnight lysis with proteinase K at 55 °C, followed by robotic extraction using a QIAGEN BioSprint 96 robotic magnetic-particle purification system (Qiagen, Valencia, California, USA) and Invitrogen Dynal bead extraction chemistry (Life Technologies, Carlsbad, California, USA). The recovered DNA was quantified using a

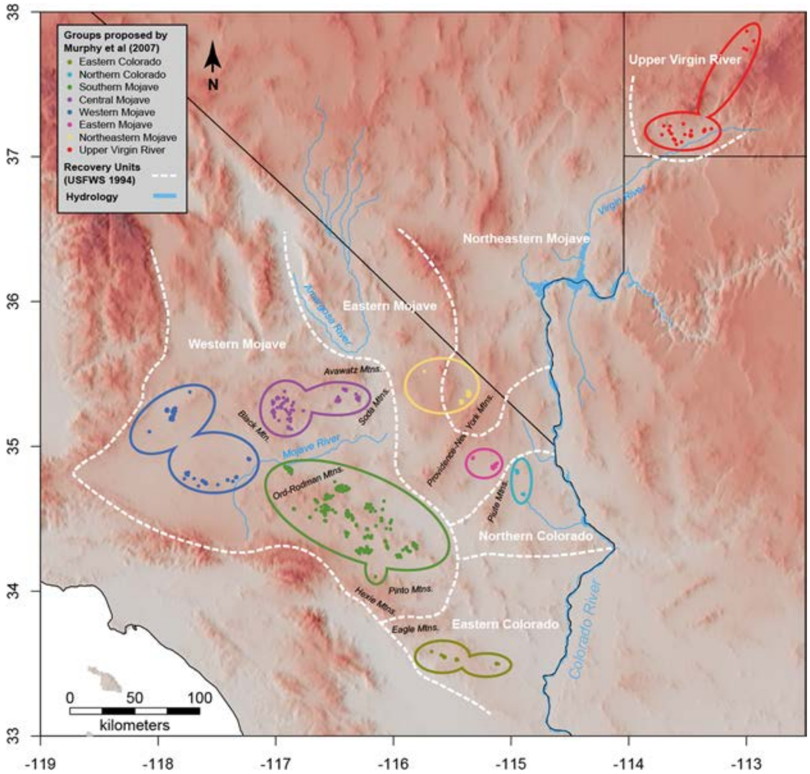

Figure 1. Map of the area with orographic and hydrological details that might act as barriers. USFWS[12] recovery units are delineated in white. Points represent samples used in this study and are colored by the populations inferred by Murphy *et al*.[9]. T e hillshade ef ect was computed using the *hillShade* function in the R package *raster*[46] af er extracting slope and aspect rasters from elevation data at a resolution of 3.6 arc seconds (USGS, and Japan ASTER Program, 2011, SC:ASTGTM.002:2088835414, 1B, USGS, Sioux Falls, 2011-10-07, downloaded from https://earthexplorer.usgs.gov/). T e map was generated with the R package raster v2.6 (https://cran.r-project.org/web/packages/raster/index.html).

BioTEK Synergy HT (BioTEK, Vermont, USA) and diluted working stocks to 5 ng/µl in Low TE (10 mMTris-pH 8.0, 0.1 mM EDTA). Genotyping was performed at the University of Arizona Genetics Core following the protocol of Peterson *et al*.[32]. In brief, genotyping consisted of cutting genomic DNA with two restriction endonucleases (*Sph*I and *Mlu*CI), followed by size-selection, PCR amplifc ation, quantifc ation, and adaptor ligation. Barcode adapters, which recognized individual samples, were ligated to each fragment. Samples were pooled as equimolar concentrations, having 43–48 samples per pool (7 pools per sequencing lane). Libraries were later massively pair-ended sequenced using 4-5 fo w-cell lanes with Illumina HiSeq2500 at a read length of 100 bp.

Bioinformatics. Sequences were retrieved from the University of Arizona Genetics Core server and transferred to SciNet, a high-performance computing server at the University of Toronto. All Illumina pair-end sequence data were f ltered for quality control, de-multiplexed (separated and clustered into groups of reads based on individual-level sequence tags) and assembled using *Stacks* v1.44[38], a sof ware package for restriction-site associated sequencing analysis. Raw reads were initially processed with the program *process_radtags*, f ltering all reads with at least one uncalled base (-c option), reads with at least 10% of their length (about 10 bp) having contiguous low-quality bases (<20 Phred score; options: -q -w 0.1 -s 20), and recovering ambiguous barcode tags (-r option). De-multiplexing involved looking for a four-base in-read barcode tag, followed by the restriction site of *sph*I on forward reads (–renz_1 sphI), and the restriction site of *mlu*CI (–renz_1 mluCI) on the reverse end, and the Illumina library index in the FASTQ header (–inline_index). Next, de-multiplexed sequences were mapped (locally aligned) to the reference genome of *G. agassizii*[31] using *Bowtie2*[39] and the following settings: -D 15 -R 2 -N 0 -L 20 -i S,1,0.75. T e resulting sequence alignment/map f le was converted to binary data, sorted, and indexed with *Samtools* v1.3.1[40]. Locus identifc ation, cataloging, and re-matching were performed with *pstacks*, *cstacks*, and *sstacks*, respectively. Only stacks with a read depth of ≥5 (-m in *pstacks*) were kept. For cataloging, loci were determined by genomic position (-g), allowing a maximum of 3 mismatches per sample locus (-n in *cstacks*). A variant-call format f le was generated by the program *populations* (*Stacks*) reporting all variable sites per locus (e.g., scaf old/contig); loci found in at least 50% of the samples were retained. In a second f ltering step, SNPs with a minor allele frequency below 0.001 were excluded, retaining the SNP with the highest minor allele frequency per linkage group (scaf old) using a Perl script (https://github.com/santiagosnchez/sing_snp_vcf).

Population structure. We assessed population structure with *Admixture*[41], which can efcien tly handle thousands of SNPs and uses a block relaxation algorithm that accurately estimates ancestry coefcien ts per individual. To select the best genetic group size (K), 10 bootstrap runs were executed using a 5-fold cross-validation (50 cross-validations per K) for K values ranging from 1 to 10. Only the K cluster with the smallest cross-validation error and signifc antly (Wilcoxon rank sum test) dif erent bootstrapped cross-validation distributions was used for subsequent analyses; other K clusters that were only marginally worse were reported. Q-matrices were imported into R v3.4[42] and bar plots with stacked proportions of ancestry per individual were generated.

In addition to *Admixture*, a discriminant analysis of principal components (DAPC)[43] was performed using the R package *adegenet*[44]. T e discriminant analysis of principal components used ordination to graphically depict total genetic variation, maximizing between-group genetic variation, while minimizing within-group variation. Given that the analyses did not allow inclusion of missing data, missing genotypes were substituted for the mean of the available data per locus, where allelic data represented allelic counts separated into two columns (e.g., for a homozygote AA, heterozygote AT, and homozygote TT, the genotypes would be represented as [2,0], [1,1], and [0,2], respectively). DAPC required the *a priori* selection of both the number of retained principal components (PCs) and the number of discriminant functions. T us, analyses ran a 50-fold cross-validation with data separated into training (90%) and testing (10%) sets (maximum number of retained PCs = 100) using the function *xvalDapc* in *adegenet*. Af erwards, the optimization with the best trade-of between retaining too few or too many principal components was selected. Ordinated genetic distances were then visualized in a scatter plot and colored by genetic cluster in R[42].

Spatial interpolation of ancestry coefficients. Te Q-matrix generated by *Admixture* was used to predict ancestry coefcien ts on a spatial grid. An R implementation of Kriging interpolation (the *Krig* function from the package *fe lds*[45]) was applied using a scaling theta of 1, assuming that the unknown covariance was a realization of a Gaussian random spatial processes. To improve model predictions, 200 random locations from outside the predicted distribution were added. For this, a binary grid mask based on the species distribution model (SDM) was generated, which included habitat suitability values above a minimal threshold of 0.2 (based on multiple cross-validation evaluations, see *Species distribution model* below). To exclude internal areas with low suitability scores, the raster was converted to polygons (*rasterToPolygons*) and we used only the polygon with the largest area (electronic Supplementary data S3). Random coordinates of cells outside this polygon were sampled and assumed to have an ancestry coefcien t of zero for all groups. Once Kriging models were generated for each group, the *interpolate* function (bilinear method) from the package *raster*[46] was used to extrapolate ancestry coef-fcien ts to the whole surface. Finally, all cells that had ancestry coefcien ts below the 80% quantile were ignored. Ti s approach was similar (i.e., same under-the-hood functions) to the package *tess3r*[47].

Species distribution model. T e distribution of *G. agassizii* was reconstructed based on 11 environmental variables that were proposed previously to represent desert tortoise distribution[19]. T ese variables encompassed topography (elevation and slope), climate (precipitation and temperature), soil (depth to bedrock, f ne earth density, coarse fragment volume) and vegetation (vegetation coverage) (Table 1). A detailed variable explanation and plausible connections to tortoise biology and ecology were supplied as electronic Supplementary f le S2. All grid/raster data were downloaded at a resolution equal to or higher than 0.01 degrees or 1,000 × 1,000 meters. Raster f les with higher resolution were downscaled to 0.01 degrees in R, using the *aggregate* and *resample* functions from the package *raster*. All layers were adjusted to the same coordinate projection system (EPSG: 4326 or +proj = longlat + ellps = WGS84 + datum = WGS84 + no_defs) and cropped to an extent delimited by longitude: −120, −112, and latitude: 32, 38.

Presence data consisted of 1,848 downloaded georeferenced records of *G. agassizii* from the Global Biodiversity Information Facility (GBIF) server within the area of study. Af er adding our own georeferenced data, 2,565 presence coordinates were obtained. To avoid data redundancy and same-cell overrepresentation, our presence data were reduced to 645 coordinates representing cells with presence data only (600 × 800 matrix). To generate pseudo-absence data, 10,000 random coordinate points were simulated and cells (1000 × 1000 m) were selected based on those points. Cells with presence data were excluded from the absence data set.

MaxEnt[48] was employed to model habitat suitability based on the environmental data as predictor variables, and presence and pseudo-absence coordinate data. *MaxEnt*, which is a statistical machine-learning model based on the principle of maximum entropy, has been used of en for predicting distributions of species[49]. T e model was evaluated using a 10-fold cross-validation approach where all the data were separated into small training and testing sets. All statistical evaluation parameters, such as the area-under-the-receiver-operating-characteristic curve (AUC), were summarized across replicates. Variable importance was determined using a jackknife approach. Tr eshold values were estimated for each replicate and averaged. Habitat suitability scores were inferred using the *predict* function of the package *raster*. Because *G. agassizii* mostly occurs west and north of the Colorado River, we excluded suitability scores east of the Colorado River in the SDM (see electronic Supplementary f le S3).

Geographic- and landscape-based distance matrices. An individual-based approach was used to test for IBD, IBE and IBR. First, genetic distances were estimated with the function *dist_amova* using multivariate genotypic data in the R package *gstudio*[50]. T ese distances were equivalent to the sum of the squared Euclidean distance between the ith and the jth genotype[51,52]. Next, matrices with Euclidean geographic and environmental distances were constructed, as well as landscape resistance distances either based on LCD or RD[18]. To have a single individual per cell, one individual was randomly selected in cases where more than one individual was found per cell. Samples from the Upper Virgin River recovery unit (electronic Supplementary f le S3) were excluded due to the sampling gap between California and Utah. Af er this reduction, data for 277 individuals were analyzed. All raster and spatial objects were transformed to Universal Transverse Mercator (UTM) units either using the *projectRaster* or the *spTransform* functions from the R packages *raster* and *sp*. T e spatial resolution of all raster grids was 1000 × 1000 m. Euclidean distances were calculated using the R function *dist*, and given that UTM units were

Variable (abbrev.)	Ecology	Units	Value range	Source
Elevation (elev)	Topography	m	(−74.91, 4066.31)	ASTER GDEM
Slope (slope)	Topography	radians	(0, 0.52)	*terrain* function in R package *raster*
Absolute depth to bedrock (d2b)	Soil	cm	(0.00, 65155.67)	SoilGrids[106]
Bulk density of fn e earth (bd)	Soil	kg/m^3; depth: 30 cm	(1037.29, 1749.79)	SoilGrids
Coarse fragment volume (cfv)	Soil	percent (%); depth: 30 cm	(0.00, 62.11)	SoilGrids
Wettest quarter mean temperature (Nov–Jan) (bio8)	Climate	°C	(−7.96, 33.20)	WorldClim v2[107]
Driest quarter mean temperature (April–June) (bio9)	Climate	°C	(−4.17 33.01)	WorldClim v2
Wettest quarter mean precipitation (Nov–Jan) (bio16)	Climate	mm	(19.0, 556.3)	WorldClim v2
Driest quarter mean precipitation (April–June) (bio17)	Climate	mm	(0.00, 116.55)	WorldClim v2
Vegetation coverage during the summer (June 2006) (vegS)	VegetationS	NDVI	(−0.20, 0.86)	eMODIS
Vegetation coverage during the winter (Feb 2005) (vegW)	VegetationW	NDVI	(−0.19, 0.93)	eMODIS

Table 1. Environmental variables used for species distribution modeling (see electronic supplementary f le S2). Elevation and vegetation data were downloaded from https://earthexplorer.usgs.gov; soil data were downloaded from https://www.soilgrids.org; and climate data was downloaded from http://www.worldclim.org. ASTER: Advanced Spaceborne T ermal Emission and Refe ction Radiometer, GDEM: Global Digital Elevation Map, eMODIS: EROS Moderate Resolution Imaging Spectroradiometer, NDVI: Normalized Dif erence Vegetation Index.

meters, Euclidean distances were scaled to km. Data from all environmental layers (Table 1) were proportionally rescaled to f t values between 1 and 10. For environmental distances, we extracted environmental values for subsampled individuals with genetic data ($n = 277$) and for all rasters. T en, we calculated Euclidean environmental distances between individuals.

Expert opinion has been the most common way to empirically assign resistance values. Analytical approaches that involve applying parametric statistical models based on individual distributions have been shown of en to be more f exible, informative, and pragmatic[53]. T erefore, we assigned resistance values analytically. First, we extracted the values of cells with presence data ($n = 1,848$) and calculated the density distribution (*density*) for each variable. T en, we f tted cubic smoothing splines (*smooth.spline*) with the values of the density distribution as the response variable and the sampled environmental values from the distribution as predictor variables. We used this model to extrapolate density values to all data cells for each raster. Resistance was assumed to be 1–*density* to assign lower values to cells with higher density or less friction. T e cell values in all rasters were again rescaled [1, 10]. We did this for all environmental variables except for the SDM, where direct habitat suitability (1–*suitability score*) was taken as a proxy for resistance; low suitability scores equaled higher resistance. Similarly, slope was evaluated by using both the degree of the slope as a measure of friction and by using the density approach described above. To improve computational efcien cy, all 12 layers were trimmed to a polygon defn ed by the convex Hull of the largest polygon in the SDM (electronic Supplementary f le S3).

LCD was calculated using the function *costDistance*, which is based on Dijkstra's algorithm, in the R package *gdistance*[54]. First, a conductance *transition* object was generated on all layers, considering the eight immediate neighboring cells. Because *gdistance* required transition objects for conductance, rather than resistance values, the function 1/*mean*(*resistance*) was used to obtain a conductance matrix. An R script (https://github.com/santiagosnchez/runCS) that ran *CircuitScape*[55] in the background was used to calculate RD, directly loading matrices as *dist* objects in R. Least-cost distance and resistance distance matrices were linearized as vectors and stored as data frames.

Statistical analyses. Following Shirk *et al.*[23], two approaches for model evaluation were used. T e fr st approach used linear mixed-ef ect modeling with MLPE[24]. Models were f tted using the function *MLPE.lmm* in the R package *ResistanceGA*[56]. Population assignments ($K = 5$) for every pair of individuals or every distance value in the matrix were used to build the correlation structure. Ti s information was specife d as a sparse matrix, which was built using a matrix with two columns and $n(n-1)/2$ rows (n is the number of individuals), to the ZZ argument in the *MLPE.lmm* function. T e model considered the relationships between genetic distances and the predictor distances as fx ed ef ects, and the population structure relationships as random ef ects. Univariate models were compared using the Akaike Information Criterion (AIC)[23,57] and Bayesian Information Criterion (BIC) with maximum likelihood, not restricted maximum likelihood (REML), as REML has caused issues in mixed-ef ect model comparisons[58]. *MLPE.lmm* used the *lme4*[59] package internally.

T e second approach applied reciprocal causal modeling (RCM) with partial Mantel tests[16,25]. T e *mantel* function in the *ecodist* package[60] was used to perform partial Mantel tests for each pair of variables. In every case, the R_m (Mantel's R) was calculated using 999 permutations having one of the variables as the main variable and suppressing the alternative variable (model A). T e reciprocal test (model B) was performed next. If the dif erence in R_m between model A and model B was positive, then the test favored model A, and if it was negative or zero it favored model B[61]. As in Ruiz-Gonzalez *et al.*[61], $R_{mA} - R_{mB}$, results were reported in a colored heat map where red colors indicated negative values and blue colors indicated positive values. $R_{mA} - R_{mB}$ values were summed for each column to simplify variable ranking. T e heat map was plotted using the R package *plotly*.

Outlier loci detection analysis. *BayeScan* v2.1[62] was used to detect outlier loci ($n = 646$, loci = 6,859). Ti s used a Bayesian multinomial Dirichlet model to estimate allele frequencies and F_{ST} coefcien ts, which were then decomposed into population-specifc (beta) and locus-specifc (alpha) components. Loci for which the locus-specifc component was necessary to explain the observed variation were considered non-neutral (e.g., alpha signifc antly dif erent than 0). Positive alpha values indicated that the locus was under positive diversifying selection, while negative values indicated negative purifying selection. A reversible-jump Monte Carlo Markov chain was then used to select one of two models, in which the alpha component was added or not. Before running the program, a VCF f le was converted to the input format required by *BayeScan* for SNP data (https://github.com/santiagosnchez/vcf2bayescan). Next, *BayeScan* was run with default MCMC settings (-n 5000 -thin 10 -nbp 20 -pilot 5000 -burn 50000), except for the posterior odds prior (pr_odds), which was set to 100. Increasing the posterior odds prior increased the sensitivity and made the analysis more conservative, particularly because more than 1,000 markers were analyzed. Outlier loci were detected by plotting the F_{ST} coefcien ts against the $\log_{10}$ of the posterior odds, and the *q*-values (false discovery rate analog of *p*-value) against alpha. Tr esholds were marked by 2 ($\log_{10}(100)$) on the x-axis, and *q*-value of 0.05 on the y-axis, for each case. T e *closest* function in *bedtools* v2.26[63] was used to fn d the closest annotated gene for each outlier locus.

T e distribution of the minor allele (lowest frequency allele) of outlier loci was modeled in a similar way as in the spatial ancestry interpolation. A VCF f le with outlier SNPs was imported into R using *read.vcf* from the package *pegas*[64]. T en each locus was converted to a numeric multivariate format in which both alleles were separated into homozygotes (1 or 0) and heterozygotes (0.5). T e spatial analysis was done as described earlier using Krig interpolation. Ti s analysis was only performed on loci that were close to annotated genes to facilitate physiological interpretation in a spatial context.

Data availability. Sequencing data were deposited in NCBI under the BioProject ID PRJNA450441. Scripts used for bioinformatics were made available through GitHub (https://github.com/santiagosnchez). All other data were supplied as online supplementary f les.

Results

Sequence and SNP data. An average of 930,203 reads (SD = 1,335,739, min = 3,098, max = 15,846,603, n = 1032) were generated per individual af er quality control f ltering. From these, an average of 906,208 reads were successfully mapped to the reference genome. Read depth averaged 13.6 across all samples (SD = 16.8, max = 1049.7). T e average number of scored loci was 54,152 (SD = 47,805.54, min = 5,014, max = 342,811, n = 845) per sample af er excluding samples with less than 5,000 scored loci. Due to poor data-yield, 386 samples were excluded (good quality, $n = 646$ af er exclusion). We catalogued 1,046,121 loci, most of which were excluded for not being present in at least 50% of all samples. Ultimately, af er f ltering out low quality data, 6,859 SNPs were retained for analyses.

Genetic structure. A group size of 5 clusters ($K = 5$) had the lowest cross-validation error (CVE = 0.42897), followed closely by $K = 4$ clusters (CVE = 0.42979; Fig. 2A,B). *K* values ranging from 3 to 9 had marginally worse errors (Fig. 2A,B). For $K = 5$, groups included the following proposed recovery units based on Murphy *et al.*[9]: Cluster 1 (purple) represented the central Mojave group; Cluster 2 (blue) the western Mojave group; Cluster 3 (green) the southern Mojave group; Cluster 4 (yellow) included the Eastern Colorado, Eastern Mojave, and Northern Colorado recovery units; Cluster 5 (red) included Northeastern Mojave and Upper Virgin River recovery units (Fig. 2B). For $K = 5$, pairwise F_{ST} values ranged between 0.209 (between Cluster 1 and 2) and 0.283 (between Cluster 3 and 5). Recovery units that were recognized with other *K* values included Northeastern Mojave and Upper Virgin River groups ($K = 6$ and $K = 7$) and the Eastern Colorado ($K = 8$) (Fig. 2B). Eastern Mojave and Northern Colorado appeared as a single cluster at $K = 8$ (Fig. 2B). In addition, the population at Daggett, found between the southern, western, and central Mojave groups, was resolved as a distinct group at $K = 7$ and $K = 8$ (Fig. 2B). T e DAPC (Fig. 2C) was mostly congruent with the structure found by *Admixture*, as we also found 5 groups. T e group representing the most variation in PC1 and the most genetically distant was Cluster 5 (Fig. 2C). Clusters 1–4 dif erentiated from each other along PC2, with Cluster 4 being the most distinct among them. T e most genetically heterogeneous group, with ordination values more centrally distributed, was the southern Mojave (Cluster 3; Fig. 2C). T e DAPC based on the $K = 5$ clusters retained the fr st 30 PCs and three discriminant functions, while the one based on the populations from Murphy *et al.*[9] retained the fr st 60 PCs and seven discriminant functions.

Species distribution modeling. An average AUC of 0.875 (SD ± 0.021) from 10 cross-validation runs indicated a good model f t and a signifc ant deviation from random or homogeneous prediction (i.e., AUC close to 0.5). Based on Jackknife and permutation analyses, the variable depth-to-bedrock (soil) had the largest contribution to the model (average = 42.3%), followed by elevation (topography; average = 15.7%), and mean temperature during the wet season (climate; bio8, average = 13.6%). All other variables contributed from 7 to 1%, with the lowest being coarse fragment volume (soil, Table 1). Visually, the predicted SDM coincided with the Mojave and Colorado deserts. A map of the SDM excluding areas south and east of the Colorado River, and areas with habitat suitability <0.2, was supplied in electronic Supplementary f le S3.

Spatial and landscape genetics. By interpolating the ancestry coefcien ts, 5 spatially well-defn ed clusters were identife d (Fig. 3F). Most of Cluster 1 was confn ed to the north-central part of the populations in California (Fig. 3A). Cluster 2 included the far western portion of geographic range (Fig. 3B). Cluster 3 was largely conf ned to the south-central portion of the Mojave Desert with some presence of admixed individuals (Fig. 3C). Cluster 4 dominated the eastern and southern portions of California, in the eastern and northern Colorado Desert and eastern Mojave Desert (Fig. 3D). Cluster 5 (Northeastern Mojave, Upper Virgin River)

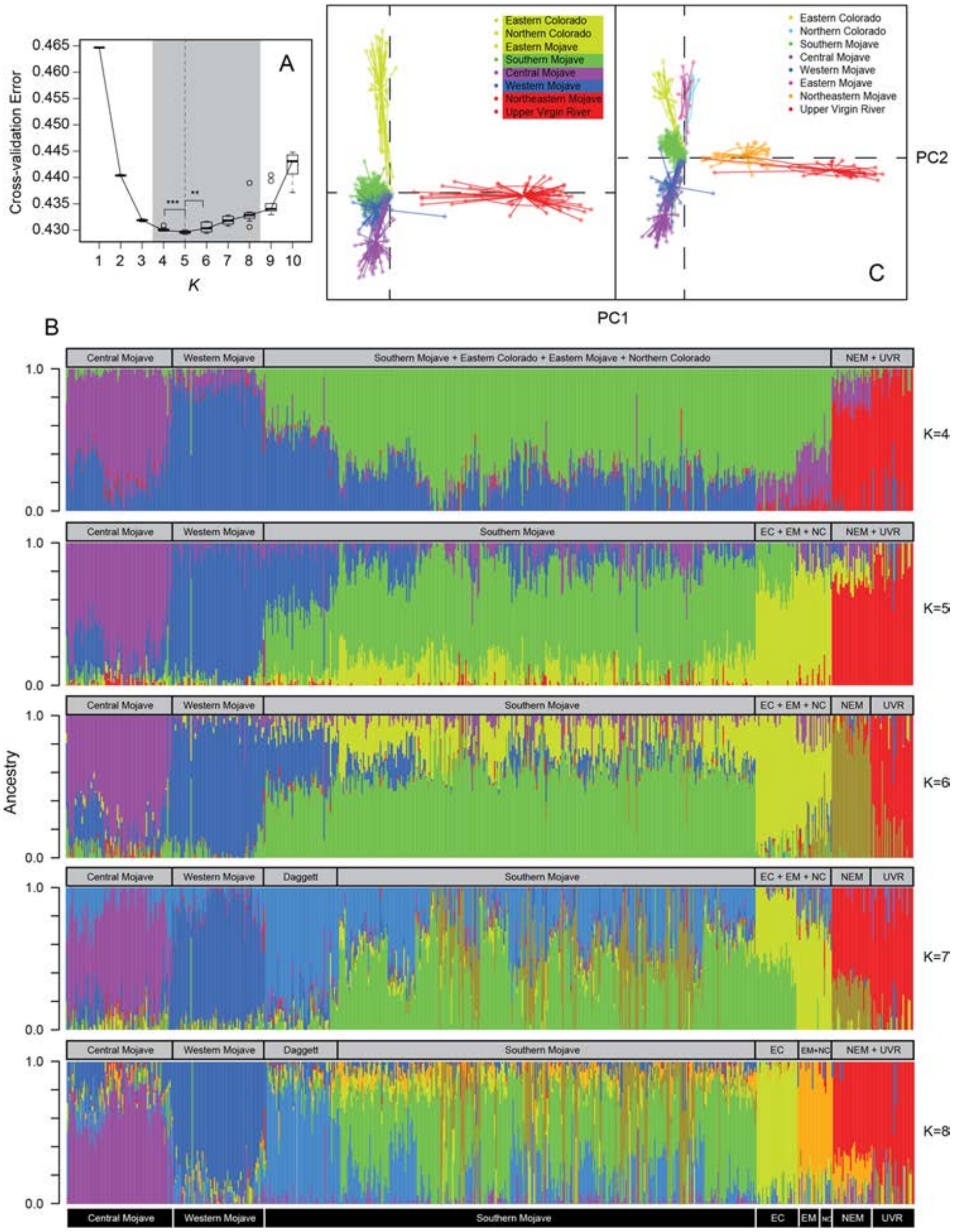

Figure 2. Analysis of genetic structure in Agassiz's desert tortoise (*Gopherus agassizii*). (**A**) Bootstrapped (n = 10) 5-fold cross-validation error estimations for clusters form $K = 1$ to $K = 10$. T e best K value is marked with the vertical dashed line. Statistically signifc ant dif erences were found between the best K, and the second and third best K values, respectively (Wilcoxon rank sum test: W = 91.5, p-value = 0.002 [***]; W = 82,5, p-value = 0.01 [**]). (**B**) Bar plot with ancestry proportions per individual for 4 to 8 clusters. (**C**) Genetic ordination analysis using the population structure inferred by Admixture ($K = 5$) and that from Murphy *et al.*[9] central Mojave (n = 81), western Mojave (n = 71), southern Mojave (n = 374), Eastern Colorado (n = 31), Eastern Mojave (n = 17), Northern Colorado (n = 10), Northeastern Mojave (n = 30), Upper Virgin River (n = 32).

stretched from the northeastern portion of the geographic range in California, into Nevada and the southwestern corner of Utah (Fig. 3E).

Both landscape genetic approaches were consistent with each other for the best selected landscape factors. For MLPE, the best model resulted in the mixed-ef ect linear correlation of genetic distance and LCD based on elevation, followed by average winter precipitation (bio16), habitat suitability (SDM), and depth-to-bedrock (d2b) (Table 2). T ese variables were better predictors of genetic distance than Euclidean geographic distances (geo) or IBD (Table 2). Similarly, LCD based on variables such as slope (based on slopeD), vegetation coverage (vegS, vegW), the volume of coarse soil fragments (cfv), and the average summer precipitation (bio9) were also better predictors of genetic distance than the null, geographic distance model. In contrast, only one RD variable (summer vegetation coverage) was better than the null model. RCM with partial Mantel tests showed similar results.

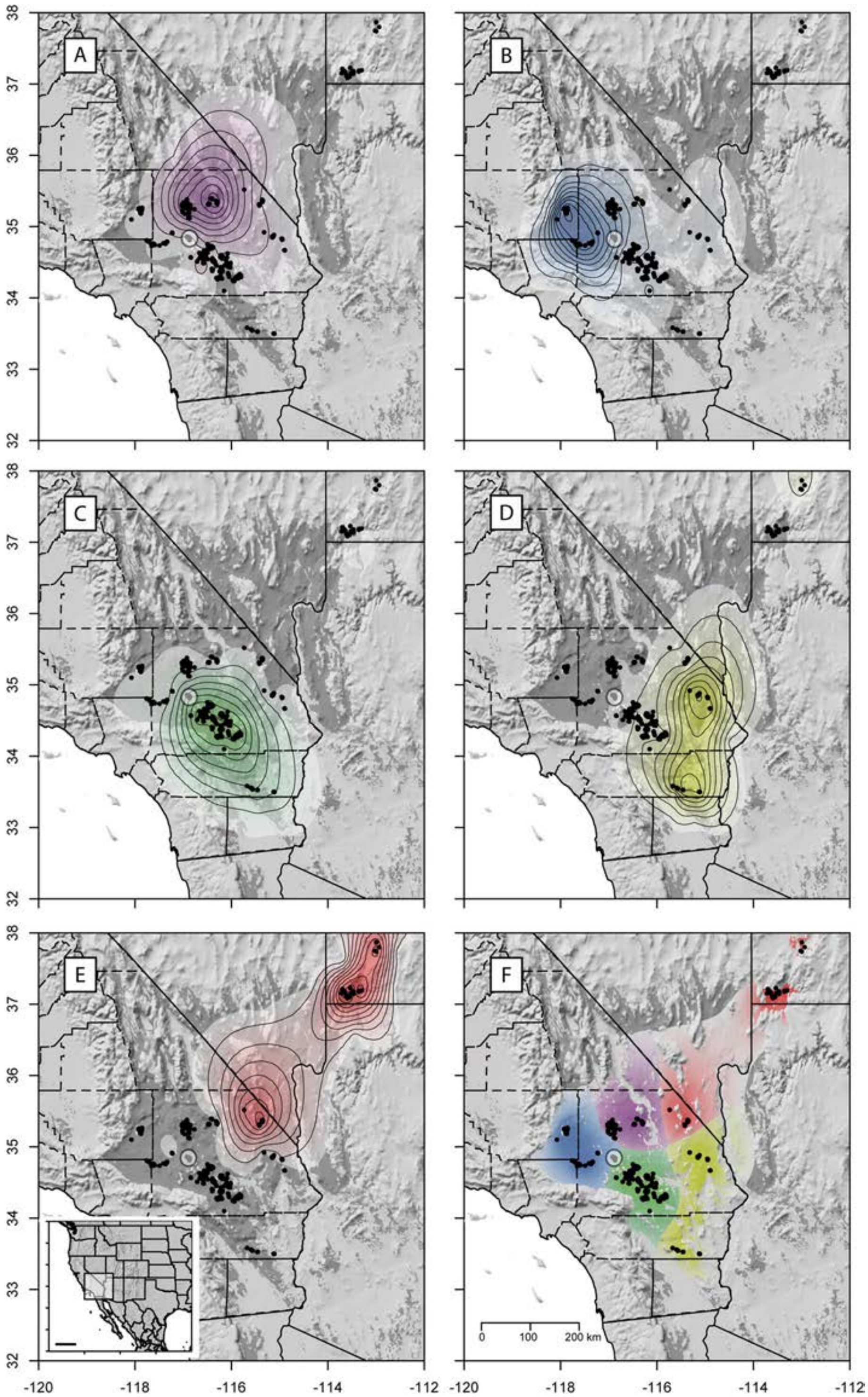

Figure 3. Spatial interpolation of ancestry coefcien ts of Agassiz's desert tortoises (*Gopherus agassizii*) using Krig modeling, superimposed on a shaded relief (made with Natural Earth. Free vector and raster map data@http://www.naturalearthdata.com/downloads/10m-raster-data/10m-manual-shaded-relief/). (**A**) Cluster 1; (**B**) Cluster 2; (**C**) Cluster 3; (**D**) Cluster 4; (**E**) Cluster 5. T e last map (**F**) combines areas of maximal ancestry proportion for each of the f ve genetic groups. In F, the total area was trimmed using the species distribution model (darker grey area). Contour lines indicate 0.1–0.9 quantiles. T e scale bar in the smaller map in E is equivalent to 500 km. T e points highlighted in the white, transparent circle indicate to the population at Daggett. Maps were generated with the R package raster v2.6 (https://cran.r-project.org/web/packages/raster/index.html).

Distance (model)	Variable	AIC	BIC	logLik	ΔAIC
LCD (IBR)	**elev**	**−58881.0**	**−58846.8**	**29444.5**	**0.0**
LCD (IBR)	**bio16**	**−58238.2**	**−58204.0**	**29123.1**	**642.9**
LCD (IBR)	**sdm**	**−57764.8**	**−57730.6**	**28886.4**	**1116.3**
LCD (IBR)	**d2b**	**−57153.7**	**−57119.5**	**28580.9**	**1727.3**
LCD (IBR)	**slopeD**	**−57051.7**	**−57017.5**	**28529.9**	**1829.3**
LCD (IBR)	**vegS**	**−56945.1**	**−56910.9**	**28476.6**	**1935.9**
LCD (IBR)	**vegW**	**−56909.8**	**−56875.6**	**28458.9**	**1971.3**
LCD (IBR)	**cfv**	**−56884.0**	**−56849.8**	**28446.0**	**1997.1**
LCD (IBR)	**bio9**	**−56881.9**	**−56847.7**	**28445.0**	**1999.1**
RD (IBR)	**vegS**	**−56874.3**	**−56840.1**	**28441.2**	**2006.7**
GD (IBD)	geo	−56820.4	−56786.2	28414.2	2060.7
LCD (IBR)	bio8	−56814.2	−56780.0	28411.1	2066.8
LCD (IBR)	slopeF	−56764.2	−56730.0	28386.1	2116.9
LCD (IBR)	bio17	−56702.8	−56668.6	28355.4	2178.2
LCD (IBR)	bd	−56611.6	−56577.4	28309.8	2269.5
RD (IBR)	bio16	−56051.5	−56017.2	28029.7	2829.6
RD (IBR)	sdm	−55851.8	−55817.6	27929.9	3029.2
RD (IBR)	slopeF	−55741.4	−55707.2	27874.7	3139.6
RD (IBR)	bio9	−55692.4	−55658.2	27850.2	3188.6
RD (IBR)	vegW	−55395.9	−55361.7	27702.0	3485.1
RD (IBR)	d2b	−55300.4	−55266.2	27654.2	3580.6
RD (IBR)	bd	−54839.2	−54805.0	27423.6	4041.9
RD (IBR)	elev	−54636.6	−54602.4	27322.3	4244.4
RD (IBR)	bio17	−54552.4	−54518.2	27280.2	328.7
RD (IBR)	cfv	−54189.8	−54155.6	27098.9	4691.2
ED (IBE)	vegW	−54175.1	−54140.9	27091.6	4705.9
ED (IBE)	vegS	−54138.7	−54104.4	27073.3	4742.4
ED (IBE)	bio17	−54111.2	−54077.0	27059.6	4769.8
RD (IBR)	slopeD	−54111.1	−54076.9	27059.6	4769.9
ED (IBE)	bio16	−53332.9	−53298.7	26670.4	5548.1
RD (IBR)	bio8	−53169.2	−53135.0	26588.6	5711.8
ED (IBE)	bio9	−53141.3	−53107.1	26574.6	5739.7
ED (IBE)	elev	−52919.0	−52884.8	26463.5	5962.0
ED (IBE)	cfv	−52901.5	−52867.3	26454.7	5979.6
ED (IBE)	d2b	−52888.9	−52854.7	26448.4	5992.2
ED (IBE)	slope	−52873.2	−52838.9	26440.6	6007.9
ED (IBE)	bd	−52868.7	−52834.5	26438.3	6012.4
ED (IBE)	bio9	−52866.9	−52832.7	26437.4	6014.2

Table 2. Mixed-ef ects linear regression modelling results with maximum-likelihood population ef ects based on least-cost and resistance-distances. SlopeD stands for 'slope resistance based on density' and slopeF stands for 'slope resistance based on friction'. Rows highlighted in bold indicate models with a better f t than IBD (GD geographic distance) based on AIC and BIC. AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; logLik, log-likelihood; LCD, least-cost distance; RD, resistance distance; ED, environmental distance; GD, geographic distance; IBD, isolation-by-distance; IBR, isolation-by-resistance; IBE, isolation-by-environment. See Table 1 for details on variable abbreviations.

Six LCD variables (elev, bio16, SDM, bio9, d2b, vegS) had overall better support than the null model (Fig. 4A). RCM did not show strong support for RD models when compared to geographic distances (Fig. 4B). With respect to IBE, none of the environmental distance matrices were better predictors of genetic distance than the IBD or IBR models (Table 2, Fig. 4C). MLPE and RCM dif ered mainly in the number and relative importance of the best supported predictor variables.

Loci under selection. Convergence of the MCMC chain in *BayeScan* was assured by plotting the log-likelihood against generations. T e prior odds value of 100 was used to select loci with $\log_{10}(PO) > 2$, which resulted in loci emitting a very strong to decisive signature (q-value > 0.99). Ti s identife d 32 outlier loci (Fig. 5A). Eighty-one outlier loci (Fig. 5B) were detected by choosing a q-value threshold of 0.05. Given that the fr st threshold was more conservative, and that the fr st 32 loci were included in the later 81, we only report the former *BayeScan* results and their closest genes with annotation (if any) in Table 3. From the 32 loci, 21 were on scaf olds with no annotations, 10 were close to an annotated gene of known function, two were close to an annotated gene of unknown function, and

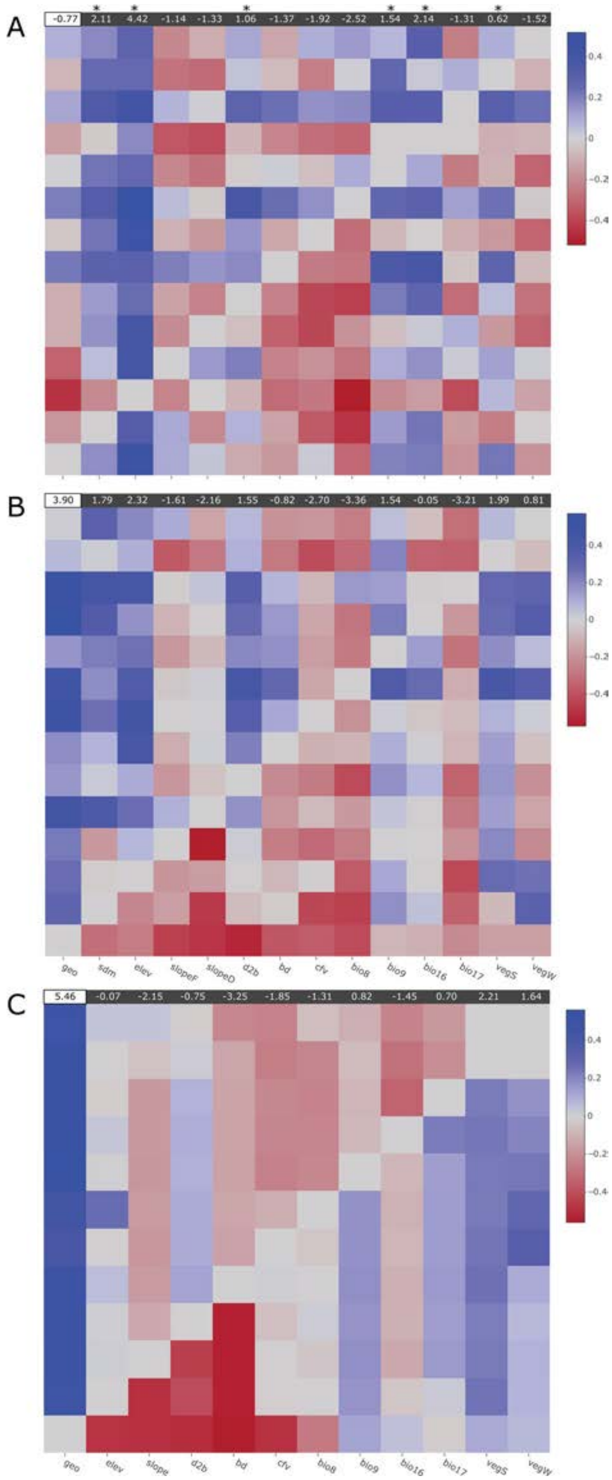

Figure 4. Pairwise heatmaps with reciprocal causal modelling results showing $R_{mA} - R_{mB}$ for (**A**) least-cost distance models, (**B**) resistance-distance models, and (**C**) environmental distance models. Columns represent the main variables and rows represent the alternative variables. T us, the fgur e should be read by columns and not by rows. For each column, blue squares indicate a supported variable against an alternative variable. Red squares indicate support for the alternative variable (degree indicated by scale on the right). On top of each heatmap the $R_{mA} - R_{mB}$ value is summed for the null model (geographic distance), marked by a white box, and the testing variables marked by a grey box. Variables that were better supported than the null model are also marked with an asterisk.

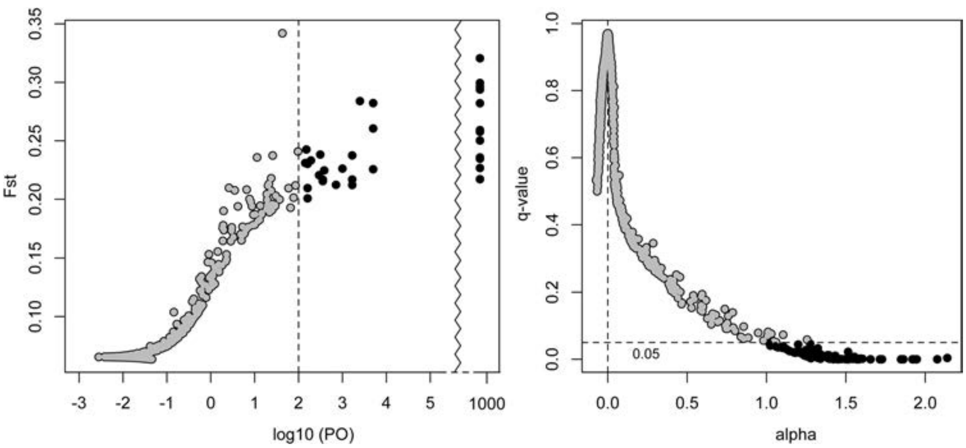

Figure 5. BayeScan outlier loci detection using a $\log_{10}$ posterior odds threshold of 100 (lef) and a false discovery rate (FDR) threshold of 0.05 (right). Values at 1000 $\log_{10}$ posterior odds in the lef panel should be infni ty because the probability was estimated to be 1; however, BayeScan automatically fx es the $\log_{10}$(PO) to 1000 in these cases. All black-colored loci had a probability ≥ 0.99.

the SNP position of f ve loci occurred within the gene (Table 3). T e f ve SNPs that were found within genes were in introns. T e farthest distance from the nearest annotated gene was 67 kbp.

T e distributions of the minor alleles of outlier loci that were on or close to annotated genes were modeled (Fig. 6). Overall, the distributions of some loci were fairly population-specifc (e.g., 3264_0, 11119_0 and 15060_0 in Fig. 6). Other alleles were found mostly among northern populations (e.g., 2293_0, 2747_0, 4574_0, 5683_0, 15846_0 in Fig. 6), or, to some extent, were rather widespread (e.g. 7003_0 and 15920_0 in Fig. 6).

Discussion

A major goal in conservation genetics involves performing spatial and genetic assessments of evolutionary significant units to gain knowledge about factors inf uencing population structure[2,65,66]. T e extent to which the landscape limits genetic connectivity may potentially inform about the species potential for dispersal and interactions with the environment[67]. Analyses of vast genotypic data (more than 6,000 SNPs), ample sampling throughout the Mojave and Colorado deserts[68], and high-resolution GIS data enable powerful insights about the spatial features and genomic composition of desert tortoise populations. T e type and volume of data of er unprecedented value for desert tortoise conservation, making possible a more accurate assignment of individuals to spatially defn ed genetic units, measurement of intra- and inter-population relationships, and allowing for identifc ation of candidate genes on which natural selection may be ocurring[27,28].

Species distribution modelling. Species distribution models are an important tool for modern spatial analyses in conservation, and other biological applications[69]. Our SDM constitutes 'proof-of-concept' by enhancing multiple analyses. For instance, it improves our spatial ancestry prediction (Fig. 3) where we characterize the absence of genetic data outside a probable distribution margin. We also use the SDM to remove ancestry predicted outside the species' known range (electronic Supplementary f le S3), visually resolving landscape features (e.g. mountains and deep valleys) that may inf uence spatial genetic structure (Fig. 3F); this step can help us identify likely contact zones between genetic groups. Lastly, we incorporate and test the SDM as a source of heterogeneity in our landscape genetic analyses, as others have done[13], f nding that individual variables can be more informative in explaining genetic connectivity than only using habitat suitability scores.

Genetic structure. Our analyses detect from four to seven genetically distinct groups (Fig. 2) with well-defn ed spatial boundaries (Fig. 3) that coincide well with existing and proposed recovery units[9,10,12]. For example, Clusters 1, 2 and 3 ($K = 5$) essentially correspond to the central, western, and southern Mojave populations proposed as recovery units in Murphy *et al.*[9]. Some agreement also occurs with respect to the Eastern Colorado, Northeastern Mojave, and Upper Virgin River populations at $K = 6$ and $K = 8$. To a large extent, our second DAPC analysis (Fig. 1C), based on the populations delimited in Murphy *et al.*[9], mirrors their 2-dimensional scaling plot using F_{ST} distances between sampled locations (Fig. 5 in Murphy *et al.*[9]). T e high resemblance in results might be partially due to the re-analysis of many of the same samples, albeit using considerably more, new and dif erent data. Analyses of these data show strong genetic relationships within the southeastern (Eastern Mojave, Eastern Colorado, and Northern Colorado), western (western, central, and southern Mojave), and northeastern (Northeastern Mojave and Upper Virgin River) groups.

Our genome-level analyses, together with the results in Murphy *et al.*[9], support the hypothesis that the Western Mojave recovery unit, as proposed originally in the *Desert Tortoise Recovery Plan*[12], is a conglomerate of at least three distinct genetic groups. Our results contrast with the study of Hagerty and Tracy[10], which supports the Western Mojave recovery unit as a single group. In support of our hypothesis, the genetic distinctiveness of these three groups remains consistent at K values ranging from 4 to 8 (Fig. 1B), and in the DAPC analysis (Fig. 1C).

Scafo ld	SNP position	loci ID	Gene Id	Annotation	Distance in bp	alpha
scaf old6464	54911	11119_0	00009179	Roundabout homolog 2	60263	1.92
scaf old12629	133684	2293_0	00012395	Cholesteryl ester transfer protein	0	1.73
scaf old22827	31344	5683_0	00018421	Histone H4	5606	1.65
scaf old13833	49357	2747_0	00017165	T ymosin beta-4	36710	1.58
scaf old2756	134627	15060_0	00010622	Protein of unknown function	60624	1.57
scaf old551	55350	15846_0	00017701	SCO-spondin	0	1.53
scaf old15252	24572	3264_0	00018750	Disintegrin and metalloproteinase domain-containing protein 9 (ADAM9)	0	1.53
scaf old2856	267921	7003_0	00010106	Cytoplasmic aconitate hydratase	0	1.52
scaf old19223	291661	4574_0	00009239	Zinc-binding alcohol dehydrogenase domain-containing protein 2	67214	1.50
scaf old2859	55437	15163_0	00012080	Centrosome-associated protein 350	0	1.45
scaf old63	3109	15920_0	00013645	Copine-4	10969	1.45
scaf old491	6232	15794_0	00014935	Protein of unknown function	23631	1.45
C51021930	80	392_0	Not annotated	Not annotated	N/A	2.07
scaf old19860	6644	4787_0	Not annotated	Not annotated	N/A	1.95
scaf old22858	22863	5691_0	Not annotated	Not annotated	N/A	1.93
C52703107	136	690_0	Not annotated	Not annotated	N/A	1.86
scaf old20680	7416	5039_0	Not annotated	Not annotated	N/A	1.86
scaf old11896	12432	1999_0	Not annotated	Not annotated	N/A	1.85
scaf old63199	2272	11018_0	Not annotated	Not annotated	N/A	1.72
scaf old10201	20884	1311_0	Not annotated	Not annotated	N/A	1.71
scaf old3734	10067	8445_0	Not annotated	Not annotated	N/A	1.60
scaf old11541	20785	1856_0	Not annotated	Not annotated	N/A	1.58
scaf old2439	63530	14768_0	Not annotated	Not annotated	N/A	1.57
scaf old8091	75743	12255_0	Not annotated	Not annotated	N/A	1.54
scaf old16925	10756	3814_0	Not annotated	Not annotated	N/A	1.51
scaf old24177	1816	6032_0	Not annotated	Not annotated	N/A	1.51
scaf old3201	8894	7644_0	Not annotated	Not annotated	N/A	1.47
scaf old22935	7321	5705_0	Not annotated	Not annotated	N/A	1.44
scaf old12752	138732	2334_0	Not annotated	Not annotated	N/A	1.42
scaf old7716	3799	12019_0	Not annotated	Not annotated	N/A	1.42
scaf old3736	47634	8451_0	Not annotated	Not annotated	N/A	1.40
scaf old2298	8101	5715_0	Not annotated	Not annotated	N/A	1.34

Table 3. BayeScan results for 32 outlier loci. Loci are sorted by alpha value showing those with annotation on the top. Distance = 0 indicates variants that occur within a gene

Other than this disagreement, our analyses are consistent with the Eastern Colorado and Northern Colorado groups described by Hagerty and Tracy[10]. To some extent, our analyses also correspond to their groupings in Nevada and Utah (specifc ally Southern Las Vegas and Virgin River), which match our Northeastern Mojave and Upper Virgin River groups, respectively. Dif erences in sampling may account for discordance between our results and Murphy *et al.*'s compared to Hagerty and Tracy's. For instance, using stronger sampling in Nevada and Utah, Hagerty and Tracy resolved a higher level of structure than we resolve. In contrast, our study has stronger sampling in the western portion of the Mojave Desert, where we fn d a higher level of genetic subdivision. Recent genetic simulations on IBD models[69] demonstrate that population-level sampling (e.g.[9] and this study) may better resolve membership identifc ation than does random sampling (e.g.[10]) in a IBD scenario. However, we suggest that for conservation purposes all information available should be synthetized into a single framework.

Although we do not quantify gene fo w directly, and drif can also be an important factor leading to divergence, both structure and landscape genetics analyses (next section) suggest admixture patterns between the dif erent groups. T e southern Mojave population (Cluster 3) seems to be the most admixed group (Fig. 1B,C). Clusters with genetic contributions mainly include geographically contiguous populations, such as those in the western and central Mojave to the west and north, respectively, as well as the Eastern Colorado in the south. Admixture appears to occur between the central Mojave and western Mojave populations, which are close to one another (Figs 2 and 3). While few barriers exist (i.e., Black Mountain in Fig. 1) between these populations, environmental dif erences are more notorious[9]. Tortoises in the eastern and southern recovery units (Eastern Mojave, Eastern Colorado, and Northern Colorado; as described in[12]; Fig. 1) appear to be more admixed with populations in the southern, central and western Mojave than with populations in the Northeastern Mojave and Upper Virgin River recovery units (Figs 2 and 3). Admixture between the central Mojave group and populations further east may be limited by the Avawatz, Soda, Clark and Mesquite mountains. Similarly, the Northeastern Mojave

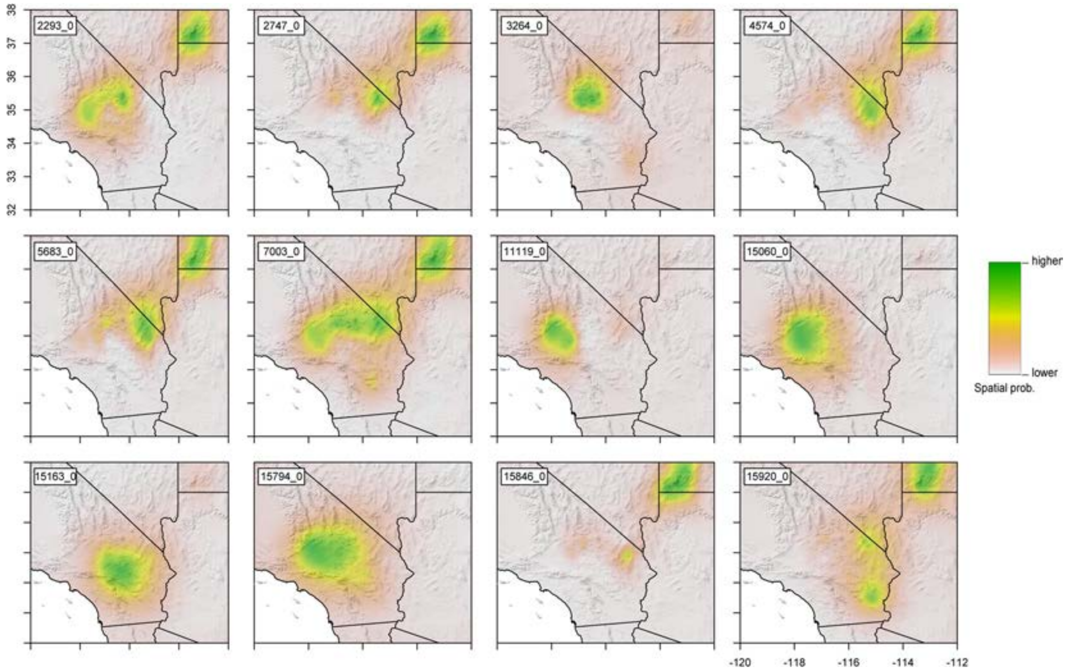

Figure 6. Spatial modelling of outlier minor alleles on or close to an annotated gene. See Table 3 for reference. Raster data is superimposed on a shaded relief (made with Natural Earth. Free vector and raster map data @ http://www.naturalearthdata.com/downloads/10m-raster-data/10m-manual-shaded-relief/). Maps were generated with the R package raster v2.6 (https://cran.r-project.org/web/packages/raster/index.html).

recovery unit and populations to the south in the East Mojave and Colorado Desert recovery units may be limited by the Providence, New York, Piute and El Dorado mountains in northeastern California and southern Nevada (Fig. 1). Despite the close geographical distance of our samples in the Northeastern Mojave recovery unit to other Californian groups (Fig. 1), this population still has a higher genetic afni ty with the more distant Upper Virgin River recovery unit (Fig. 2C,B). Ti s genetic afni ty between both groups occurs even in spite of the sampling gap in Nevada, which should result in structured populations[29].

T e extent and directionality of admixture, together with the spatially explicit genetic structure (Figs 2 and 3), suggest a pattern recognizable as IBD. Five previous studies have described IBD as a likely evolutionary force driving population structure in desert tortoises[8–10,13,14]. As the authors suggested, limited dispersal, previous and present barriers, and climatic features are thought to be important factors ef ecting genetic dif erentiation[3,9,71–74].

Landscape effects on genetic connectivity. T e ef ects of IBD are usually assessed by inspecting relationships between Euclidean (e.g., straight line) inter-individual or inter-population geographic distances and genetic distances[15]. In contrast, more sophisticated landscape genetic approaches[1] apply IBR models to evaluate the ef ect of landscape heterogeneity on genetic connectivity[16,18]. Because IBD can conf ate IBR, our assessment uses multiple IBE models in a comparative framework. Our results do not fn d a direct inf uence of raw environmental distances on population structure. In contrast, IBD and IBR models are consistently better supported than IBE, suggesting that spatial features may be more important than raw environmental dif erences. Moreover, analyses fn d that several landscape features are better predictors of genetic connectivity than geographic distances (Table 2, Fig. 4A). Some of these features also may seem to be relevant for niche partitioning between *G. agassizii* and *G. morafa i*, which are genetically close and geographically adjacent species[74].

Elevation is the best supported variable by both MLPE and RCM, and also contributes signif cantly to the SDM model. Previous microsatellite-based landscape genetic analyses have concluded that topological features restrict gene fo w in desert tortoises[13,14]. Hagerty *et al.*[13] reported that mountains and deep valleys serve to limit gene fo w, albeit with marginal support. T is reinforces f eld observations and distribution models suggesting that tortoises generally avoid steep slopes, high elevation areas, and playas[12,19,75]. Typical desert tortoise habitat can range from sandy plains to rocky or rolling foothills, including alluvial fans, washes, and canyons[12]. Tortoises also spend most of the year underground[76], which means that they are likely to be found in areas with soils suitable for burrowing or caves in well-developed calcic layers[77,78]. Ti s makes the idea of testing soil variables appealing. In fact, our analyses fn d support for variables such as the absolute depth-to-bedrock and fraction of coarse (>2 mm) soil fragments (Table 2, Fig. 4A), which might be relevant to burrowing. Depth-to-bedrock also has the highest contribution to the SDM, even more so than elevation, indicating that it is a relevant landscape feature for predicting tortoise habitat[78].

Rainfall has strong ef ects on food plant production[79–81] and provides drinking water essential for life[35,76,82]. Better nutrition and access to water can, in turn, improve health, and increase growth, activity, and reproductive output[35,37,76,82–85]. Rainfall also stimulates growth of plants (e.g., shrubs and other perennials) that provide tortoises shade and shelter, plus stability to soils that support tortoise burrows. Interestingly, our analyses fn d average winter precipitation and vegetation coverage (winter and summer) to be good predictors of genetic connectivity (Table 2, Fig. 4A). Because tortoises can fn d suitable habitat conditions at a fn e scale[86], both the scale of the study (1000 × 1000 m) and/or the high variability of the landscape due to low primary productivity of deserts, could have hindered the relationship between vegetation coverage and genetic connectivity. However, our results show that even at broader scales the amount of vegetated land, in particular perennial plants, can have a substantial impact on how desert tortoise populations are structured.

Circuit-based IBR models were introduced as more realistic alternatives to LCP analyses, which assume that individuals have preferred dispersal routes[1,16,18]. In contrast, RD is quantife d as the average random walks between locations, assuming that gene fo w happens through multiple, alternate routes[18,56]. LCD models for the best variables (Table 2, Fig. 4) are better predictors of genetic distance, which implies that genetic corridors among tortoises tend not to follow random routes. Instead, corridors may follow narrower paths that are optimal for them to increase their movement efcien cy. Noteworthy, in nature, tortoises have high site fde lity, and tend not to move far away from burrows, rock shelters and dens. Tortoises are aware of geophagy sites[87,88], drinking basins[82] and other resources (e.g., conspecifcs) in their home ranges. T us, because genetic variation accumulates over time, it is important to frame genetic connectivity as a measure that represents evolutionary tendencies of genetic exchange, and not as a measure that represents contemporary movement.

Management perspective. Understanding the genetic units of tortoises is important for managing this threatened species. Genetic units, among other factors, form the basis of recovery units for the Mojave population of desert tortoises[12]. It is possible to improve management techniques, including population augmentation (e.g., headstarting and translocation), by incorporating knowledge of genetic boundaries and distances that tortoises should be moved. Our analyses delineate genetic population boundaries by using robust sampling for most of the species' geographic range. T ese genetic boundaries are similar but not identical to those proposed by Murphy *et al.*[9] and Hagerty and Tracy[10].

Averill-Murray and Hagerty[89], using genetic boundaries drawn by Hagerty and Tracy[10], wrote that populations "within a 200–276 km straight-line radius of each other (249–308 km measured around topographic barriers) tend to be genetically correlated and may be considered single genetic units for management purposes.". Our fn dings, drawing on more robust genetic analyses, indicate the prudence of considering the importance of population boundaries in addition to distance. Distances of 200 km extend across several genetically identif able populations (i.e., western Mojave, central Mojave, Daggett, and the southern Mojave) in the Western Mojave recovery unit, and across genetically identif able populations in the southern Mojave to the eastern Colorado Desert. Mixing genetic populations could lead to outbreeding depression, failure to integrate, thrive, and survive[9,90,91], or outbreeding vigor[90], although there are no 'common garden' studies[92,93] or other empirical investigations that explore these phenomena for *G. agassizii*. Via conservative management, however, we may limit risks by avoiding population augmentations across genetic population boundaries or over long distances[94]. Consistent with this approach, headstart tortoises in the western, central, southern, and northeastern Mojave genetic populations are being placed within their genetic population of origin.

Loci under selection and their functions. Our analyses consider outlier loci for two reasons. First, we confr m that the majority (99.5%) of loci are neutral, which is an assumption in models of population structure[95]. Second, the approach can identify genes or neighboring genes of loci that strongly conform to a non-neutral model[26]. In a recent conservation genomics study of the Burmese roofed turtle (*Batagur trivittata*), from about 1500 SNPs, not a single locus departed signifc antly from neutrality[96]. In contrast, our analyses discover at least 32 loci under potential diversifying selection. Among 12 loci that associate with annotations, f ve variants occur within introns of f ve genes (Table 3), upon which the ef ects of selection are likely to be stronger due to linkage[97,98], if, in fact, these genes are targets of selection. Analyzing RNA expression of these candidate genes can help understand their f tness ef ects. Likewise, d_N/d_S-type analyses of sequence data for the whole gene and multiple species can also provide additional evidence for selection.

Some genes in the vicinity of these loci have functions that may be involved with neurogenesis, wound healing, lipid metabolism and vitellogenesis. More specifc ally, noteworthy functions include the following: Beta-thymosin (IPR001152), a multi-function protein involved with cellular processes such as wound healing, actin formation (muscle development), embryonic organ development, and disease pathogenesis[99,100]; *ADAM9* (IPR006586), a membrane-anchored protein involved with cell adhesion, fertilization, muscular development and neurogenesis[101]; Roundabout homolog 2 (IPR032985) and SCO-spondin (IPR030119), which are independently related to axonal migration, growth, neural development, and tissue development[102]; and cholesteryl ester transfer protein (IPR017130), with functions related to lipid and cholesterol control[103].

T e direct relationship between allele frequencies, gene functions, and their implication on the biology of tortoises is difc ult to assess. However, the cholesteryl ester transfer protein (IPR017130) might point to interesting future research given the association of lipid metabolism with energy storage and vitellogenesis among desert tortoises[37,85]. Lipid metabolism helps females increase body lipid reserves they use subsequently during periods of low resource availability, such as drought and brumation, and stimulates egg production[85]. Cholesterol and triglyceride levels have been found to vary between females and males, and among seasons, where they are high in spring when females are preparing eggs[37]. Egg production among female desert tortoises varies with the amount of rainfall or concomitant primary production[81,104] and distribution (i.e., East-to-West Mojave[108]). However, our results show that the minor allele associated with the cholesteryl ester transfer protein occurs mostly in northern areas (Fig. 6: 2293_0) and has no east-to-west variation. Moreover, this protein may serve other functions. For instance, a variant of the cholesteryl ester transfer protein in humans has been linked to larger high- and low-density lipoprotein particle sizes, which may decrease hypertension and cardiovascular disease, therein promoting longevity[105]. A recent comparative genomic analysis in chelonians has revealed several genes involved with longevity and fatty acid metabolism to be under a high rate of molecular evolution[31].

Conclusions

Landscape genomics aims at identifying complex interactions between the environment and the genome of individuals in a population. T ese interactions include, but are not limited, to how the landscape limits gene f ow between and within populations, and how genome-wide allele frequencies change as a function of space and the environment. With better inferences about these interactions and underling biological processes, better conservation and wildlife management actions can take place to restore major, threatened species, such as the desert tortoise. For the fr st time, we generate thousands of genome-wide genotypic data for hundreds of individuals in desert tortoises, which have helped to robustly assess the population structure in the species. By coupling genetic and spatial interpolation techniques, analyses delimit genetic clusters spatially, which can help inform potential locations for translocation and headstart releases, and where interpopulation interactions may occur. We also apply novel statistical methods to evaluate the ef ect of the landscape on genetic connectivity, using geographical distance as a null model. Our results allow us to build on previous studies, showing how several environmental, climatic, and biotic features explain genetic dif erences between populations. Finally, we identify potentially non-neutral loci that are in the vicinity of genes that may be involved with neurogenesis, wound healing, lipid metabolism and vitellogenesis. While their direct correlation to the environment is still uncertain, this research opens new directions for conservation genomics in desert tortoises.

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Author Contributions

S.S.R., Y.R. and R.W.M. conceived the experiments. K.H.B., A.E.K. and B.T.H. provided the samples. Y.R. and T.E. performed laboratory procedures. S.S.R. processed and analyzed the data, and wrote the fr st draf of the manuscript, A.E.K., B.T.H. and R.W.M. provided fn ancial support. All authors reviewed the manuscript.

Additional Information

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August 27, 2018

Submitted via email to (blm_nv_sndo_geminisolar@blm.gov)

Herman Pinales
Project Manager
Bureau of Land Management

Re: Gemini Solar Scoping Comments

Dear Mr. Pinales,

Please accept these scoping comments on the proposed Gemini Solar project on behalf of The Wilderness Society; we appreciate the opportunity to comment. Gemini Solar is a proposed 690 megawatt (MW) solar project on 7,100 acres of public lands 25 miles northeast of Las Vegas, Nevada.

The Wilderness Society supports responsible, well-planned and sited renewable energy development, including on appropriate public lands, as part of a strategy for addressing climate change. This strategy also includes aggressive efforts to increase energy efficiency, build distributed generation such as rooftop solar, and reduce demand with demand-side management. We also recognize other important benefits of renewable energy development, including helping to maintain clean air and water and providing economic development that benefits local communities.

Areas with important and sensitive resources and values are inappropriate for development of any kind, and disturbed and degraded lands, including both public and private lands, will best serve as areas for focusing renewable energy development away from areas of greatest importance or sensitivity for ecological and other resources and values.

We also support the guided development approach established in BLM's Solar Programmatic Environmental Impact Statement (Western Solar Plan) and the BLM Wind and Solar Leasing Rule, including the focus on development in appropriate areas within Solar Energy Zones/Designated Leasing Areas (DLAs). The BLM has demonstrated the value of this approach for reducing impacts and increasing permitting efficiency; at the Dry Lake Solar Energy Zone in southern Nevada, the zone-based approach resulted in low-conflict development, projects permitted in half the average time, and commitments to offset unavoidable impacts through compensatory off-site mitigation.

BLM should continue to focus its efforts on designation of new DLAs in appropriate areas and advancing development in DLAs, as directed by the Wester Solar Plan and the Wind and Solar Leasing Rule. The agency's ongoing work to designate the Dry Lake East DLA through an amendment to the Las Vegas-Pahrump Resource Management Plan (RMP) and to designate other new DLAs through the Las Vegas-Pahrump RMP revision are crucial for advancing additional responsible renewable energy development and protecting natural and cultural resources in southern Nevada. Projects like Gemini Solar that are proposed for areas outside of DLAs merit additional scrutiny.

All energy development should follow the mitigation hierarchy of avoiding, minimizing and mitigating impacts through compensatory, off-site mitigation.

I. BLM should notify the public that the project development area may be different than what is displayed in the scoping maps and extend the scoping period 45 days

We met with the Gemini Solar project developer on August 23, 2018 to discuss their proposed project. We appreciate Gemini Solar's outreach to The Wilderness Society and other stakeholders. During the meeting, the developer informed us that they are considering moving some of the proposed project units from the southern portion of the proposed project area shown in BLM's scoping maps to an area north of the Valley of Fire Highway. This was a surprise to us, because while BLM did include the broader 44,000-acre application area on its scoping maps, the maps also show specific polygons described as "Proposed Solar Development Area" in the map legend. Based on this, we have focused our analysis and comments on the land within the Proposed Solar Development Area polygons.

The purpose of scoping is to identify the scope of issues relating to a proposed action that need to be addressed in the NEPA process and gather information from the public on those issues and potential impacts. Because BLM did not make it clear in its scoping materials that the solar development footprint could include areas outside of the Proposed Solar Development Area on the map, BLM has created a serious obstacle to identifying the full scope of issues and gathering relevant information from the public.

To address this issue, BLM should provide notice to the public that they should comment on potential impacts and issues across the entire 44,000-acre application area and extend the scoping period 45 days. Note that these scoping comments do not attempt to address potential issues and impacts across the entire 44,000-acre application area because we learned of this just days before the scoping comment deadline.

II. BLM must analyze ways to avoid, minimize and offset impacts and include requirements for doing so in the Environmental Impact Statement and Record of Decision

BLM is subject to a broad range of authorities supporting mitigation measures to avoid, minimize and offset unavoidable impacts. The Federal Land Policy and Management Act (FLPMA) requires BLM to manage for multiple use and sustained yield, and to avoid unnecessary or undue degradation of resources and values.[1] The National Environmental Policy Act (NEPA) and associated Council on Environmental Quality (CEQ) regulations require BLM to analyze potential impacts and consider ways to avoid, minimize and mitigate impacts – in accordance with the mitigation hierarchy.[2] The mitigation hierarchy aims to minimize environmental harms associated with agency actions. First and foremost, BLM must seek to avoid impacts; then minimize impacts (e.g., through project modifications, permit conditions, interim and final reclamation, etc.); and, generally, only if those approaches are insufficient to fully mitigate the impacts, will BLM seek to require compensation for some or all of the remaining impacts (i.e., residual effects). BLM must apply the mitigation hierarchy to evaluation of Gemini Solar.

When translated into common-sense policies, the legal authorities described below allow DOI agencies to manage their various mandates more efficiently, providing better conservation outcomes to the American public and clearer expectations for American businesses and landowners. Tools such as regional mitigation strategies, compensatory mitigation funds, and conservation agreements allow land managers, in partnership with developers and stakeholders, to prioritize areas for different uses based on the full range of trust resources present and determine whether avoidance, minimization, or compensation of development impacts is appropriate in specific contexts and locations. This protects the other uses of public

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[1] *See* 43 C.F.R. §§ 1701, 1732(b).

[2] 40 C.F.R. §§ 1508.8, 1502.14, 1502.16.

land – including hunting, fishing, and outdoor recreation – and gives industry better information to plan their investments and a more predictable and efficient permitting process.

a. Legal framework supporting the authority of DOI and BLM to require mitigation and in some cases compelling them to do so

Despite recent guidance from BLM in Instruction Memorandum 2018-093 instructing agency staff not to require compensatory mitigation to offset impacts from development on public lands, there is a strong legal framework supporting the authority of BLM to require mitigation and in some cases compelling it to do so.

FLPMA provides for the administration of the public lands by the Secretary of the Interior through the BLM.[3] BLM has broad authority and obligations under FLPMA to require mitigation[4] when exercising its authority to engage in land use planning, approve site-specific projects, or engage in other management activities. In accordance with FLPMA, the Administrative Procedure Act, other laws and case-law, BLM's decisions regarding mitigation must not be arbitrary or capricious. BLM's specific obligations for mitigation stem from the following:

<u>Multiple use/sustained yield</u> – The basis for BLM's broad authority is centered on the manner in which the FLPMA principles of multiple use and sustained yield require consideration of the interests of current and future generations, as well as the requirement that BLM avoid unnecessary or undue degradation of resources and values.[5] While these principles do not elevate certain uses over others, they do delegate discretion to the BLM to determine whether and how to develop or conserve resources, as well as whether to require enhancement of resources and values to offset impacts through compensatory mitigation.[6]

<u>BLM as manager and proprietor</u> – BLM's authority under FLPMA is broader than that exercised by purely land use or regulatory agencies such as EPA or zoning boards because BLM is both a regulator and as a proprietor. Accordingly, BLM can require mitigation through all the tools provided by FLPMA for managing the public lands, including issuing regulations, developing land use plans, implementing land use plans or in permitting decisions.[7]

<u>Mitigation authority from obligation to prevent unnecessary or undue degradation</u> – BLM's obligation under FLPMA to "take any action to prevent unnecessary or undue degradation of the lands" is an independent source of authority for requiring mitigation, in addition to BLM's broad authority to manage the public lands under FLPMA's multiple use and sustained yield principles.[8] Imposing mitigation measures can prevent unnecessary or undue degradation, and this is another source of BLM's authority to require mitigation.

<u>Mitigation authority from Title V and Title III of FLPMA</u> – Since Title V, regarding issuing rights-of-way, and Title III, regarding issuing easements and other permits, require BLM to determine appropriate measures to

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[3] 43 U.S.C. § I 702(e).
[4] 40 C.F.R. § 1508.20.
[5] *See* 43 C.F.R. §§ 1701, 1732(b).
[6] P. L. 94-579 (Oct. 21, 1976) (stating an intent "[t]o establishes public land policy; to establish guidelines for its administration; to provide for the management, protection, development, *and enhancement of the public lands;* and for other purposes." (emphasis added)).
[7] 43 U.S.C. §§ 1712(a), 1732(a), 1732(b)
[8] 43 U.S.C. § 1701(a).

protect public interests in the affected lands, these can also be seen as empowering and even requiring BLM to require mitigation of impacts as part of granting these rights.[9]

Interaction with other laws – BLM also has authority to require mitigation under other laws. BLM has authority and/or obligations to ensure all operations protect natural resources and environmental quality, including by imposing mitigation requirements, under NEPA, the Endangered Species Act, the National Historic Preservation Act, the Paleontological Resources Preservation Act, and the National Landscape Conservation System Act.

b. Avoidance

BLM must analyze and require measures to avoid impacts from Gemini Solar. BLM should analyze alternative project sizes, including projects with lower total MW capacity and projects with the same MW capacity in a smaller project footprint. The proposed Desert Quartzite solar project on public lands in California provides an example of the opportunity to analyze an alternative with the same MW capacity in a smaller footprint. The "Resource Avoidance Alternative" in the Draft Environmental Impact Statement (EIS) for the project provides for the same 450 MW capacity as the Proposed Action, but only requires 2,607 acres, 27% less land than the 3,575 acres required for the Proposed Action. The Resource Avoidance Alternative is BLM's preferred alternative in the Desert Quartzite Draft EIS.

BLM should also analyze alternative project layouts to avoid impacts to sensitive resources and values that are only present in certain portions of the proposed project area or are of higher quality in certain portions of the proposed project area.

Based on the results of these analyses, BLM must require measures to avoid impacts from Gemini Solar.

c. Minimization

BLM must analyze and require measures to minimize impacts from Gemini Solar. BLM should analyze use of a project layout that provides movement corridors for desert tortoise between units of the project. The recently approved Sweetwater Solar project on public lands in Wyoming provides an example of this type of minimization – the Sweetwater Solar project footprint was adjusted to maintain a pronghorn movement corridor around one corner of the project.[10]

BLM should also analyze ways to minimize impacts on-site through limiting blading and grading. The Sweetwater Solar EA provides an example of this approach as well; "Site preparation of 455 acres of vegetated areas would involve cutting shrubs near their base and leaving the root structure intact to minimize soil disturbance."[11]

BLM should also analyze the techniques used to minimize impacts at the Pahrump, Nevada Community Solar Project built by the Valley Electric Association in partnership with Bombard Renewable Energy. This project was constructed using limited grading and mulching or mowing of plants, a method that leaves roots intact. The height of the panels is also higher than for most solar projects, allowing vegetation to grow

[9] 43 U.S.C. §§ l 765(a)(i), (ii), l 765(b)(i), (iv), (vi).

[10] *See* Sweetwater Solar EA p. 2-15, *available at:* https://eplanning.blm.gov/epl-front-office/projects/nepa/69990/149052/183074/508_sweetwater_solar_EA_text_20180625.pdf

[11] *See* Sweetwater Solar EA Appendix A pp. 3-4, *available at:* https://eplanning.blm.gov/epl-front-office/projects/nepa/69990/149052/183073/508_sweetwater_solar_EA_appendices_20180625_(1).pdf

more underneath. The project also included a fence design that allows desert tortoise to move into and out of the project area, and the developers are conducting ongoing research on tortoise use of the site.[12]

The First Solar Topaz project in California provides another example of use of several of these techniques, though in a different ecosystem.[13]

The Department of Energy's InSPIRE project also includes valuable information on minimizing onsite impacts. InSPIRE is described on the project website as follows: "The InSPIRE project utilizes field research sites located across the United States to provide foundational and actionable data on low-impact solar development opportunities, as well as region-specific benefits and tradeoffs. Low-impact development strategies can reduce costs and environmental impacts of solar development, while also providing benefits to local agriculture, soils, and ecosystems."[14] Their webpage on low-impact solar development basics provides general principles for low-impact site preparation.[15]

Based on the results of these analyses, BLM must require measures to avoid impacts from Gemini Solar.

d. Compensatory mitigation to offset unavoidable impacts

BLM must analyze and require compensatory mitigation to offset unavoidable impacts to important and sensitive resources and values, including but not limited to those described in this letter. BLM has already developed a regional mitigation strategy (RMS) for the nearby Dry Lake DLA, and BLM should use this RMS as a starting point to inform mitigation fees and actions for Gemini Solar.[16] Using this RMS to inform compensatory mitigation for Gemini Solar is both defensible and pragmatic given that some of the same resources and values are present on both sites. That said, adjustments will need to be made to address the differing quality of the resources and values present in the two sites and to address any resources and values present at Gemini Solar that were not present at Dry Lake. In general, BLM should direct mitigation fees from Gemini Solar into implementation of the Dry Lake RMS; if there is a portion of the Gemini Solar mitigation fee associated with resources and values present at Gemini Solar that were not present at Dry Lake, that portion of the fee should be directed towards other mitigation actions that would specifically address those impacts.

Additional mitigation fees collected from Gemini Solar development would help support the implementation of BLM's ongoing Dry Lake RMS and provide measurable conservation outcomes to key threats within the Mojave ecoregion that offset development impacts consistent with FLPMA authorities and the Western Solar Plan. Indeed, BLM's RMSs under the Western Solar Plan are some of the best policy examples of sound mitigation as they are supported by robust analysis of potential impacts and the RMSs themselves are tailored to proportionally offset predicted impacts under a transparent approach that is based on sound mitigation principles and standards.

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12 http://vea.coopwebbuilder2.com/sites/vea/files/PDF/ruralite/2017/November%202017%20Ruralite%20Magazine.pdf

13 http://cse.ucpress.edu/content/early/2018/05/29/cse.2018.001123

14 https://openei.org/wiki/InSPIRE

15 https://openei.org/wiki/InSPIRE/Basics

16 Regional Mitigation Strategy for the Dry Lake Solar Energy Zone Technical Note 444 (March 2014) *available at* http://blmsolar.anl.gov/documents/docs/TN_444_March_2014.pdf and Implementation Plan for the Dry Lake Solar Energy Zone Regional Mitigation Strategy (December 2015) *available at* http://blmsolar.anl.gov/documents/docs/Dry_Lake_SEZ_Implementation_Plan.pdf

To calculate the per acre mitigation fees for Gemini Solar, BLM should follow the same step-wise approach in the Dry Lake RMS and the subsequent Implementation Plan (again, with any appropriate adjustments based on differences between the Gemini Solar and Dry Lake sites) – *with the exception of* eliminating the application of any DLA adjustment discount in Step 4. BLM should eliminate this discount when using the RMS for Gemini Solar because Gemini Solar is not in a DLA; further, BLM has discontinued the use of this type of discount in subsequent RMSs. These discounts were discontinued in the RMSs that BLM developed after the Dry Lake RMS because the agency gained a better understanding that the primary incentive for developers pursuing projects in DLAs is the increased certainty and permitting efficiency and reduced administrative burden for applicants. RMSs help provide these benefits, but unnecessary discounts provide minimal added incentive for developers to pursue projects in DLAs and result in underfunded mitigation strategies that are unable to fully achieve intended goals and objectives. In addition, consistent with BLM's Implementation Plan for the Dry Lake RMS, BLM should correct the error in the Technical Note with respect to the Durability Fee and multiply the $20 Per-Acre Effectiveness and Durability Fee by 30 to incorporate the anticipated 30-year life of solar energy development projects.

We support BLM's ongoing commitment to implementation of the Dry Lake RMS. Given concerns with the time lag of conservation outcomes associated with restoration actions, BLM should continue to advance this RMS implementation to ensure industry mitigation payments are effectively utilized on the ground and produce the anticipated benefits. This commitment to the RMS is good for wildlife, the public, and industry.

III. The Gemini Solar project developer should commit to voluntary measures to avoid, minimize and offset impacts

To ensure that all impacts to important resources and values are addressed appropriately, the Gemini Solar project developer should commit to voluntary measures to avoid and minimize impacts and to offset unavoidable impacts through compensatory mitigation. Such voluntary commitments are an important way that the project developer can demonstrate their commitment to responsible use of our public lands.

IV. BLM must ensure it has an up-to-date lands with wilderness characteristics inventory for the Gemini Solar project area and address impacts as part of this NEPA process

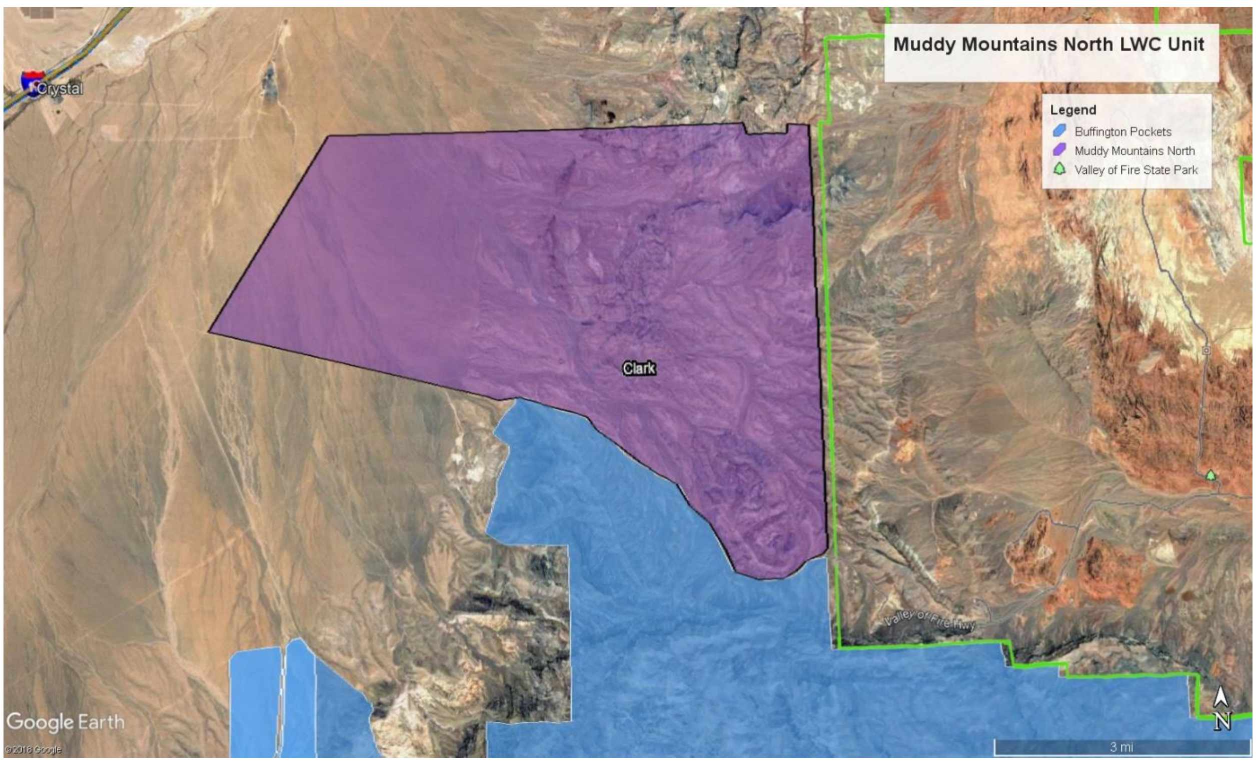
a. Lands with wilderness characteristics inventory requirements

Lands with wilderness characteristics (LWC) are one of the resources of the public lands that must be inventoried under the Federal Land Policy and Management Act (FLPMA). 43 U.S.C. § 1711(a); see also *Ore. Natural Desert Ass'n v. BLM*, 625 F.3d 1092, 1122 (9th Cir. 2008) (holding that "wilderness characteristics are among the 'resource and other values' of the public lands to be inventoried under § 1711"). BLM's guidance for implementing this requirement of FLPMA is currently set forth in BLM Manual 6310. BLM must ensure that all LWC inventories are conducted compliant with this manual, including the documentation of the inventory findings. Manual 6310 reiterates that, "[r]egardless of past inventory, the BLM must maintain and update as necessary, its inventory of wilderness resources on public lands." BLM Manual 6310 at .06(A).

In addition to FLPMA requiring the agency to maintain an inventory of LWC, an accurate and comprehensive inventory of LWC is necessary to inform management alternatives, impact analysis and decision-making under NEPA. NEPA, 42 U.S.C. § 4321 *et seq.*, requires agencies to "describe the environment of the areas to be affected or created by the alternatives under consideration." 40 C.F.R. § 1502.15; *see also Half Moon Bay Fisherman's Marketing Ass'n v. Carlucci*, 857 F.2d 505, 510 (9th Cir. 1988) ("without establishing . . . baseline conditions . . . there is simply no way to determine what effect [an action] will have on the environment, and consequently, no way to comply with NEPA").

b. The project area may contain wilderness characteristics and must be inventoried as part of this NEPA process.

As described above, during our August 23, 2018 meeting with the Gemini Solar developer we learned that the developer is considering moving some of the proposed project units from the southern portion of the proposed project area shown in BLM's scoping maps to an area north of the Valley of Fire Highway. We have identified lands with wilderness characteristics in this area in 20,000+ acre unit that we call Muddy Mountains North, shown in the map below. We have not yet completed a full citizen inventory for the area, because we are still verifying appropriate boundaries. Nonetheless, this information constitutes significant new information about the affected environment that BLM is required to consider in this EIS. BLM should utilize this information to conduct LWC inventory of the entire project area as part of this NEPA process.



Muddy Mountains North, between Valley of Fire Highway in the south, Valley of Fire State Park in the east, and the Moapa Indian Reservation and existing transmission lines in the west and north contains over 20,000 acres of contiguous unroaded BLM lands that require further inventory and assessment. This area has interesting topographical diversity and difficult access, which provide outstanding opportunities for solitude. BLM has identified lands with wilderness characteristics in the same landscape just across the Valley of Fire Highway, in the Buffington Pockets unit. BLM's inventory found that, "The natural screening available within the unit, particularly those areas within the North Muddy Mountains would allow for a visitor to find a secluded spot. The topography of the unit provides rugged terrain in the form of the rugged mountains, side canyons, and draws where opportunities for solitude are outstanding." These same outstanding opportunities for solitude are present in the Muddy Mountains north of the Valley of Fire Highway as well.

According to the inventory information that BLM has posted as part of the Las Vegas-Pahrump RMP revision, it does not appear the agency has reviewed the proposed Gemini Solar project area as part of its recent inventory update, including the areas shown as proposed solar development areas on BLM's scoping maps and the other areas described by the Gemini Solar developer during our August 23, 2018 meeting. There is no information posted for the project area demonstrating that BLM has assessed the area and determined it does not have wilderness characteristics. Therefore, as part of this NEPA process, BLM must assess the project area and ensure that it has up-to-date LWC inventory information, which requires inventorying the Muddy Mountains North unit.

c. BLM must analyze impacts to LWC from Gemini Solar and commit to ways to avoid, minimize and offset impacts

i. BLM must analyze impacts to LWC from Gemini Solar

Impacts to LWC from Gemini Solar must be analyzed in the impact analysis in the EIS. NEPA is our "basic national charter for the protection of the environment." 40 C.F.R. § 1500.1 NEPA achieves its purpose through "action forcing procedures. . . requir[ing] that agencies take a hard look at environmental consequences." Id.; Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (citations omitted). This includes the consideration of best available information and data, as well as disclosure of any inconsistencies with federal policies and plans.

NEPA requires federal agencies to consider "any adverse environmental effects which cannot be avoided." 42 U.S.C. § 4332(C)(ii). Effects that must be considered include "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. § 1508.8.

Therefore, BLM must analyze the potential impacts to LWC in the Gemini Solar project area, as well as the beneficial impacts that avoiding LWC would have on other resources, including scenic viewsheds, cultural resources, wildlife habitat, recreation opportunities and nonmarket economic values.

ii. BLM must consider ways to avoid and minimize impacts to LWC

We recommend that BLM and the project developer consider ways to avoid impacts to LWC as much as possible by adjusting the project footprint to limit overlap with LWC. BLM should also require on-site minimization of impacts through use of Best Management Practices for construction, operation and maintenance.

iii. BLM and the project developer should commit to compensatory mitigation to offset any unavoidable impacts to LWC

BLM and the project developer should commit to offsetting any unavoidable impacts to LWC through compensatory mitigation. The Western Solar Plan established several measures for avoiding, minimizing and mitigating impacts to LWC which BLM and the project developer should use to address potential impacts.[17]

Two examples of compensatory mitigation for impacts to LWC from other energy development on public lands illustrate how compensatory mitigation can address impacts to LWC. For the McCoy Solar Project, the

[17] Western Solar Plan Record of Decision pp. 54-56, *available at:* http://blmsolar.anl.gov/documents/docs/peis/Solar_PEIS_ROD.pdf; excerpt included as Attachment 1.

construction of Unit 2 would cause the loss of 1,089 acres of LWC. To address these impacts, the final decision documents required that the Notice to Proceed for Unit 2 will provide that, before any ground disturbance occurs in the area inventoried to have wilderness characteristics, McCoy Solar shall pay BLM to fund work to mitigate these impacts and that the work shall be completed no later than 18 months from the commencement of construction for the relevant portion of Unit 2. McCoy Solar Project Protest Resolution Agreement pp. 2-3. The mitigation shall be focused in the Big Maria Mountains Wilderness Area, Palen-McCoy Wilderness Area or other designated wilderness areas in general proximity to the project, as identified with BLM. Mitigation will be implemented by:

- Removal and restoration of approximately 15 miles of unauthorized vehicle routes;
- Conversion of approximately 3 miles of vehicle route into a hiking trail; and
- Installation of vehicle barriers and signing along publicly accessible portions of the wilderness boundaries.

The final decision documents further required that McCoy Solar shall make a not-to-exceed payment of $251,000 to fund the mitigation. Such payment shall be made prior to any ground disturbance in the area inventoried to have wilderness characteristics and will complete McCoy Solar's obligations regarding this mitigation measure.

In a second example, BLM's Record of Decision for the TransWest Express Transmission Project required that unavoidable impacts to LWC be offset by either 1) purchasing and protectively managing private land inholdings from willing sellers in existing Wilderness Areas and Wilderness Study Areas (WSAs); or 2) completing restoration projects inside existing Wilderness Areas and WSAs.[18]

V. BLM must analyze ways to avoid, minimize and offset impacts to desert tortoise and include requirements to do so

The proposed Gemini Solar project area includes intact, high-quality habitat for Mojave desert tortoise. We understand that the desert tortoise surveys that were recently completed for the area found many live tortoises; the surveys estimate that there are 273 breeding size tortoises in the 10,000 acres that were surveyed. For these reasons, BLM must take special care to analyze and address impacts to desert tortoise through avoidance, minimization and compensatory mitigation. Our partners at Defenders of Wildlife are submitting detailed scoping comments on desert tortoise impacts, and BLM must address their comments.

VI. BLM must analyze ways to avoid, minimize and offset impacts to other resources including the Old Spanish Trail, the BLM-proposed California Wash and Old Spanish Trail ACECs and cultural resources

As detailed in Section I of these comments, BLM must analyze ways to avoid, minimize and offset impacts from Gemini Solar and include requirements for doing so in the Environmental Impact Statement and Record of Decision. BLM's Federal Register Notice of Intent to develop an EIS for Gemini Solar noted that the Old Spanish Trail and cultural resources are among its preliminary list of issues to be addressed in the EIS. The Old Spanish Trail runs directly through the proposed project area, so it is clearly an important issue to be addressed in the EIS.

Gemini Solar also overlaps almost entirely with two BLM-proposed Areas of Critical Environmental Concern (ACECs), which were both included in Alternative 2 of BLM's 2014 Draft Las Vegas-Pahrump RMP. The proposed Old Spanish Trail ACEC follows the Old Spanish Trail and is intended to protect the trail and its

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[18] TransWest Express ROD pp. F-20-F-21, *available at:* https://eplanning.blm.gov/epl-front-office/projects/nepa/65198/92793/111802/AppF_TWE_ReqdMitigation.pdf

resources. The proposed California Wash ACEC is intended to protect cultural resources and the three-cornered milkvetch, a BLM special status species.

BLM must analyze potential impacts to these and other resources and values and commit to ways to avoid, minimize and offset any impacts.

We appreciate the opportunity to comment.

Sincerely,

Alex Daue
Assistant Director, Energy & Climate
The Wilderness Society – BLM Action Center
alex_daue@tws.org

Attachments:

- Attachment 1: Excerpt from Western Solar Plan Record of Decision on mitigation measures for LWC impacts.

Attachment 1

Attachment 1 – excerpt from Western Solar Plan Record of Decision (pp. 54-56)

A.4.1.2 Design Features for Specially Designated Areas and Lands with Wilderness Characteristics

The following design features have been identified to avoid, minimize, and/or mitigate potential impacts on specially designated areas and lands with wilderness characteristics from solar energy development identified and discussed in Sections 5.3.1 and 5.3.2 of the Draft and Final Solar PEIS.

A.4.1.2.1 General

LWC1-1 Protection of existing values of specially designated areas and lands with wilderness characteristics shall be evaluated during the environmental analysis for solar energy projects, and the results shall be incorporated into the project planning and design.

(a) Assessing potential impacts on specially designated areas and lands with wilderness characteristics shall include, but is not limited to, the following:

• Identifying specially designated areas and lands with wilderness characteristics in proximity to the proposed projects. In coordination with the BLM, developers shall consult existing land use plans and updated inventories.
• Identifying lands that are within the geographic scope of a proposed solar project that have not been recently inventoried for wilderness characteristics or any lands that have been identified in a citizen's wilderness proposal in order to determine whether they possess wilderness characteristics. Developers shall consider including the wilderness characteristics evaluation as part of the processing of a solar energy ROW application for those lands without a recent wilderness characteristics inventory. All work must be completed in accordance with current BLM policies and procedures.
• Evaluating impacts on specially designated areas and lands with wilderness characteristics as part of the environmental impact analysis for the project and considering options to avoid, minimize, and/or mitigate adverse impacts in coordination with the BLM.

(b) Methods to mitigate unavoidable impacts on specially designated areas and lands with wilderness characteristics may include, but are not limited to, the following:

• Acquiring wilderness inholdings from willing sellers.
• Acquiring private lands from willing sellers adjacent to designated wilderness.
• Acquiring private lands from willing sellers within proposed wilderness or Wilderness Study Areas.
• Acquiring other lands containing important wilderness or related values, such as opportunities for solitude or a primitive, unconfined (type of) recreation.
• Restoring wilderness, for example, modifying routes or other structures that detract from wilderness character.
• Contributing mitigation monies to a "wilderness mitigation bank," if one exists, to fund activities such as the ones described above.
• Enacting management to protect lands with wilderness characteristics in the same field office or region that are not currently being managed to protect wilderness character. Areas that are to be managed to protect wilderness characteristics under this approach must be of sufficient

size to be manageable, which could also include areas adjacent to current WSAs or adjacent to areas currently being managed to protect wilderness characteristics.

A A.4.1.2.2 Site Characterization, Siting and Design, Construction

LWC2-1 Solar facilities shall be sited, designed, and constructed to avoid, minimize, and/or mitigate impacts on the values of specially designated areas and lands with wilderness characteristics.

VIA ELECTRONIC MAIL

August 26, 2018

BLM, Las Vegas Field Office
Attn: Herman Pinales
4701 North Torrey Pines Drive
Las Vegas, Nevada 89130–2301
Email: blm_nv_sndo_geminisolar@blm.gov

Re: BLM Notice of Intent to Prepare an EIS and Land Use Plan Amendment for the Proposed Gemini Solar Project in Clark County, Nevada

Dear Project Manager Pinales,

These comments are timely submitted on behalf of the Center for Biological Diversity ("Center") regarding the Bureau of Land Management Notice of Intent to Prepare an Environmental Impact Statement and Land Use Plan Amendment for the Proposed Gemini Solar Project in Clark County, Nevada. 83 Fed. Reg. 32681-83 (July 13, 2018).

The Center is a non-profit environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has over 1.6 million members and supporters throughout the United States including many members who reside in Nevada. The Center's Nevada program focuses on the protection of wildlife and endangered species, the preservation of public lands, and the sustainability of Nevada's groundwater resources.

The development of renewable energy is a critical component of efforts to reduce greenhouse gas emissions, avoid the worst consequences of global warming, and to assist Nevada and the nation in meeting emission reduction goals. The Center strongly supports the development of renewable energy production, and the generation of electricity from solar power, in particular. However, like any project, proposed solar power projects should be thoughtfully planned to minimize impacts to the environment. In particular, renewable energy projects should avoid impacts to sensitive species and habitats, and should be sited in proximity to the areas of electricity end-use in order to reduce the need for extensive new transmission corridors and the efficiency loss associated with extended energy transmission. Only by maintaining the highest environmental standards with regard to local impacts, and effects on species and habitat, can renewable energy production be truly sustainable.

The proposed right of way for the project includes development of 7,115 acres of federal lands administered by the BLM within a 44,000 acre application area. Much of the site is high quality intact habitat that is relatively devoid of human disturbance. As a result, the project may have significant impacts to biological resources in this area including robust desert tortoise populations within the Northeastern Mojave Recovery Unit. The Center urges the BLM to consider alternatives that would avoid these irreplaceable public lands resources including but not limited to: an alternative site design that will avoid the highest density desert tortoise populations on site and maintain connectivity with other desert tortoise habitat in the region while also reducing impacts to other resources; a reduced footprint alternative that avoids occupied desert tortoise habitat and maintains landscape connectivity including washes, desert dry wash woodlands and other rare habitats; and off-site alternatives including on previously disturbed/type converted lands or brownfields and distributed solar power projects sited in urbanized areas.

The Center provides the following comments regarding resource impacts that must be addressed in the EIS and alternatives:

1. Impacts to desert tortoise.

The desert tortoise is protected as Threatened under the Federal Endangered Species Act and is a Nevada State protected and threatened species. The project area lies in the Northeastern Mojave Recovery Unit for the desert tortoise, and within occupied habitat. The desert tortoise is continuing to decline throughout its range despite these protections due to loss of habitat, habitat fragmentation, and habitat degradation. The most recent status information shows that this recovery unit is the only unit with a stable or upward trend. The desert tortoise population on the proposed site appears to be robust and have significantly higher density than many other desert tortoise populations, even those in critical habitat and protected areas. It is critical to the desert tortoise that populations that are doing well are maintained in order to ensure the species as a whole can survive and recover.

The EIS must address the impacts of this project to the survival and recovery of desert tortoise in this recovery unit and take seriously the development of meaningful alternatives to this project that will avoid impacts to the species and its habitat. BLM must look at the impacts of the proposed project in a comprehensive way that would allow it to formulate meaningful alternatives that could *avoid* many of the impacts of the project. Maintaining high quality occupied habitat is critical to the survival and recovery of the desert tortoise and avoidance of high density population areas must be a central part of the alternatives analysis. After alternatives have been formulated to avoid impacts, then remaining that cannot be avoided through alternatives must also be minimized and mitigation measures developed that will ensure that impacts to desert tortoise and other resources are appropriately mitigated.

Minimization measures such as relocation/translocation and mitigation measures including habitat restoration and compensatory mitigation are important but cannot substitute for avoidance. Indeed while some short-distance relocation efforts for desert tortoise from large-scale solar site have had some limited success in maintaining populations, long-distance translocation has had far less success. While translocation of desert tortoise has been proposed as a tool for augmenting conservation of the desert tortoise in certain vulnerable host populations, it cannot substitute for avoidance and other mitigation such as preservation of habitat. Moreover, to date, translocation does not have a proven track record of success and translocation as mitigation has been questioned for its effectiveness in aiding recovery. Indeed the latest research shows us that translocated male desert tortoises are failing to reproduce within host populations, resulting in a fifty percent loss of genetic diversity from translocated individuals. Thus, any augmentation is of limited value to the persistence and recovery of the species if there is a complete loss in genetic diversity passed on by males. Relocation and translocation must be utilized as a means of avoiding direct mortality of individuals displaced by development of the proposed project if permitted, but its dubious efficacy further highlights the need for a robust alternatives to be designed that will avoid occupied tortoise habitat to the greatest extent possible, including reduced footprint alternatives, alternative site designs within the application area, and off site alternatives.

Further, there is a need to maintain habitat linkages between current occupied desert tortoise habitats as well as between current and future desert tortoise habitat as climate may shift optimum habitat areas– see discussion below. The EIS must thoroughly disclose and analyze the impacts on the desert tortoise and its recovery and consider meaningful alternatives that would avoid significant impacts to the tortoise and other resources.

2. Climate change and landscape linkages.

In light of unprecedented climate change, animal and plant species will attempt to adapt by expanding their ranges north and upslope to cooler conditions mimicking their current habitats, and abandoning their present no longer hospitable ranges. In order to allow desert tortoise and other species that inhabit these public lands to adapt to climate change BLM must prioritize maintenance of broad ecological connectivity and the minimization of movement barriers. Such connectivity is not only important for the physical movement of species but perhaps more so for the conservation of genetic diversity and the prevention of genetic bottlenecks.

Unless it is designed to minimize impacts to connectivity, the proposed project could impose a significant barrier to future movement and gene flow between desert tortoise populations within the Northeastern Mojave Recovery Area. The EIS must disclose and analyze the projects' impacts to movement corridors and habitat connectivity taking into account the heightened importance of such corridors in light of climate change.

3. Impacts to ephemeral streams and washes and related habitats including Desert Dry Wash Woodlands and soils.

The proposed project site contains numerous washes and ephemeral drainages that could be impacted affecting surface water flow, habitats, and species across the landscape. As BLM is well aware, desert ephemeral and intermittent streams, provide critical ecological and hydrological functions by moving water, nutrients, and sediment throughout the watershed. They also dissipate energy from high-water flows to reduce erosion and improve water quality, provide ground-water recharge and discharge, wildlife habitat and migration corridors, and support vegetation communities that stabilize stream banks. Desert microphyll woodlands (also called desert dry wash woodlands) that found in and near the proposed project site provide forage, cover, nesting, and movement corridors for local wildlife and migrating birds. Any impacts to these resources must be accurately identified and fully analyzed in the EIS along with alternatives that would avoid those impacts and minimization and mitigation measures to compensate for any remaining impacts.

Soil disturbance should also be minimized across the site to decrease dust and maintain soil structure including cryptobiotic soils which are critical to the long-term stability and health of the desert environment. Because desert soils also provide significant carbon sequestration, alternatives that maintain soil structure and avoid widespread grading should be fully explored.

4. Other species of concern

In addition to desert tortoise and other species noted above, there are other rare and endemic species that could potentially be impacted by this proposed project including desert kit fox, eagles, and rare plants. U.S. Fish and Wildlife Service geologic modeling shows soils with a "moderate" gypsiferous substrate score in the northwest portion of the project site, which have not previously been surveyed for gypsiferous soil obligate plants including the Las Vegas bearpoppy. The EIS must include an alternative which ensures that no occupied bearpoppy habitat is disturbed, as there are no proven mechanisms for mitigating lost bearpoppy habitat.

5. Water resources: source and amount of water for construction, operation and maintenance of the facility.

The DEIS must analyze and disclose both the source and amount of water to be required for the construction, operation and maintenance of the facility and the associated impacts and effects. Both surface and groundwater are scarce in this area and BLM must ensure that water withdrawals do not impact other resources including those that seem far distant but are connected to the same aquifers and support many imperiled species. In addition to water needs during construction, potable water for human use, water for sanitation and water for washing the solar panels are all potential uses of water for the proposed project operations. While many PV solar projects have reduced water use by limiting the amount of panel washing, the sheer size of the project will inevitably require a significant amount of water for this purpose. Areas that are graded and where soils are disturbed will also increase dust and the need to wash panels. In addition, given high winds and the dust that are common in this area, and other surface disturbing activities in the area including ORV use, the EIS must consider whether more panel washing will be needed to maintain efficiency. A realistic assessment of the amount of water that could be used and where and how that water would be obtained must be provided in the EIS along with an analysis of potentially significant impacts obtaining and using the water will have on the environment.

The Center looks forward to reviewing the EIS for this project that addresses these and other resource concerns. The Center hopes and expects that the EIS will analyze a meaningful range of alternatives including alternatives that would avoid impacts to the robust desert tortoise populations on this site and habitat connectivity as well as to other desert resources.

Sincerely,

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Working to protect and restore Western Watersheds and Wildlife

To: Bureau of Land Management, Southern Nevada District, Energy & Infrastructure Project Manager, 4701 N. Torrey Pines Drive, Las Vegas, NV, 89130, Emailed to blm_nv_sndo_geminisolar@blm.gov

August 22nd, 2018

Re: Scoping comments for the Gemini Solar Project – DOI-BLM-NV-S010-2018-0051-EIS-Gemini Solar

Basin and Range Watch is a 501(c)(3) non-profit working to conserve the deserts of Nevada and California and to educate the public about the diversity of life, culture, and history of the ecosystems and wild lands of the desert. Federal and many state agencies are seeking to open up millions of acres of unspoiled habitat and public land in our region to energy development. Our goal is to identify the problems of energy sprawl and find solutions that will preserve our natural ecosystems, open spaces, and quality of life for local communities. We support energy efficiency, better rooftop solar policy, and distributed generation/storage alternatives, as well as local, state and national planning for wise energy and land use following the principles of conservation biology. We have visited the site of the proposed Gemini Solar Project. We have taken photos of the region, hikes on the site and have observed unique flora and fauna on the site.

Western Watersheds Project is a non-profit organization with more than 1,500 members and supporters. Our mission is to protect and restore western watersheds and wildlife through education, public policy initiatives and legal advocacy. Western Watersheds Project and its staff and members use and enjoy the public lands and their wildlife, cultural and natural resources for health, recreational, scientific, spiritual, educational, aesthetic, and other purposes. Western Watersheds Project also has a direct interest in energy development that occurs in areas with sensitive wildlife populations and important wildlife habitat. We support solar energy and renewable energy in order to offset the dangerous trends of increasing greenhouse gas emissions. But we have comments on how to better site these utility-scale projects in the places that minimizes impacts to natural and cultural resources of the deserts, analyze alternatives that would avoid impacts to natural communities and sensitive species.

Introduction:

The Gemini Solar Project would be developed on a large site comprised of public lands that are important for threatened and rare species of plants and animals including the Threecorner milkvetch and the desert tortoise. The close distance to Lake Mead and the Muddy River will give the project the potential lake effect that could attract birds and possibly cause mortality. The project would be developed on the entrance road to Valley of Fire State Park, and be highly visible from the Muddy Mountains Wilderness Area. The project would be developed on a section of the historic Old Spanish Trail.

Short Comment Period, Lack of Information at Scoping Meetings and During the Scoping Process Precludes Meaningful Public Participation in the NEPA Process:

In July, 2018, Bureau of Land Management (BLM) held two scoping meeting for this project. At the time of the meetings, very little information was provided on the specifics of the biological, visual and archeological resources on the Project site. The BLM's website for the Project only has the project Plan of Development posted at the time which provided only minimal information. Very little information about battery storage was provided, compared to other current solar projects under review.

This spring and summer, the Southern Nevada BLM held scoping periods for two other large-scale renewable energy projects: Crescent Peak Wind and Yellow Pone Solar. These projects are also very large and would have equally disruptive impacts on the resources of the regions they would be built in. But has BLM provided 90 full days in the scoping periods for these two projects and only 45 days for the scoping for the Gemini Solar Project.

The project site for the Gemini Solar Project contains very important biological, cultural, and visual resources. BLM's rush to scope this Project without providing the public with relevant information on which to comment is a classic violation of NEPA's dual goals of disclosure of relevant information to the public and fostering of informed public participation in the "democratic decision-making" process. BLM should extend the scoping period until 60 days after it has posted all relevant information on biological and cultural studies of the project site on its website for the Project so that the public can provide meaningful comments.

Two Land Use Plans (LUP's) are Being Reviewed at the Same Time:

At this time, the BLM must amend the 1998 Southern Nevada Resource Management Plan (SNRMP) in order to approve this project. This comes at a very awkward time because the BLM is also reviewing the revision of this plan which they have a goal of completing in early 2019.

The Visual Impacts would be so disruptive that the BLM must down-grade the entire Visual Resource Management (VRM) Class for the region. The region is currently managed as VRM II and III, but must be downgraded to VRM IV, the least protected VRM Class, so the project can comply with the LUP amendment. The high visual class is due to the fact that the project would be built next to the Muddy Mountains Wilderness Area and along the Bitter Springs Backcountry Byway. Downgrading the VRM Class to accommodate one company will make the BLM quite unpopular on a public level. The beautiful desert scenery remains the same.

The new Southern Nevada Resource Management Plan has been on the table since 2014. Since that time, the population of Southern Nevada has grown considerably and it would only be a quick fix to amend the 1998 plan for this one project. Doing this only for the project proponent skirts the public NEPA process that has been used to amend the old plan. The project site is popular with recreationists who will resent having their access cut off. This decision should be decided on the RMP level and we hope BLM will not compromise the higher standards of this site in the RMP just to please the applicant.

The revised Resource Management Plan is a new land use plan which gives the public an opportunity to request revisions to each plan.

Below are justifiable reasons for the BLM to wait on this review until the RMP can be updated. According to the National Environmental Policy Act, NEPA Handbook, *"RMPs are periodically evaluated to determine if management decisions contained within them are still current and adequate. Where changing conditions (such as the Federal listing of a wildlife or plant species as threatened or endangered) and/or demands on the public lands have resulted in the need to update management decisions in the RMP, the BLM may either revise or amend the RMP to bring it into conformance with these changing conditions."*

We believe that if the BLM would evaluate current information and updates on the declining status of species like the desert tortoise and burrowing owl, they would find new and important information. Furthermore, the BLM will need to conduct more surveys for the Threecorner milkvetch. For best results, the surveys need to be conducted after a wet winter during the spring. Failure to survey the current conditions of the plant's status may result in inaccurate information used to write a Draft EIS. This justifies waiting for a completed RMP.

Secretarial Order 3355:

The new Secretarial Order – 3355 requires the BLM to have the entire review be conducted in one year from the beginning of scoping and all EIS documents should be 150 pages or 300 under special requests to the DOI. The 150 pages is supposed to exclude appendices but the BLM told us at the Gemini scoping meeting that there would be no appendices. We think that the BLM got this wrong as the order states:

"To implement the longstanding directives in 43 C.F.R. 46.405, and in 2 40 C.F.R. 1500.4 and 1502.7, all EISs 1) for which a bureau is the lead agency and 2) that have not reached the drafting stage shall not be more than 150 pages or 300 pages for unusually complex projects***, excluding appendices***." (emphasis ours).[1]

If the BLM is bound to just a 150-page document, we would like to request that all of the other information be included in the appendices – no matter how long they may be.

Compensatory Mitigation:

The Trump administration is ending a policy of off-site compensatory mitigation that requires developers to pay the government for damages their work can have on wildlife and habitats on public land. These funds are used to mitigate similar habitats for species in other parts of the desert.

By eliminating the requirement for off-site mitigation, the BLM will have to mitigate all of the impacts to these resources on site. Since the project will remove a major part of the core habitat for the Threecorner milkvetch, mitigating these impacts on site may be impossible. Equally, developing a ten square mile project in good quality desert tortoise really cannot be mitigated on site. Project proponents will often reduce their project size in their own ROW so they can mitigate on site, but you have chosen a site that very well may be occupied by close to 300 threatened desert tortoises. That is quite a number to move "on site". Even if you cut the project in half, you would still need to move this many tortoises and crowd them together on site. This is an unviable option.

We would like to closely review all of these on-site mitigation proposals.

Purpose and Need/Alternatives:

The Gemini Solar Project would develop, disturb and destroy 7,100 acres (10 square miles) of Mojave Desert habitat. The project will have impacts on biological resources, (desert tortoise, kit fox, burrowing owl, Threecorner milkvetch, sand transport, microphyll woodlands), cultural landscapes, archeological sites, air quality, public health, public access, and visual resources.

The Purpose and Need Statement should include a need to protect cultural, biological, hydrological, and visual resources, as well as air quality and recreational uses. The Purpose and Need Statement should also include a need to protect the resources on this site and in the general region by examining Distributed Generation and Brownfield alternatives. Any Bureau of Land Management Purpose and Need Statement should not narrowly interpret the following orders to justify the project. These orders do not have to narrowly apply to the region:

Executive Order 13212 mandates transmission of energy in a "*safe and environmentally sound manner".* But as we have seen from past approved BLM projects, large environmental issues have created problems for wildlife, visual resources, cultural resources and many of the projects such as the Ivanpah Solar Electric Generating System Project have not delivered the

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[1] https://www.doi.gov/sites/doi.gov/files/uploads/3355_-_streamlining_national_environmental_policy_reviews_and_implementatio.pdf

promised capacity from the developer. Some photovoltaic projects are now curtailed to alleviate an over-generation problem from the build-out of large-scale solar energy. The environmental impacts need to be considered more strongly, and conservation made a priority.

Secretarial Order 3285A1 is from 2010 and establishes the development of renewable energy as a priority for the Department of Interior (DOI), but it never says how much of that goal has been fulfilled since 2010. Thousands of megawatts of renewable energy have already been built on public lands, and grid congestion is now the result. Better regional planning needs to occur before more intermittent generation is added. This order also does not specifically say that a particularly high-resource-value location of the Gemini Solar Project is required to meet this goal.

The project is home to **BLM Sensitive Species**: the BLM is required to protect Sensitive Species as defined in BLM Manual 6840 (Special Status Species Management). The objectives of the BLM sensitive species policy are twofold, as follows:

1. To conserve or recover species listed under the Endangered Species Act of 1973 (ESA; 16 USC, Section 1531 et seq.), as amended, and the ecosystems on which they depend so that ESA protections are no longer needed for these species;

2. To initiate proactive conservation measures that reduce or eliminate threats to BLM sensitive species to minimize the likelihood of and need for listing of these species under the ESA.

State Endangered Species --the Gemini Solar Project will impact the Threecorner milkvetch by removing a large percentage of its core habitat. It is fully protect as a Nevada State Endangered Species.

The Gemini Solar Project site also will potentially impact species protected under the federal **Endangered Species Act**. These species include the Desert tortoise, Yuma clapper rail, Western yellow-billed Cuckoo and Southwestern Willow Flycatcher.

The site also contains **Fish and Wildlife Service Species of Special Concern**: Burrowing owls and Threecorner milkvetch.

The BLM has a commitment to follow guideline of the Endangered Species Act. Signed into law in 1973, *the original goal of the Endangered Species Act (ESA) was to preserve and recover key domestic species from the brink of extinction.*

Resources on the site are also protected by the **Archeological Resources Protection Act of 1979**. This statute (16 U.S.C. 470aa-470mm; Public Law 96-95 and amendments to it) was enacted: *...to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.*

The **Migratory Bird Treaty Act of 1918** was an *Establishment of a Federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory* *bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird." (16 U.S.C. 703)*

The 1998 Las Vegas Resource Management Plan……

Need for this Project?

The Over-generation Problem in California Due to Large-scale Solar Projects

The Need for this project is questionable, as it adds a large cumulative impact to grid congestion in California. The state is currently experiencing a worsening glut of solar power at peak times on the transmission system, as measured by the California Independent System Operator. This has been shown as the Duck Curve, where renewable energy generation exceeds demand in the middle of the day, then causes the need to ramp up generation at the end of the day after the sun sets with inefficient natural gas peaker plants. At times, as much as 13,000 MW is needed in 3 hours in the evening hours, as solar projects go offline at night.

The National Renewable Energy Laboratory (NREL) examined the problem (Denholm et al. 2015, p. 8): "NREL has also examined higher renewable penetration scenarios in California using PLEXOS with a Western Interconnection database derived from the Western Electricity Coordinating Council (WECC) Transmission Expansion Policy Planning Committee (TEPPC), with additional modification based on the LTPP database (Brinkman et al. 2015). The NREL study examined cases where California achieves greater than 50% reduction in electric sector carbon dioxide emissions by 2030 with a variety of renewable energy technologies and flexibility assumptions, such as increased export limits and reduced minimum local generation requirements. Total annual curtailment estimates range from 0.2% (with a balanced portfolio in a more flexible grid) to almost 10% (with a high-solar portfolio in a less flexible grid)."

Nevada has a similar over-generation problem with large-scale solar projects at midday, according to presentations given at the Renewable Energy Transmission Initiative meetings and workshops concluded in 2017 by the California Energy Commission.[2]

The 500 kV Devers-Palo Verde 2 transmission line in California, serving the Riverside East Solar Energy Zone, is already suffering from grid congestion and may need to be reconductered to increase capacity.

Thus both California and Nevada have no need under present grid scenarios for more utility-scale solar power to be stuffed onto the grid. Some developers are looking towards Arizona to send midday generation to load centers in Arizona that use high amounts of air conditioning (NextEra, pers. communication June 2018). The draft EIS should clearly state how the project proponent will interconnect to the grid and what state the generation will be used in. Western grid regionalization may also be crucial to increasing renewable energy, and this needs to be clearly analyzed with respect to the Gemini Solar Project.

In other words, increased curtailment of solar projects (shutting them off during peak times) is likely under higher penetration of photovoltaics onto the California grid, despite storage options.

[2] https://www.energy.ca.gov/reti/

With increasing penetration of photovoltaic solar energy onto the grid, will instability problems be alleviated with battery storage?

Can an on-site battery storage project alleviate this problem? How many megawatt hours of storage will these batteries provide? Please provide the exact make and model of batteries, detailed descriptions of housing, cooling, and replacement/recycling of used batteries. Given the critical importance of battery storage now as a potential avenue to higher penetration of renewable energy on the grid, the details of battery storage need to be explained.

Would the battery facility need to be cooled? How much energy would be required to do so? This is a hot desert with summer temperatures reaching 118 degrees F at times. How will this heat affect battery efficiency?

To conserve habitat, the BLM should consider a No Action Alternative based on local small-scale distributed battery technology in urban centers. Battery storage is making advances or smaller-scale solar energy and would not require such a large facility that would need cooling. Batteries will create a waste/recycling issue as well and the BLM should be asking how batteries will be recycled.

Alternatives:

A full range of alternatives should be considered in every EIS document. That is required by the National Environmental Policy Act (NEPA). Following the guidelines of NEPA, the final EIS should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public.

The Draft Environmental Impact Statement should consider an alternative that utilizes degraded brownfields and distributed generation in the built environment. Under the National Environmental Policy Act, agencies are required to consider alternatives outside of their jurisdiction. Since our above comments raise the issue of lacking Need for this project, BLM can easily justify a **No Action Alternative** based on available distributed resources located close by, such as the load center of Las Vegas.

Area of Critical Environmental Concern/Conservation/No Project Alternative:

The Basin and Range Watch preferred alternative would be the **ACEC/Conservation/No Project Alternative**. Two Areas of Critical Environmental Concern (ACEC) were nominated for this region under the revision of the Southern Nevada Resource Management Plan. These ACEC alternative are being considered under Alternative 2 for the Southern Nevada Resource Management Plan.

The BLM would have to evaluate an additional Land Use Plan amendment in the DEIS to consider this alternative. An ACEC could be viewed as an action alternative if provisions are made to close illegal roads, eliminate invasive plants, or construct interpretive signage at the ACEC.

The first nomination is the California Wash Area of Critical Environmental Concern. It would designate over 11,000 acres as an ACEC to protect cultural and historic values as well as vegetation communities. It would also be instrumental in protecting desert tortoise populations. Much of the nomination overlaps with the solar project.

The second nomination that partially overlaps with the south side if the solar proposal is the Bitter Springs ACEC. This is a 61,000 acre nomination designed to protect bighorn sheep, scenic values and vegetation communities.

We would also like to request that the Visual VRM Classes be upgraded to VRM I and VRM II to highlight this alternative.

This alternative should be separate from, and in addition to, the “no action” alternative required under NEPA, which would simply deny the right-of-way requested by the developer. This separate action alternative would provide BLM the efficiency of using a single EIS to determine whether to designate the area where the Project is proposed for additional protection as the optimal use of the area for the benefit of the public and the environment.

The Purpose and Need for the Draft EIS should include the same goals and objectives as the Castle Mountains ACEC nomination.

ACEC’s can be considered under the following BLM guide-lines and the Castle Mountain region meets at least 4 of the below listed criteria to establish an ACEC:

To be considered as a potential ACEC and analyzed in RMP alternatives, an area must meet at least one criterion for both relevance and importance.
1) Relevance. An area must meet one or more of the following criterion:
a. A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans).
b. A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species, or habitat essential for maintain species diversity).
c. A natural process or system (including but not limited to endangered, sensitive, or threatened plan species; rare, endemic, or relic plants or plant communities which are terrestrial, aquatic, or riparian; or rare geological features).
d. Natural hazards (including but not limited to acres of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action may meet the 6 *relevance criteria if it is determined through the RMP process that it has become part of a natural process.*
2) Importance. The value, resource, system, process, or hazard described above must have substantial significance and values in order to satisfy the ‘‘importance’’ criteria. This generally means that the value, resource, system, process, or hazard is characterized by one or more of the following:
a. Has more than locally significant qualities which give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.
b. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
c. Has been recognized as warranting protection in order to satisfy national priority concerns to carry out the mandates of FLPMA.

Evaluation of Areas of Critical Environmental Concern
d. Has qualities which warrant highlighting in order to satisfy public or management concerns about safety and public welfare.
e. Poses a significant threat to human life and safety or to property[1]

The region meets most of these criteria for an ACEC. The region has *significant historic, cultural, or scenic value, wildlife resource (including but not limited to habitat for endangered, sensitive, or* *threatened species, or habitat essential for maintain species diversity).* The ACEC would also preserve a *Natural Process and System* by maintaining connectivity for desert tortoise, keeping the region impact-free for migratory avian fauna and preserving the sandy habitat for the Threecorner milkvetch.

The nomination also meets the criteria of *Importance.* While the visual quality of the region is local, it attracts international visitors. The region is also an important spot for migratory birds, many of which travel hundreds of miles and pass through the region. It connects two recovery units for the desert tortoise and provides connectivity for more than a local population—it would help keep the desert tortoise from being uplisted to federally Endangered status. This would make the area more than *"locally significant".* The region also meets the criteria of *qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.*

This alternative would be beneficial for the future conservation of several species, cultural resources as well as a future tourism potential for the region.

A **No Project Alternative that designates the entire 44,000 acre ROW application as a Large-Scale Solar Energy Free Zone**. The region should also be recognized as an **Area of Ecological Importance**. The location is a poor choice due to the number of resources that would be impacted. This would be an Action Alternative because it does not preclude other uses. We would also like to request that the BLM consider upgrading the VRM Classes on the site to VRM I and VRM II. The BLM should evaluate the growing recreational use statistics of numbers of visitors to the Valley of Fire, Muddy Mountains Wilderness Area and the Bitter Springs Backcountry Byway. The alternative should include measures that would be taken to protect sensitive species and cultural resources from growing visitor use. This would make it an action alternative. Closing illegal OHV tracks and removal of invasive plants could be the "action."

Environmental Consequences

Biological Resources

Avian Mortality/Lake Effect:

There are updated numbers that confirm there are significant numbers of bird mortalities found at solar projects. Photovoltaic project companies are turning in many of these numbers. Since the projects are very large, these numbers only likely represent a smaller percentage of what is actually taking place. Updated information about avian-solar interactions by US Fish and Wildlife Service shows this is a concern. Solar projects can have significant impacts to sensitive species, and those listed under the federal Endangered Species Act. Data reported and gathered from seven solar projects in the southern California desert and arid grassland habitats from 2012 through April 2016 show that 183 bird species have been killed at solar projects, a number that rises with new information. 3,545 individual birds were reported dead at solar projects, from a mix of incidental finds and systematic surveys (Dietsch 2016). This is likely an underestimate.

The Fish and Wildlife Service has identified several Birds of Conservation Concern that use the vicinity of the Gemini Solar Project. The 1988 amendment to the Fish and Wildlife Conservation Act mandates the U.S. Fish and Wildlife Service (USFWS) to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973.

Birds that are of concern have been found dead at solar projects, and may be impacted by the Gemini Solar Project, including these Birds of Conservation Concern:

• Federal Endangered/Threatened – Yuma Ridgeway's (Clapper), Willow flycatcher, and Yellow-billed cuckoo.
• Birds of Conservation Concern – Eared grebe, American white pelican, Burrowing owl, Calliope hummingbird, Bald Eagle, Ferruginous Hawk, Golden Eagle, Peregrine Falcon, Snowy Plover, Long-billed Curlew , Black Swift, Calliope Hummingbird, Lewis's Woodpecker, Willow Flycatcher, Loggerhead Shrike, Virginia's Warbler, and Sage Sparrow.

Many of these Birds of Conservation Concern have been found in or in the vicinity of Lake Mead, the Muddy River and the Pahranagat National Wildlife Refuge as migrants or permanent residents (in the case of the burrowing owl). The arid regions between these water sources (Dry Lake Valley, Muddy Mountains, etc.) serve as flyways and a potential false lake could create issues. The 10 square mile Gemini Solar Project could potentially create this lake effect and polarized light may attract birds to photovoltaic solar projects as they mistake the panels for water. US Fish and Wildlife Service says many of these birds of conservation concern may be at risk.[3]

Because the proposed Gemini Solar Project would be up to 10 square miles in size and would be situated in a significant location for migrating birds in the Pacific Flyway, we believe that the project has the potential to cause significant avian mortality.

In addition, the potential for the project to cause deaths of ESA-listed birds means that the project must undertake ESA section 7 consultation and discuss that consultation in the EIS for this project.

Burrowing Owls:

During the desert tortoise surveys, 14 burrowing owl burrows were observed and 8 burrowing owls. Burrowing owls are declining in population in some parts of the western US. The primary reasons for the decline of Burrowing Owls have been identified as the elimination of burrowing mammals through control programs and habitat loss. In the Mojave Desert the owls also use tortoise burrows commonly. In the case of Southern Nevada, burrowing owls are impacted by off highway vehicle activity, urbanization, overgrazing, solar energy and new roads. To the Southwest of the Gemini Solar Project is a proposal to build the Crescent Peak Wind Project. Wind energy has also been identified as a threat to burrowing owls. The cumulative scenario of building out the 10 square mile Gemini Solar Project in good burrowing owl habitat is presents a future potential list the Burrowing Owl as Threatened or Endangered under the Endangered Species Act.

They are a federal Species of Concern, state protected, considered a high-priority evaluation species by the Clark County MSHCP, and considered a priority species by the Nevada Partners in Flight Working Group. They are typically found in shrub/steppe or desert shrub habitats along valley floors and in

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[3] https://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php

association with burrowing animals such as kit fox, desert tortoise, and badgers; often using those animals burrows for nesting.

Kit Fox:

The biologists who conducted the desert tortoise surveys for this project found 99 active kit fox burrows on the project site. This is a significant number.

During the construction of the Genesis Solar Project in Riverside County, California, an outbreak of canine distemper spread to several kit foxes because of stray dogs in the area that were brought in by workers. This problem was thought to be caused by the coyote urine that was used to repel kit foxes during the construction of the project or from workers who brought domestic dogs to the construction site.

The ICUN Red List has described the following threats to the Kit Fox"

"The main threat to the long-term survival of the Kit Fox is habitat conversion, mainly to agriculture but also to urban and industrial development. In both western and eastern Mexico, prairie dog towns, which support important populations of Kit Foxes are being converted to agricultural fields (e.g., Ávila-Flores et al. *2012), and in eastern Mexico the road network is expanding, producing a concomitant increase in the risk of vehicle mortality. In the San Joaquin Valley of California, habitat conversion for agriculture is slowing, but habitat loss, fragmentation, and degradation associated with industrial and urban development are still occurring at a rapid pace. More recently, expansive industrial-scale solar energy generating facilities are being constructed throughout the western USA, but particularly in California, Arizona, and Nevada."*
http://www.iucnredlist.org/details/41587/0

We are concerned that the Gemini Solar Project will have a negative effect on the kit foxes in the area.

Desert Tortoise:

The 2017 and 2018 desert tortoise for the proposed Gemini Solar Project surveys found 172 live tortoises, and based on density calculations, estimate that the project site contains 273 live tortoises. In addition to the live tortoises, biologists observed 2,774 desert tortoise burrows, 391 pallets, 323 carcasses, and 241 scats.

Because of the high number of tortoises found here, we recommend that BLM and US Fish and Wildlife Service consider designating this area as new Critical Habitat and an Area of Critical Environmental Concern, since so many Critical Habitat Units are now no longer viable (see discussion below).

The project site is located between two recovery units and in considered an important connectivity corridor or least cost pathway due to suitable topography. The surrounding Areas of Critical Environmental Concern (ACEC's) that contain designated desert tortoise Critical Habitat include the Mormon Mesa, Gold Butte, and Coyote Springs Desert Wildlife Management Areas.

Recent modeling by Sanchez-Rameriz et al. (2018) using single nucleotide polymorphism markers and spatial data consistently associated genetic connectivity with least-cost distance, based on multiple landscape features associated with tortoise habitat, despite landscape distance. Spatial and landscape genetics identified cluster 5 as tortoise inhabiting northeastern Mojave Desert in California, through southern Nevada, to southwestern Utah. The Gemini Project would threaten to disconnect this genetic population and fragment habitats, which have already undergone major development pressures.

Hagerty and Tracy (2010) undertook a finer-level genetic study of the Northeastern Mojave populations of desert tortoises in Nevada, and delineated a Muddy Mountains genetic segment. The Gemini Solar Project would endanger a large part of this unique genetic population.

The cumulative impacts have stacked up in this region for the desert tortoise. The area has a major Interstate highway running through it and there are also several transmission utility corridors in the area. The Dry Lake South Solar Energy Zone (Designated Leasing Area) has filled up 3,000 acres and BLM wants to approve the Dry Lake East DLA which would be built on over 1,500 acres hugging a mountain range. The Moapa Solar Project was built on almost 2,000 acres very close by and there is a proposal to build the 300 MW Eagle Shadow Mountain Solar Project on the reservation as well. This project would be close to 3,000 acres in size, the Red Flats Solar Project near Glendale would be 4,000 acres, the Ayia Solar Project on 900 acres of the Moapa Reservation and the Red Flats Solar Project on 2,000 acres near the Moapa Reservation. To the southwest is Las Vegas, Nevada which is experiencing a big economic urban growth boom now and thousands of acres of undeveloped public lands are being converted to housing subdivisions under the Clark County Multi Species Habitat Conservation Plan. Recently, the county passed a resolution which approved the transfer of over 40,000 acres of BLM lands to the county which would be used for housing subdivisions. If the Senate and Congress agree to this, that would add considerably to the cumulative loss of tortoise habitat in the region. To the north in the St. George, Utah area, the Northern Corridor highway project is proposed to slice directly through the Red Cliffs Tortoise Preserve, further leading to unmitigated mortality. At this rate of growth, there will not be much left for the tortoise if BLM approves the Gemini Solar Project.

The Desert Tortoise Council in recent letters to Congress opposing the Northern Corridor in Utah have stressed that these cumulative impacts, coupled with range-wide declines to the desert tortoise warrant uplisting to Endangered status under the federal Endangered Species Act. The large size of the Gemini Solar Project and its siting in a connectivity corridor between the Northeastern Mojave Recovery Unit and Upper Virgin River Recovery Unit, will only cause more declines in tortoise populations.

US Fish and Wildlife Service in its latest status review (USFWS 2015), based on surveys and sampling from 2004 to 2014, found that 10 of 17 populations of the Mojave desert tortoise declined over that ten year period, and that 11 of 17 populations of the Mojave desert tortoise are no longer viable. These 11 populations represent 89.7 percent of the range-wide habitat in Critical Habitat Units/Tortoise Conservation Areas.

While the BLM is a Multiple Use Agency, you are required to enforce the Endangered Species Act and when BLM just keeps approving large developments like this, there is no longer a balance between development and conservation. The Bureau of Land Management ensures the protection of the nation's federally-listed plants and animals found on its public lands. Collaboration and Partnerships at the national, state, and local level are essential components of successful conservation.

Desert tortoise translocation has created problems in the past. Moved tortoise often become disoriented and can end up pacing fences. This can lead to hyperthermia and increased predation by predators such as coyotes.

A recent study[4] has shown that translocated desert tortoise are not reproducing. Genetic paternity testing of 92 hatchlings by Smithsonian Conservation Biology Institute (SCBI) geneticists revealed that the translocated males are failing in one key way—they are reproducing at a far lower rate than resident males. The findings suggest that for some species, translocation may not be as effective a tool to rescue populations at risk, or bolster genetic diversity and health, as previously thought.

Translocation issues have occurred at the Ft. Irwin National Training Center. During a previous translocation effort to move desert tortoises out of an expansion area in Ft. Irwin Army National Training Center in the 1990's, 50% of tortoises suffered mortality due to the translocation. A 50% mortality rate over three years or more is usual for tortoises moved out of their home ranges. Predation is the most common cause of tortoise deaths.

The Moapa Solar Project also had some translocation problems. Eight were killed by predators and others suffered from over-heating and fence pacing.

Equally, these problems also occurred in the relocation area for the Silver State South Solar Project.

According to the Fish and Wildlife Service, ten year trend data from 2004 to 2014 has shown a steady decline in the populations of 15 out of 22 recovery units for the desert tortoise. [5]

Construction and solar facility toxic wastes, chemicals, and pollutants could have the potential to trigger diseases in desert tortoise populations surrounding the project. Raven and coyote predation could rise, as well as Sahara mustard and red brome invasions. What wildfire-prevention measures will be used? How will the project mitigate these threats without compensatory mitigation measures?

Bighorn Sheep:

A bighorn sheep horn was found on the project site during the desert tortoise surveys for this project.

Desert bighorn sheep have been well documented within the Muddy Mountains. Including the wilderness area and surrounding non-wilderness lands, the population is estimated to be approximately 265, with a potential population estimate of 505 based on forage supply (*Rangewide Plan for Managing Habitat of Desert Bighorn Sheep on Public Lands*). Two wildlife guzzlers were constructed within the wilderness to convert the area from cool season to year-long habitat. Desert bighorns are a state protected species and considered a watch species under the Clark County MSHCP. Desert bighorn sheep are associated with rugged terrain including canyons, steep slopes, cliffs, and mountain tops. In the Muddy Mountains, desert bighorns could be described as nomadic; remaining mobile throughout their range to take advantage of variable rainfall patterns and available water sources (many of which are ephemeral). NDOW biologists have observed that desert bighorns usually limit summer activity to an area within two miles of water, although some summer movements can be greater.

[4] https://insider.si.edu/2017/05/smithsonian-study-shows-relocated-desert-tortoises-reproduce-lower-rate/

[5] http://conserveswu.org/wp-content/uploads/Desert-Council-Stewart-letter-May-16-2018.pdf

Bighorn sheep have the potential to cross California Wash when traveling between the Muddy Mountains and ranges to the west, including the Sheep range.

Hunting tags are issued for this herd yearly.

The BLM portion of the Muddy Mountains Wilderness is located within the Muddy Mountain and White Basin Grazing Allotments. These grazing allotments were closed to grazing as of the date the wilderness was designated. Closure of the allotments protects bighorn sheep and desert tortoise, yet now BLM proposes to remove a large portion of habitat adjacent to the Muddy Mountains on this same land.

Gila Monster:

Banded Gila monsters are known to occur in the Muddy Mountains. Gila monsters are typically found below 5,000 feet elevation and are associated with desert wash, spring and riparian habitats that integrate with complex rocky desert scrub landscapes. They spend over 95 percent of their lives underground using deep crevices and caves on rocky slopes for refuge from extreme winter and summer temperatures. Gila monsters are a federal species of concern, a state protected species, and are listed as a high-priority evaluation species in the Clark County Multi Species Habitat Conservation Plan (MSHCP).

How will BLM passively translocate any gila monsters discovered in dens and burrows during construction activities?

Bats:

Suitable roosting and/or foraging habitat for sensitive bat species, such as the spotted bat (*Euderma maculatum*), occurs throughout the Muddy Mountains Wilderness. The spotted bat is on the Watch list for the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and is considered at moderate risk by the Nevada Bat Working Group. The spotted bat is found year round in a wide variety of habitats from low elevation desert scrub to high elevation coniferous forests and is highly associated with rocky cliffs.

Based on known species habitat characteristics and data collected in southern Nevada, the following sensitive bat species may occur within the Muddy Mountains Wilderness: pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), big brown bat (*Eptesicus fuscus*), western mastiff bat (Eumops perotis californicus), Allen's lappet-browed bat (*Idionycteris phyllotis*), California myotis (*Myotis californicus*), small-footed myotis (*Myotis ciliolabrum*), fringed myotis (*Myotis thysanodes*), cave myotis (*Myotis velifer*), long-legged myotis (*Myotis volans*), Yuma myotis (*Myotis yumanensis*), western pipistrelle bat (*Pipistrellus hesperus*), big free-tailed bat (*Nyctinomops macrotis*), and Brazilian free-tailed bat (*Tadarida braziliensis*). Caves, rock crevices and overhangs, and abandoned mines and prospects may serve as roosts. There is no documentation indicating that bat surveys have been conducted within the Muddy Mountains Wilderness area.

How will bats be impacted by the solar project?

Birds of Concern:

Phainopeplas (*Phainopepla nitens*) nest and forage in mesquite and cat claw acacia habitat where stands of the trees and shrubs are infested with mistletoe. No surveys for phainopeplas have been conducted within the Muddy Mountains Wilderness. Ephemeral drainages containing this vegetation may support this species.

Swainson's (*Buteo swainsoni*) and ferruginous hawks (*Buteo regalis*) may be observed hunting within the wilderness in areas vegetated with creosote-bursage scrub and Mojave desert scrub. Ferruginous hawks hunt for rodents and rabbits, while Swainson's hawks hunt small mammals and insects. Both species are state protected and the ferruginous hawk is on the Clark County MSHCP watch list.

Sensitive bird habitat is also found in the wilderness. Le Conte's thrashers (*Toxostoma lecontei*), loggerhead shrikes (*Lanius ludovicianus*), and prairie falcons are all found within the Muddy Mountains Wilderness. Peregrine falcons (*Falco peregrinus anatum*) and golden eagles (*Aquila chrysaetos*) may also be present as the rocky cliffs provide many potential nesting sites and the open valleys and bajadas provide good hunting grounds.

How will these bird species be impacted by the solar project?

Rare Plants:

According to the Nevada Natural Heritage Database[6] Threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*) occurs in the project area in Clark and adjacent Lincoln Counties. On sandy areas. This taxon may have only roughly 5,000 individual plants known since the last surveys. Only 41 extant mapped occurrences at 1.0 km separation are known, and one extirpated occurrence is recorded.[7] The taxon is a species of concern with US Fish and Wildlife Service, and a BLM Special Status Species in Nevada. Apparently a significant part of the population was inundated by Lake Mead. The conservation status rank is G4 (apparently secure, though frequently quite rare in parts of its range, especially at its periphery), S2 (imperiled due to rarity or other demonstrable factors). The Nevada Native Plant Society lists it as threatened.

Three-corner milkvetch is a Fully Protected species in the state of Nevada (on the state Critically Endangered Species List). The Nevada Division of Forestry performs administrative and regulatory actions involving state- protected plants. The Nevada Division of Forestry State Forester Firewarden has an established list of "fully protected" native plant species (NAC 527.010) that are critically endangered and threatened with the potential to become extinct within the state of Nevada. Fully protected native plant species require a special permit from the State Forester Firewarden for their removal or destruction from both public and private lands (NRS 527.270). [8]

The species germinates only in wetter years, potentially resulting in accidental losses of undetected populations—will surveys be done during rainy and wet years to maximize detection probability of this taxon? What percentage of the total population of this taxon in Nevada will be impacted by the project?

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[6] http://heritage.nv.gov/sites/default/files/atlas/astrageyertriqu.pdf

[7] http://heritage.nv.gov/taxon_detail/16691

[8] http://www.clarkcountynv.gov/comprehensive-planning/advanced-planning/Documents/ConservationReport.pdf, pp. 17-18.

The proposed project would remove over ten square miles of desert habitat in the region and also will more than likely block the sand transport corridor that provide habitat for the Threecorner milkvetch. How much of the sand transport corridor will be blocked by the solar panels? BLM will need to study this and create a map showing the process of sand transport. This species has list much of its habitat with the creation of Lake Mead. The BLM may approve a large-scale solar project in the core of this habitat. Will this create an extinction scenario for this species? At what point does BLM have more of a responsibility to protect the remaining habitat for state sensitive species over approving a ROW for yet another speculative solar project? Better options such as moving the project to degraded lands such as old mine sites and abandoned agricultural fields can avoid the need to list taxa such as these under the federal Endangered Species Act.

The largest population of Las Vegas buckwheat, a sensitive species under review for candidate status under the Endangered Species Act, occurs within the Muddy Mountains Wilderness. The Las Vegas bear poppy is a sensitive species which has limited occurrence in the wilderness. Both of these species occur on gypsum rich soils present in the eastern and southern portion of the wilderness. Surveys for these species should be undertaken in the project area.

Microphyll Woodlands:

On the project site, we observed honey mesquite (*Prosopis glandulosa*), desert willow (*Chilopsis linearis*), and catclaw acacia (*Senegalia gregii*). It appears that there is more microphyll on this site than most of the other solar energy site BLM has reviewed. At the public scoping meeting however, BLM told us that no microphyll would be disturbed on the site. But that is inconsistent with what we found. We did find microphyll on the proposed ROW for the project. Will this be avoided? BLM should provide a map of all the microphyll located on the project site.

In the Clark County MSHCP,[9] the mesquite/catclaw ecosystem provides habitat for 11 Covered Species and 5 High Priority Evaluation Species:

> <u>Covered Species:</u> Silver-haired bat, Long-eared myotis, Phainopepla, Vermilion flycatcher, Banded gecko, Desert iguana, Western chuckwalla, Great Basin collared lizard, Western red-tailed skink, Sidewinder, Pahrump Valley buckwheat,
>
> <u>High Priority Evaluation Species:</u> Kit fox, Pale Townsend's big-eared bat, Desert pocket mouse, Banded Gila monster, Southern desert horned lizard.

How will BLM conserve these species and mitigate impacts from a large utility-scale solar project and associated new transmission lines and possible substation nearby?

How will BLM follow the Clark County MSHCP in implementing this measure?

> BLM(99) Enter into conservation agreements or easements with the U.S. Fish and Wildlife Service and the State of Nevada, that if implemented, could reduce the necessity of future

[9] http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-240.

listings of species in question. Conservation agreements may include, but not be limited to, the following: Las Vegas bearpoppy, white-margined penstemon, and phainopepla.[10]

The Gemini Solar Project proposal overlaps with the Valley of Fire Unit proposed MSHCP Reserve.[11] How will this be mitigated?

Cultural Resources/Old Spanish Trail:

The Old Spanish Trail was in use between 1829 and 1848. Spain searched for a trade route between New Mexico and California in the 1700s. Traders with mule caravans stopped here as early as 1829, using the area as a link from the abundantly watered flowing springs of Las Vegas--"The Meadows."

Congress designated the area as part of the Old Spanish Trail in 2002. Several segments in Nevada are listed in the National Register of Historic Places.

The trail goes through the Gemini Solar Project site. If the project is built, it will completely change and disrupt the historic character of the trail and change the original landscape to something unrecognizable, as well as directly remove this trail segment in California Wash.

Air Quality/Fugitive Dust:

The BLM may allow a ten square mile development happen in this location. This will require many massive scraper-grader Earth-moving machines.

If you build roads, transmission, large scale renewable projects and scrape up the Mojave Desert habitat, you will have fugitive dust. When deserts are scraped, a Pandora's Box of air quality issues is opened. Biological soil crust, desert pavement and old growth vegetation will all be lost. This is an **Environmental Justice** issue. The health impacts that will arise from airborne particulates from construction dust could have very negative on the local residents of the area. Dust control in hot, arid climates is very problematic. The removal of established vegetation, biological soil crusts and centuries old desert pavement creates opportunities for dust to be airborne every time the wind blows. Not only does fugitive dust create problems for visual and biological resources, it creates issues for public health as well. Coccidioidomycosis (**Valley Fever**) is a common issue in the desert regions when too much land is disturbed. There have been hundreds of cases of Valley Fever in Clark County and 33 cases reported in Clark County alone in 2016.[12] The rapid growth creates quote a bit of dust. The cumulative impact pf scraping 10 square miles will only add a cumulative

The land rush of large solar projects all over the southwestern US has resulted in approval of many of these projects. In most of the cases, the developers have not adequately mitigated the fugitive dust that has resulted in the removal of large acreages of vegetated desert lands.

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[10] http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-251.

[11] http://www.clarkcountynv.gov/comprehensive-planning/advanced-planning/Documents/ConservationReport.pdf, p. 46.

[12] http://nvophie.weebly.com/home/valley-fever

Visual Resources:

In order to approve the project, the BLM will need to downgrade the VRM Class to VRM IV, the lowest class.

The Gemini Solar Project site location is managed under Visual Resource Management (VRM) Classes II and III. These VRM Classes were created under the 1998 Southern Nevada Resource Management Plan. The BLM will be required to ***downgrade*** all of the VRM Classes on the site to Class IV in order to approve this project. The BLM must do this by amending the 1998 Resource Management Plan. Visual Resource Management under FLPMA and NEPA is very much tied to public perception. We believe it is a premature for BLM to quickly approve this project under the outdated 1998 Southern Resource Management Plan rather than wait for the updated plan to be finalized and it is being reviewed at exactly the same time. We also believe that such downgrading cannot be justified given the scenic quality of the area where the Project is being proposed.

Visual resources must be protected under the Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701 et. seq.;
1. Section 102 (a)(8). States that "...the public lands be managed in a manner that will protect the quality of the...scenic...values...."
2. Section 103 (c). Identifies "scenic values" as one of the resources for which public land should be managed.
3. Section 201 (a). States that "The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values (including...scenic values)...."
4. Section 505 (a). Requires that "Each right-of-way shall contain terms and conditions which will... minimize damage to the scenic and esthetic values...."

Both NEPA and FLPMA recommend that Visual Resource Management be decided on the RMP level. The project site is now managed under VRM II and VRM III standards.

VRM II is managed to: *retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.*

VRM III is managed to: *partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.*

If the BLM approves this project, they will have no choice but to DOWNGRADE the VRM Class to VRM IV. This would be the lowest visual class in spite if the fact that this is along a scenic byway.

VRM Class IV is managed to: provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements. This rating does not necessarily mean the area has low visual value.

Due to the new conservation designations and the very high scenic quality of the area**,** Basin and Range Watch and Western Watersheds Project request that the region be upgraded to both VRM I and VRM II.

- **VRM Class I Objective**: To preserve the existing character of the landscape. Allowed Level of Change: This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

- **VRM Class II Objective**: To retain the existing character of the landscape. Allowed Level of Change: The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

The BLM will need to select a complete range of Key Observation Point simulations. Factors that should be considered in selecting KOP's are; angle of observation, number of viewers, length of time the project is in view, relative project size, season of use, and light conditions. But to accurately disclose the impacts of the Project on the scenic beauty of the area where it is being proposed, KOP simulations should be presented from the Muddy Mountains Wilderness Area, the Bitter Springs Backcountry Byway, the Old Spanish Trail, Whitney Pockets and the Valley of Fire Road. Several simulations at different times of day should be available.

Socioeconomics, Recreation and Public Access:

If a 10 square mile ROW is issued to the applicant, the land is no longer public for all intents and purposes. The project will be completely cut off from public access and be surrounded by a large wire fence. Anyone entering the project would be arrested. The region is vast and a motorsport event crosses through the area each year. Closing off so much public land for only one use is not consistent with the BLM's Multiple Use Philosophy.

The BLM should also evaluate visitor use demographics for the Valley of Fire Road, the Muddy Mountains Wilderness Area and the Bitter Springs Backcountry Byway. The BLM should also evaluate how much money is spent in Clark County relating to these areas. The Valley of Fire State Park is now one of the most popular tourist destinations in Nevada. Do the economic benefits of a solar project that would only create 5 to 15 full time jobs outweigh the growing demographics of tourism in the region? Will the destruction of so much scenery drive people away from the region? How will this impact the region economically?

Wilderness:

How will the large-scale solar project and construction lead to diminishment of the wilderness qualities of the adjacent Muddy Mountains Wilderness Area, which is to be managed for its "scenic qualities" and "to provide for the long term protection and preservation of the area's wilderness character under a principle of nondegradation. The area's natural condition, opportunities for solitude, opportunities for primitive and unconfined types of recreation, and any ecological, geological, or other features of scientific, educational, scenic, or historical value present will be managed so that they will remain unimpaired."[13]

Restoration:

Clark County requires important habitat to be restored, and we recommend the applicant have a restoration fund to restore this desert habitat after its lease is ended:

> BLM(123) Within desert tortoise critical habitat/ACECs, Las Vegas bearpoppy habitat, and other important habitats for covered and evaluation species, require reclamation of activities which result in loss or degradation of habitat, with habitat to be reclaimed so that pre-disturbance condition can be reached within a reasonable time frame. Reclamation may include salvage and transplant of cactus and yucca, recontouring the area, scarification of compacted soil, soil amendments, seeding, and transplant of seedling shrubs. If necessary subsequent seeding or transplanting efforts may be required, should monitoring indicate that the original effort was not successful. [14]

Conclusion:

The Gemini Solar Project would disturb 7,100 acres (ten square miles) of relatively pristine Mojave Desert ecosystems. Basin and Range Watch and Western Watersheds Project support the move away from fossil fuels and towards renewable energy to help mitigate climate change, but only on previously degraded lands or on rooftops and parking lot structures in the built environment, where resource conflicts will be lessened. This location in California Wash has too many high-value resources for us to support the project: the historic Old Spanish Trail would be directly destroyed here, a popular public lands recreation area and scenic routes would be industrialized, scenic visual resources would be unnecessarily downgraded, and two at-risk taxa would be significantly impacted: the Federally Threatened desert tortoise and rare threecorner milkvetch. With better options available for siting this solar project, we may be forced to consider actions to petition to list or uplist these two taxa for greater protection and conservation because we believe mitigations will not offset the large impacts to these species from direct, indirect, and cumulative impacts that are growing without without relief in Clark County.

Thank you,

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[13] https://www.nps.gov/lake/learn/management/upload/MMFinalPlan.pdf

[14] http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/current%20HCP/cc-appa.pdf, p. A-230.

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References:

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Sanchez-Ramirez, S., Y. Rico, K. H. Berry, T. Edwards. A. E. Karl, B. T. Henen, and R. W. Murphy. 2018. Landscape limits gene flow and drives population structures in Agassiz's desert tortoise (*Gopherus agassizii*). Nature Online Scientific Reports.

August 27, 2018

Bureau of Land Management
Las Vegas Field Office
4701 North Torrey Pines Drive
Las Vegas, NV 89130-2301
Attn: Herman Pinales
Via email: blm_nv_sndo_geminisolar@blm.gov

Re: Notice of Intent To Prepare an Environmental Impact Statement and Land Use Plan Amendment, and a Notice of Segregation for the Proposed Gemini Solar Project in Clark County, Nevada

Dear Mr. Pinales;

On behalf of Defenders of Wildlife (Defenders), we thank you for the opportunity to submit scoping comments on the proposed Gemini Solar Project (Project). Defenders is a national conservation organization dedicated to the protection of native species of plants and animals and their habitats. We have approximately 1.8 million members, donors, and supporters in the U.S., including approximately 16,300 in Nevada. We have a long history of advancing clean, emissions-free renewable energy development, including solar, while simultaneously working to ensure that those projects minimize impacts to wildlife, such as direct mortality, behavioral avoidance, habitat destruction, and fragmentation.

The Mojave ecoregion has incredible solar resources but is also a unique ecosystem, home to many endemic species, including the federally and state threatened Mojave desert tortoise (*Gopherus agassizii*). Desert tortoises are declining throughout most of their range due to a myriad of threats, including habitat loss, disease, roadkill, and high juvenile mortality. Expanding infrastructure development in the Mojave, which includes utility-scale solar facilities, is significantly contributing to habitat loss and disruption of connectivity. Access roads can also disrupt connectivity and increase risk of vehicle-strike mortality and facilitate off-road vehicle access, which further degrades habitat. In addition to disrupting connectivity, transmission lines provide perching opportunities for ravens and other corvids, which prey on juvenile desert tortoise.[1] Our comments below highlight concerns and offer the following recommendations to prioritize the conservation of this threatened species.

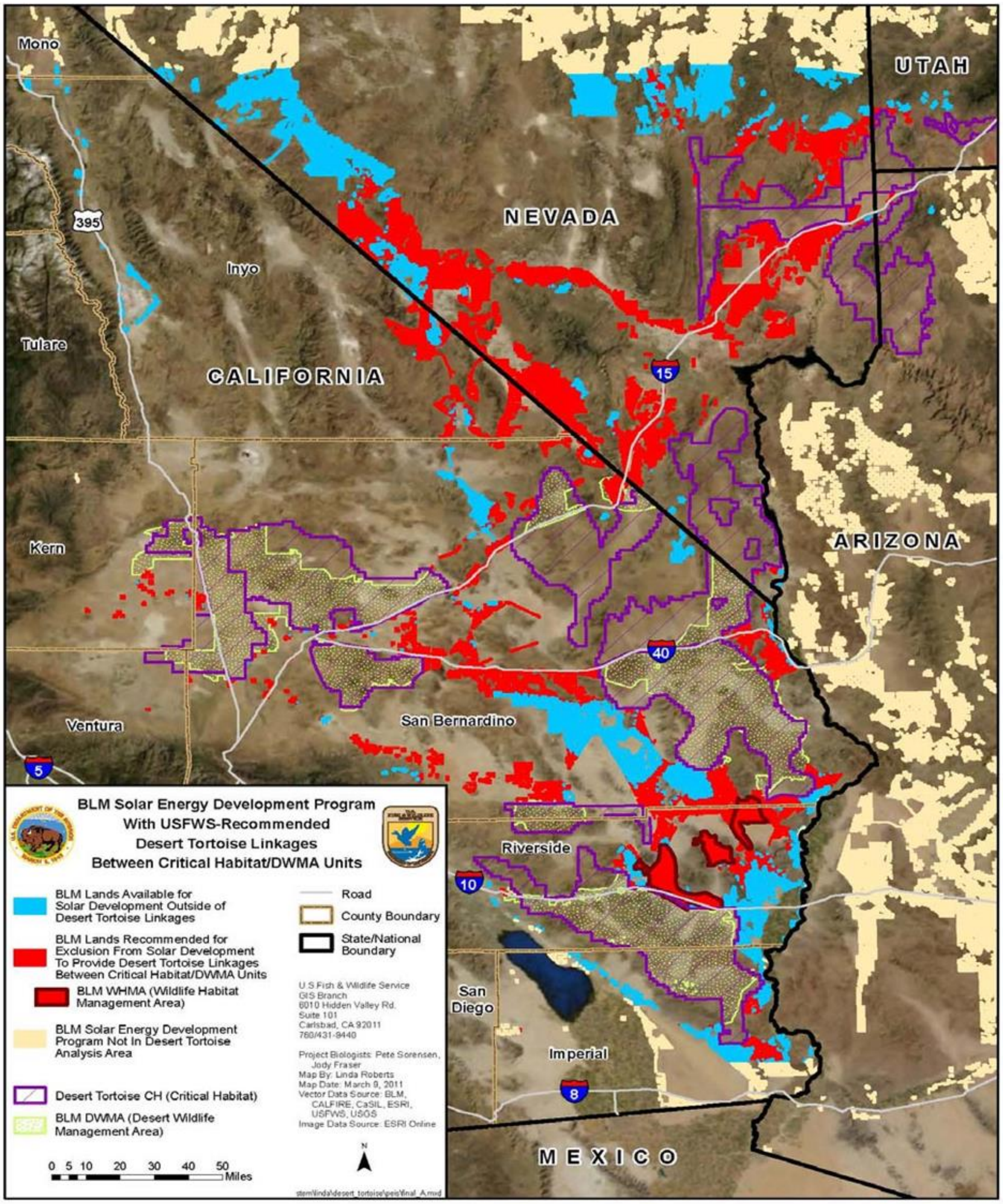
1. Project is located in high quality Mojave desert tortoise habitat

The Project, which lies within Northeastern Mojave Recovery Unit for the desert tortoise, appears to be located on relatively undisturbed, high quality habitat identified by U.S. Fish and

[1] Boarman, W., B. Heinrich. *Corvus corax*: Common Raven, in *The Birds of North America*, 476: 1-32 (1999) (finding that ravens and other corvids, which prey on juvenile desert tortoise have been shown to range as far as 4.3 miles in either direction from transmission lines in some landscapes, greatly increasing the potential threat from linear corridor development to the tortoise). See also Leu, M., Hanser, S.E., and Knick, S.T., The human footprint in the west-A large scale analysis of anthropogenic impacts, in Ecological Applications, v. 18, p. 1119-1138 (2008).

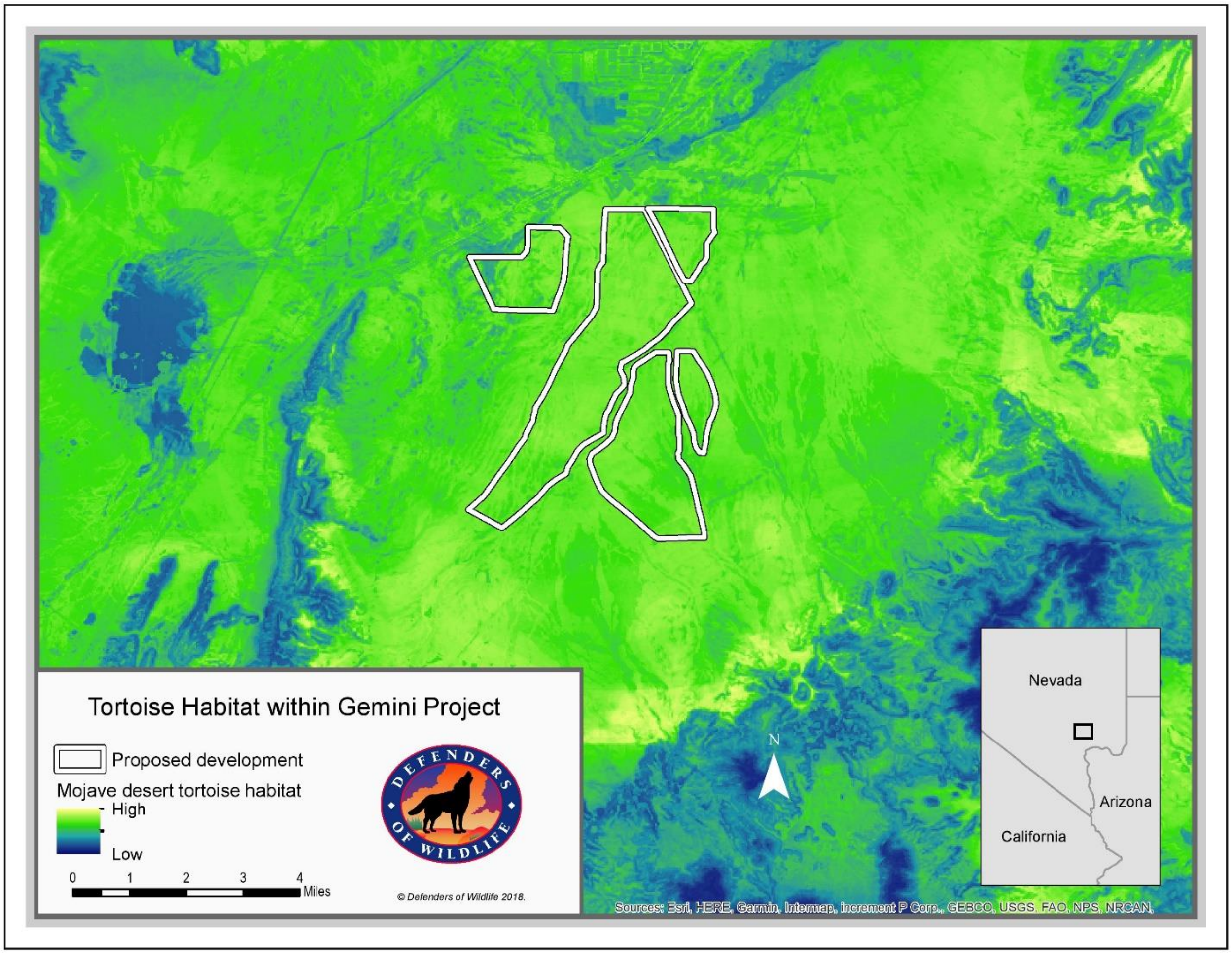
Wildlife Service (USFWS) as Priority 1 and 2 connectivity habitat. Below is a map (Figure 1) from the USFWS prepared in 2011 identifying lands (in red) that the Service recommended be excluded from solar energy development due to habitat quality and importance for the tortoise. Although the Project application is grandfathered and predates the creation of this map, Gemini is located within the recommended exclusion area northwest of Las Vegas and immediately south of the Moapa Indian Reservation.

Figure 1: BLM Solar Energy Development Program with USFWS recommended desert tortoise linkages between critical habitat and Desert Wildlife Management Areas



More recent desert tortoise habitat suitability modeling, done by NatureServe for Defenders of Wildlife, also indicates that Gemini's entire project footprint[2] represents suitable tortoise habitat. Moreover, this habitat is high quality: the average habitat suitability is 0.67 (MIN: 0.30; MAX: 0.75; STD: 0.046). For context, Piute-Eldorado Area of Critical Environmental Concern (ACEC), an ACEC designated for the protection of the desert tortoise, has an average habitat suitability of 0.51 (MIN: 0.03; MAX: 0.95; STD: 0.26), indicating that Gemini represents, on average, higher quality tortoise habitat than is found within a tortoise ACEC. This modeled high quality habitat is validated by the abundance of tortoises found within the Project area during desert tortoise surveys.

Figure 2: Desert tortoise habitat suitability for Gemini (from NatureServe / Defenders 2017)



The desert tortoise surveys for Gemini, conducted by Phoenix Biological Consulting in September-October 2017 and April-May 2018, found hundreds of desert tortoises within the Project area. However, the highest tortoise densities and the most tortoise signs (scat, carcasses, burrows) were found in the middle and southwestern parts of the Project site (specifically areas B, G, B2, eastern portion of area A, and the northwestern corner of C; see Figures 3, 4, and 5

[2] Area and analyses based on BLM's GIS data for the site.

below). Given that, siting the project footprint to the northeastern/eastern side of the survey area would likely minimize direct impacts to tortoises.

Figure 3: Gemini desert tortoise observations in areas A, C, and the northern half of B (September-October 2017)

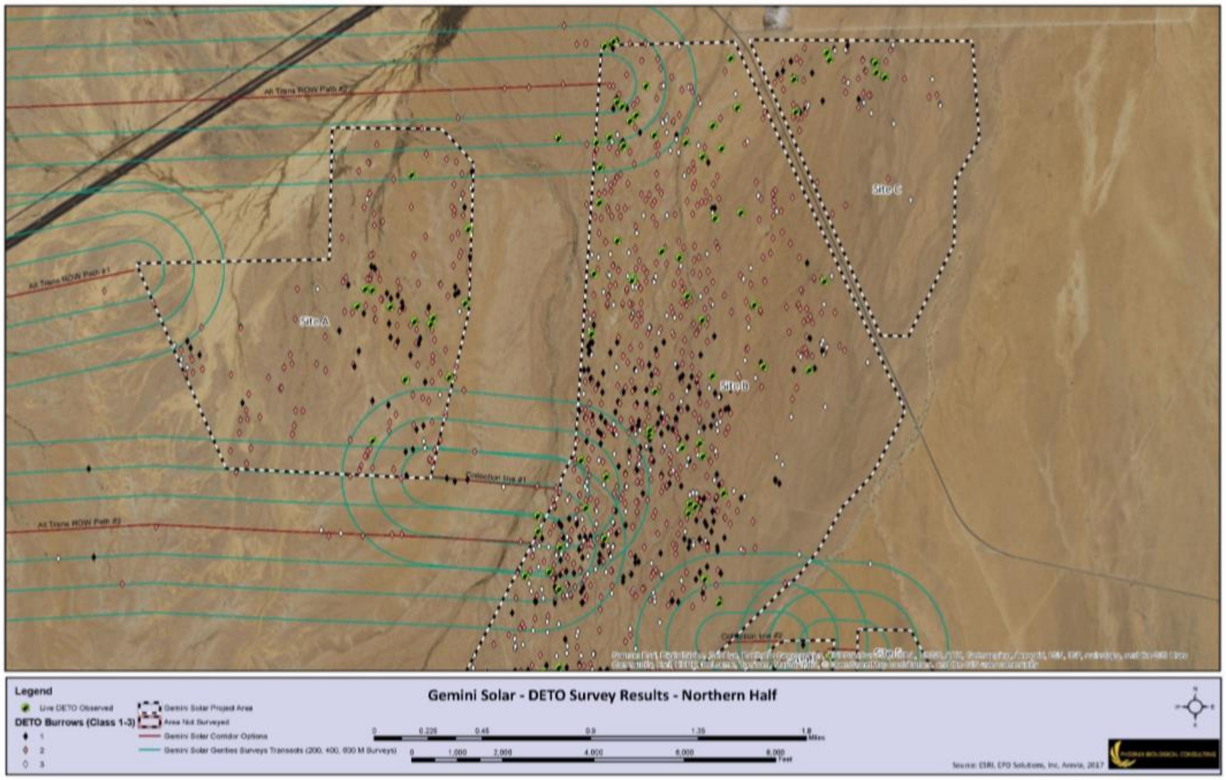


Figure 4: Gemini desert tortoise observations in areas D, E, and the southern half of B (September-October 2017)

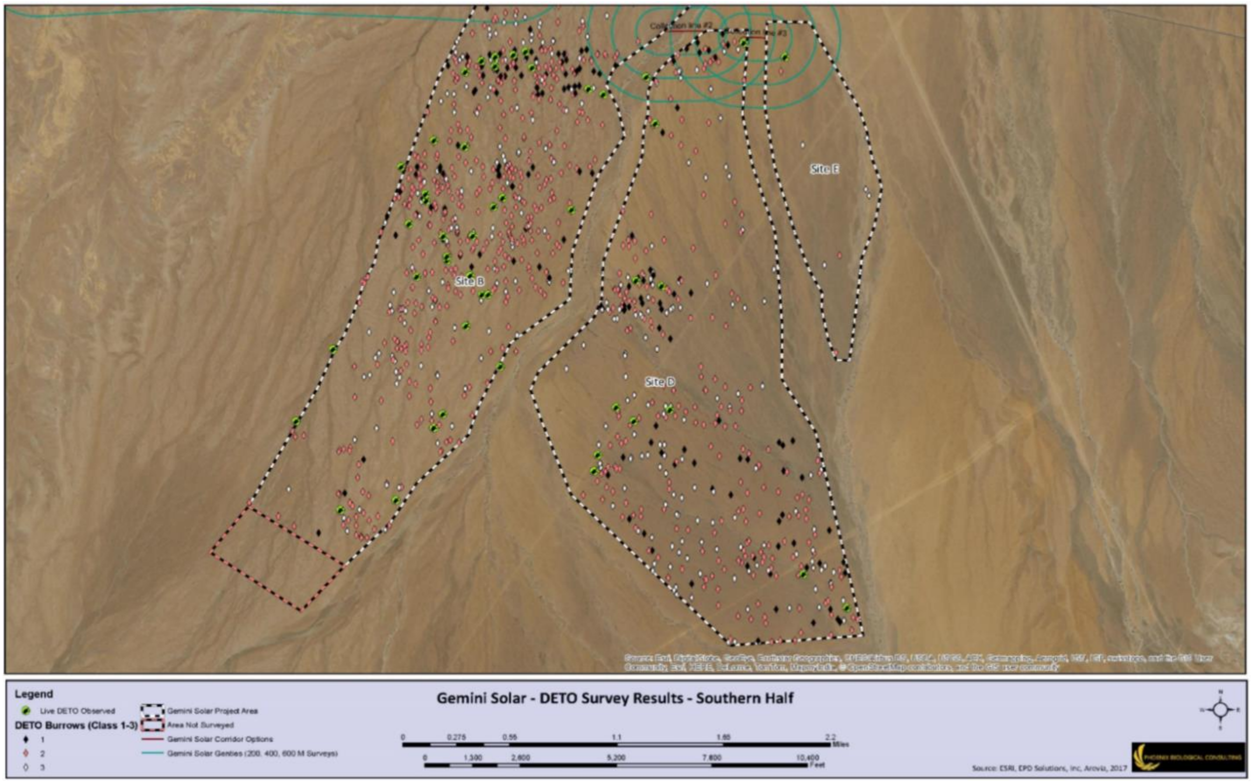
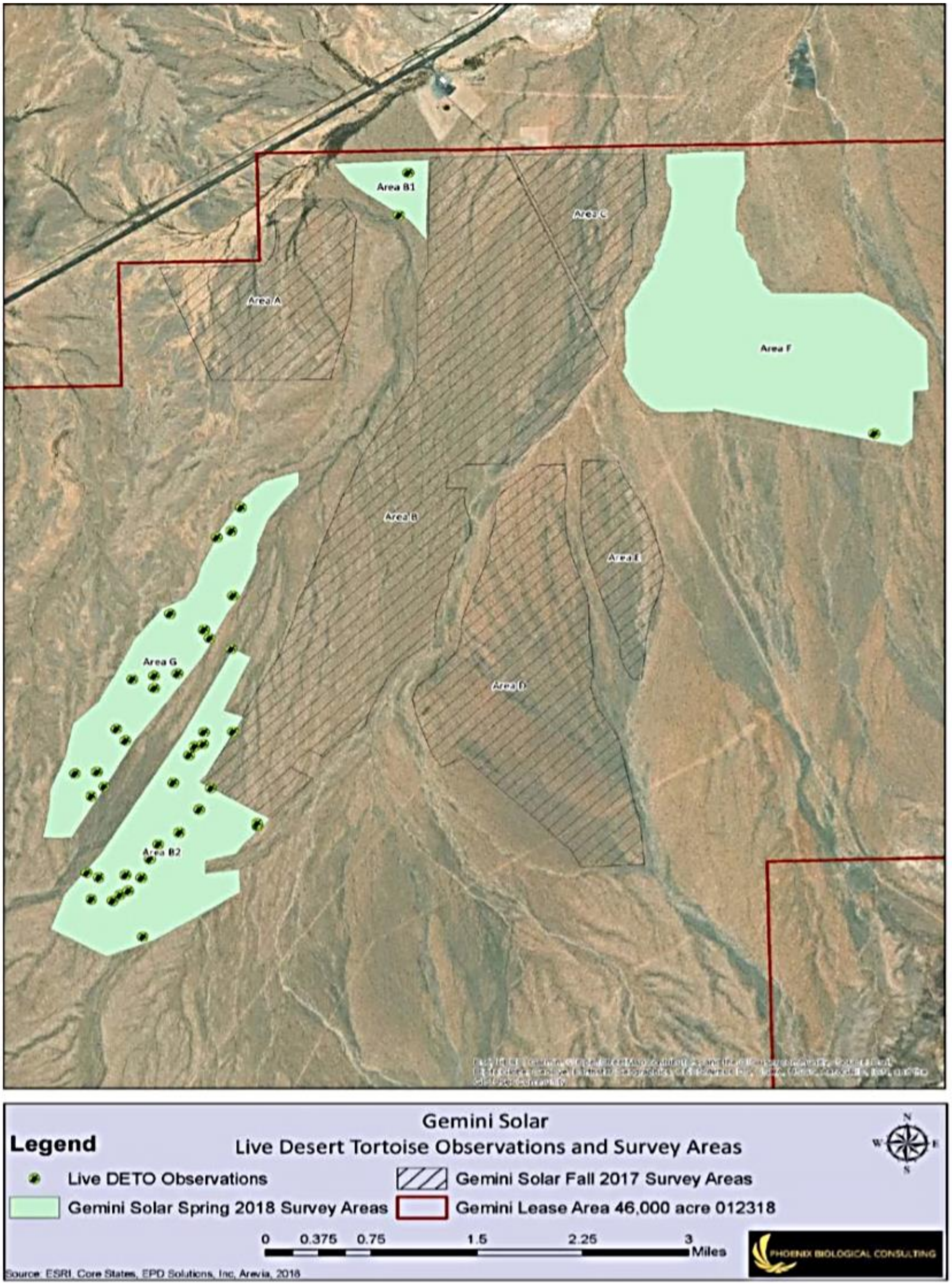


Figure 5: Gemini desert tortoise observations in areas G, B1, B2, and F (April-May 2018)



Under the 1998 Las Vegas Resource Management Plan's Record of Decision, BLM is required to "[m]anage special status species habitat at the potential natural community or desired plant community, according to the need of the species" (Objective SS-1) and "[m]anage habitat to further sustain the populations of Federally listed species so they would no longer need protection of the Endangered Species Act. Manage habitats for non-listed special status species to support viable populations so that future listing would not be necessary" (Objective SS-2). The importance of habitat in the Project area for sustaining healthy populations of the desert tortoise in both the habitat linkage and in core populations located within connected critical habitat units has been established, as described previously in comments from the USFWS, and therefore BLM should carefully analyze the impacts of the Project and determine what measures are needed to ensure BLM can achieve these management objectives.

Recommendation: The Draft Environmental Impact Statement (EIS) should propose alternatives focused on the avoidance and minimization of impacts to desert tortoise by (1) siting the Project footprint outside of the areas of highest tortoise densities, as indicated by the tortoise surveys (see Figures 3-5), and (2) recommending additional project design measures to minimize impacts on tortoise habitat.

2. Development in the region could compromise desert tortoise habitat connectivity

Habitat corridors allow for movements of individual tortoises across the landscape as well as long-term gene flow between core populations. Gene flow occurs slowly as tortoises interact within their home ranges, which requires that a stable and viable population occupies the linkage. For additional information on the importance of conserving desert tortoise habitat linkages, see Averill-Murray et al. 2013.[3]

Based on new desert tortoise connectivity modeling developed by Conservation Science Partners for Defenders of Wildlife and The Wilderness Society (Figure 6), Gemini is located in good quality tortoise connectivity (62.8 percentile,[4] above average for the Mojave ecoregion). Because the Project is sited in a large, intact area of tortoise habitat, the Project does not appear to be located in a connectivity "pinch point" (i.e. developing the Project area is not anticipated to completely sever connectivity across the region). However, while developing the Project area may, by itself, not cause the complete loss of desert tortoise connectivity across the area, this development may cause desert tortoise movements to be funneled into narrow connectivity corridors around the Project**. Ensuring subsequent development does not occur adjacent and near this Project will be critical to maintaining connectivity in the area for the tortoise.**

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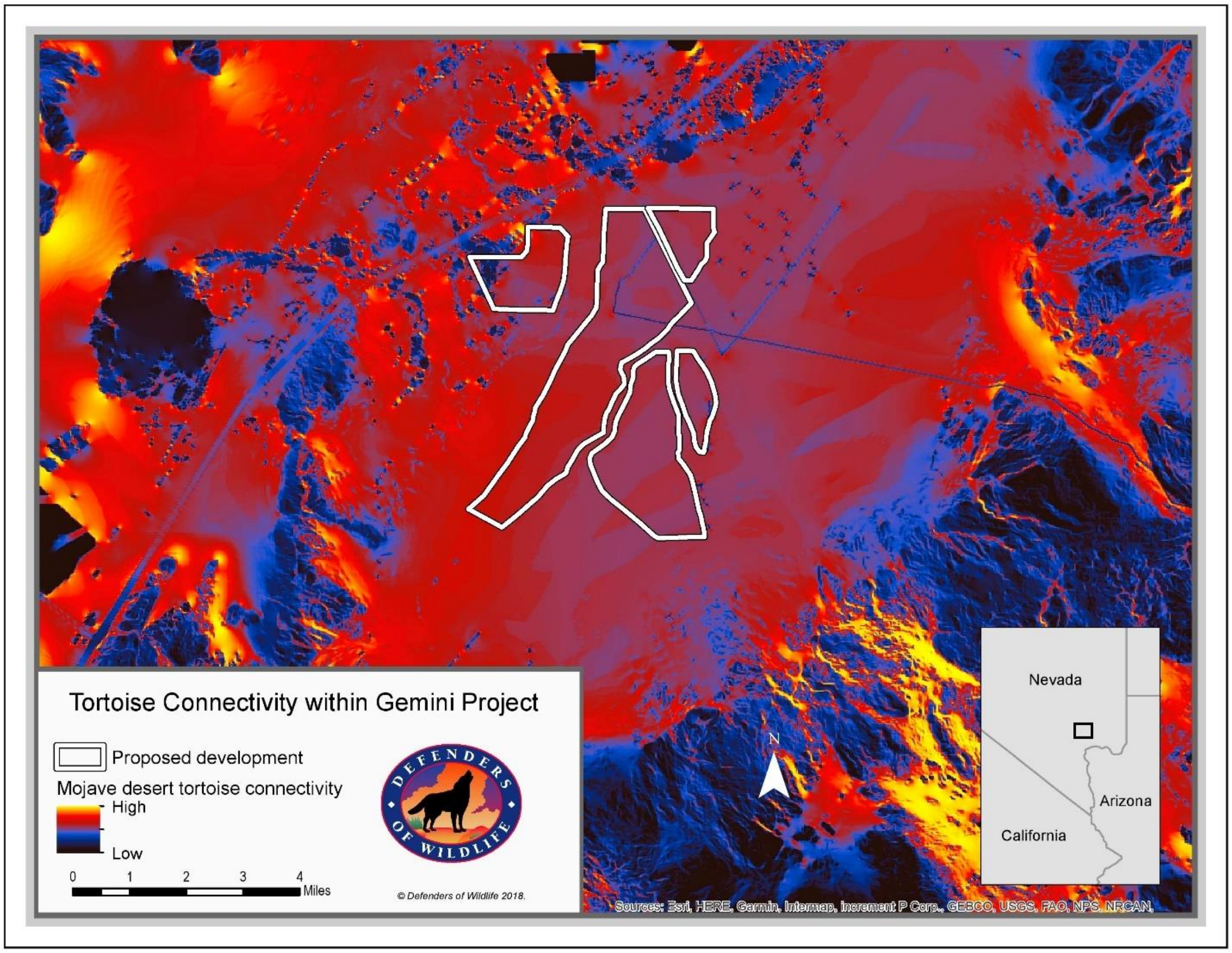
[3] https://www.fws.gov/nevada/desert_tortoise/documents/publications/2013-Conserving-popln-linkages-mdt.pdf

[4] This percentile was calculated by 1) summing the habitat connectivity values within the Project footprint for Gemini (based on GIS data provided by BLM); 2) using a moving window approach to calculate the sum of habitat connectivity values for the area of Gemini, were the project centered at every 30m pixel within the Mojave ecoregion; 3) generating a histogram of these summed connectivity values and determining what percentile Gemini's actual footprint's connectivity value (calculated in step 1) falls within.

Figure 6: Desert tortoise connectivity for Gemini (from Conservation Science Partners / Defenders / The Wilderness Society 2018)



The 1998 Las Vegas RMP Record of Decision directs that BLM "[e]stablish areas of critical environmental concern specifically for management of desert tortoise in the Northeastern Mojave [where the proposed Project is located] and Eastern Mojave recovery units identified in the Tortoise Recovery Plan. Manage a sufficient quality and quantity of desert tortoise habitat, which in combination with tortoise habitat on other Federal, State and private land, will meet recovery plan criteria. *Maintain functional corridors of habitat between areas of critical environmental concern to increase the chance of long-term persistence of desert tortoise populations within the recovery unit*" (Objective AC-1, emphasis added).

The analysis of the Project on the functionality of the linkage should be included in the draft EIS. If the analysis indicates the functionality would be lost or substantially degraded, BLM should indicate in the draft EIS that its preferred alternative is one that minimizes siting the project in any desert tortoise linkage.

Recommendation: BLM should work with USFWS to analyze the implications of the Project on desert tortoise connectivity.

Recommendation: Because there is a high risk that connectivity in the region will be jeopardized in the future by additional development around the Project, when analyzing cumulative impacts, BLM should consider opportunities such as changing land use designations around the Project footprint to limit future development in the region.

We are aware that an additional 3,722 acres were surveyed for the Project (see areas in green on Figure 5) which are not reflected in the habitat suitability and connectivity calculations above. We were unable to obtain the GIS data for these additional areas, but the entire region is high quality desert tortoise habitat, the Project's tortoise surveys found numerous tortoises in the additional surveyed areas, and the connectivity values are relatively consistent across the Project area, including the expanded survey area. Therefore, we do not expect our connectivity and habitat suitability results to significantly change with the inclusion of those additional 3,722 acres.

3. Mitigation measures for impacts to desert tortoise

Given the abundance of desert tortoises found within the Project area, we anticipate that desert tortoise translocation will be required. Long-distance relocation efforts for desert tortoises have had limited success, with recent research indicating that translocated male tortoises are failing to reproduce within host populations, resulting in a net loss of genetic diversity.

Recommendation: Desert tortoises removed from the Project area should be relocated to adjacent or nearby sites, perhaps including undeveloped areas within the initial 44,000 acre lease area. BLM should amend land use designations on the translocated site, if necessary, to ensure the long-term protection of the habitat.

Given the sensitivity of the Project area, additional mitigation measures to minimize the Project's impact on desert tortoise populations should be explored.

Recommendation: BLM should welcome any voluntary compensatory mitigation offered by Project proponents to maintain viable desert tortoise populations in the region. Otherwise, BLM risks an "unnecessary or undue degradation" finding for this project and will be limited in future decisions given cumulative impacts to desert tortoise.

4. Conclusion

As we transition towards a clean energy future, it is imperative for our future, and the future of our wild places and wildlife, that we strike a balance between addressing the near-term impact of large-scale solar development with the long-term impacts of climate change on our biological diversity, fish and wildlife habitat, and natural landscapes. To ensure that the proper balance is achieved, we need smart planning for renewable power that avoids and minimizes adverse impacts on wildlife and their habitats. Utility-scale renewable energy projects should be placed in the least harmful locations, near existing transmission lines and on already disturbed lands. All energy development should follow the mitigation hierarchy of avoiding, minimizing, and mitigating impacts. Implementation of the mitigation hierarchy is a fundamental requirement under the National Environmental Policy Act to protect the diverse resources of our public lands.

Thank you for the opportunity to provide scoping comments, and do not hesitate to contact us for additional information or clarification.

Sincerely,

Pasha Feinberg
Renewable Energy & Wildlife Policy Analyst
Defenders of Wildlife
pfeinberg@defenders.org

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Comments on Gemini Solar Project
Date:	Tuesday, August 28, 2018 7:23:34 AM

---------- Forwarded message ----------
From: **Daryl Folks** <traconride@gmail.com>
Date: Mon, Aug 27, 2018 at 10:09 PM
Subject: [EXTERNAL] Comments on Gemini Solar Project
To: blm_nv_sndo_geminisolar@blm.gov

To: Energy and Infrastructure Project Manager:

Subject: Gemini Solar Project Comments

Comments written by: Daryl Folks; Owner of Trac-On Off Road Motorcycle Rides and Tours
Co Owner and Majority share holder of Best In The Desert Racing Association (BITD)
Member of the Mohave Southern Great Basin Resource Advisory Counsel (Permitted Recreation) MOSORAC
Lifetime Member of the Motorcycle Racing Association of Nevada (MRAN)

After learning as much as possible and attending a Public Scoping Meeting along with conversations with representatives of the Gemini project I have assembled the comments that follow. Also note that I represent 350 Southern Nevadans with my business Trac-On and 7000 with Best In The Desert Racing Association and I'm commenting in there best interest. My current RAC position helps to advise and assist BLM's guidance for recreation permitting therefore I consider all stakeholders without any discrimination. Regarding the Gemini project there could be a potential affect in particular on OHV permitting and usable land for future race and or Tour Operators. The proposed area (South side of I-15 between Dry Lake Range and Valley of Fire Road) for Gemini has gone somewhat dormant for OHV races for a period of time and the last motorcycle race (MRAN-Jackrabbits M/C) in the proposed Valley to my knowledge was apx. 2001. The area hasn't been used much since then because of current lack of knowledge with new membership and other areas such as the Jean/Roach Dry lake areas however, with Clark County's Lands Bill Proposal the area will become an option again. If the CC Lands Bill passes in congress the Jean/Roach area will be affected by the Air Quality boundary by being moved farther outbound. If that becomes a reality then there will be much more limited permitting in Jean/Roach if any at all depending on where the boundary lies.

Looking at the proposed project map in which I received from Energy Project Solutions Section A and Section C would not have any affect on OHV use in the area. Section B, D and E would have an affect if the area moved back onto the OHV Radar. On the map that I received there was also Surveyed/Study Area Sections B1, B2, G and F which I was told are backup options. B1 would not have an affect as to where B2, F and G would have an affect. Note, at the Scoping Meeting F was not on the current Map. Please consider two options and or solutions that could possibly work for both Stakeholders. Proposed option 1: Move Sections

B, D and E in line with Section A and follow (Parallel to I-15) the I-15 corridor and keep the proper acreage in place without breaching too far into the Valley. Proposed option 2: If the current application is approved at it's current status create two corridors through Section B,D and E for ingress and egress (e.g. Solar One at Primm). Thank You in advance for taking the time to read my comments and I hope the right decisions will be made for the Stakeholders and the Public At Large.

Sincerely and Best Regards, Daryl Folks
Owner of Trac-On
Owner of BITD
Current member of the MOSORAC
Lifetime member of MRAN

--
Augrelio Herman Pinales
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BLM Southern Nevada District Office
Gemini Solar Project EIS
4701 N. Torrey Pines Drive
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August 27, 2018

blm_nv_sndo_geminisolar@blm.gov

Dear Sirs:

Thank you for opportunity to provide scoping comments on the Gemini Solar Project. By virtue of its' size this huge project will unavoidably have significant environmental impacts.

Following is a list of items that need to be addressed in the draft EIS:

1. The Old Spanish Trail: The Trail and its' variants pass right through the proposed site of this project. In order to provide even a slight semblance of views that the original travelers would have seen there should be a buffer of at least 750' on either side of the National Park Service designated alignment.
2. Valley of Fire access road: The Valley of Fire is Nevadas' most popular State Park. There needs to be a buffer zone at least 300' feet wide on either side of the Valley of Fire access road so that visitors to this amazing area of the Mojave Desert don't get the sense that it is situated in an industrial zone.
3. The project description states that about 2000 acre-feet of water will be used during construction. The Nevada State Engineer has recently indicated that the groundwater in the area in which the project is to be located is already over drafted. Hence, the proponent needs to identify their source of construction water.
4. With the recent BLM policy change which essentially eliminates any obligation on the part of the applicant for mitigation of environmental damage the only option is avoidance of harm to sensitive resources. Hence, the habitat for plants such as the three-corner milk-vetch and the eolian sand source it depends on must be preserved in an undisturbed state. The project layout needs to avoid all the washes and depressions which support a good growth of native vegetation.
5. The project document states that the disturbed areas will be allow to re-vegetate naturally. In this part of the Mojave Desert this means that the "re-vegetation" will be mostly non-native weeds such as Russian thistle and other invasives such as Sahara mustard and African mustard plus non-native grasses such as cheat grass, red brome and schismus species.
6. The very large photovoltaic array will, under certain lighting conditions, look to birds like a body of water and induce waterfowl to attempt to land. This will result in the deaths of those birds. The EIS needs to analyze not only the impacts of this project on bird life but the cumulative impacts of all the solar projects in the area on migrating birds.
7. The relative advantages of just mowing the existing vegetation down to a height of less than 12 inches versus grading and destroying the vegetation needs to be analyzed. Less soil disturbance means less water needed for dust control, fewer weeds to deal with and less runoff from rain events.
8. The impacts of increased runoff from rain events needs to be analyzed. The increased runoff from several thousand acres of solar panels will be substantial.

9. An alternative needs to be seriously considered that puts this same generating capacity on rooftops in the market areas. This would eliminate transmission costs and avoid all the environmental damage that will result from this project.
10. In addition to the Desert Tortoise there are other animal species of concern such as the Gila Monster and bird species such as the Burrowing Owl and LeConte's Thrasher. A cumulative impacts analysis of this and all the other similar projects in the vicinity needs to be performed to understand the effect of loss of habitat on sensitive species in this area of the Mojave Desert.
11. A clear explanation of why this project is being proposed for a variance area rather than one of the designated Solar Energy Zones identified in the Solar PEIS is needed. The whole purpose of the Solar PEIS was to identify areas with the lowest environmental conflicts in which to situate project like this.
12. A visual resource assessment with regards to the impacts on the views from the Muddy Mountains Wilderness Area, the north Muddy Mountains and the high point in the Valley of Fire State Park needs to be done.

Sincerely,

John E. Hiatt

John E. Hiatt
Conservation Chair
Red Rock Audubon Society
8180 Placid Street
Las Vegas, NV 89123
702-361-1171

Gemini Solar Project EIS and Resource Management Plan Amendment

BLM SCOPING COMMENT SHEET

The Bureau of Land Management (BLM) would like to obtain your input regarding the Gemini Solar Project EIS and associated Resource Management Plan Amendment.

Where to provide comments: You can hand this form in at a public scoping meeting, mail it in using the address on the reverse, or fax it in to 702-515-5023. **Comments can also be submitted via email to the following email address: blm_nv_sndo_geminisolar@blm.gov**

Name: KEVIN EMMERICH

Title: Organization: BASIN & RANGE WATCH

Mailing Address:

City: BOX 70 BEATTY State: NV Zip: 89003

Email:

Date:

☐ Please check box if you want to be on the mailing list for future updates and notification for this project. The Draft EIS will be posted on the BLM Southern Nevada District Office website. You will be notified when it is available.

COMMENT *(use back side if you need additional space or attach additional sheets)*

Fold in thirds so address (on reverse) is showing, add postage, tape bottom of fold, and mail, ***postmarked by Aug 27, 2018.***

☐ Please check box if you do **not** want your name released when comments are made public.

DESERT TORTOISE COUNCIL
4654 East Avenue S #257B
Palmdale, California 93552
www.deserttortoise.org
eac@deserttortoise.org

Via email only

August 26, 2018

Bureau of Land Management
Las Vegas Field Office
4701 North Torrey Pines Drive
Las Vegas, NV 89130-2301
Attn: Herman Pinales
Via email: blm_nv_sndo_geminisolar@blm.gov

RE: Comment Letter on the Bureau of Land Management's Notice of Intent to Prepare an Environmental Impact Statement and Land Use Plan Amendment, and a Notice of Segregation, both for the Proposed Gemini Solar Project in Clark County, Nevada

Dear Mr. Pinales:

The Desert Tortoise Council (Council) is a non-profit organization comprised of hundreds of professionals and laypersons who share a common concern for wild desert tortoises and a commitment to advancing the public's understanding of desert tortoise species. Established in 1975 to promote conservation of tortoises in the deserts of the southwestern United States and Mexico, the Council routinely provides information and other forms of assistance to individuals, organizations, and regulatory agencies on matters potentially affecting desert tortoises within their geographic ranges.

We appreciate this opportunity to provide comments on the above-referenced solar project. Given the location of the proposed project in habitats occupied by Agassiz's desert tortoise (*Gopherus agassizii*) (synonymous with "Mojave desert tortoise"), our comments pertain to enhancing protection of this species during activities authorized by the Bureau of Land Management (BLM).

Notice of Intent

In its Notice of Intent (NOI) (83 *Federal Register* 32681-32683) the BLM Las Vegas Field Office intends to prepare a Draft Environmental Impact Statement (Draft EIS) and land use plan amendment to the 1998 Resource Management Plan (RMP) for the proposed Gemini Solar Project (Project). BLM has received an application from Solar Partners XI, LLC requesting authorization to construct, operate, maintain, and decommission a 690-megawatt-per-year photovoltaic solar electric generating facility and associated generation tie-line and access road facilities on approximately 7,114 acres of public land entirely within the approximately 44,000 acres of the BLM right-of-way (ROW) application.

The proposed Project would be located approximately 25 miles northeast of Las Vegas and south of the Moapa River Indian Reservation in Clark County, Nevada. The Project would directly impact about 7,115 acres of federal lands administered by the BLM.

Scoping

The purpose of scoping is to allow the public to participate in an "early and open process for determining the scope of issues to be addressed, and for identifying the significant issues related to a proposed action" (40 Code of Federal Regulations (CFR) 1501.7). Although BLM published an NOI for the Project and invited the public's comments on the proposed action, BLM should have provided information in the NOI that clarified why BLM believes there is a need to segregate 44,000 acres when the proposed Project is less than 7,200 acres. We believe that providing incomplete information in the NOI hampered the public's ability to understand the proposed Project. This then hampered their ability to determine the scope of the issues for the Project and to identify their issues or concerns regarding the proposed Project to BLM. We request that BLM reissue the NOI and provide clarifying information on why there is a need to segregate 44,000 acres for a 7,200-acre Project, what BLM has planned for the remaining 36,800 acres (approximately), and how the remaining acreage relates to land uses in adjacent/nearby areas.

Compliance with BLM's Current Land Management Plan

The Draft EIS should discuss how this proposed Project fits within the management structure of the current land management plan for the area, the Las Vegas Resource Management Plan (BLM 1998). It should provide maps of critical habitat for the Mojave desert tortoise (USFWS 1994a), Areas of Critical Environmental Concern (ACECs), and other areas identified as necessary for special management by BLM [e.g., National Conservation Lands (NCLs)]; U.S. Fish and Wildlife Service (USFWS) (e.g., desert tortoise connectivity); Nevada Department of Wildlife (NDOW); other federal, state, and local agencies; and tribal lands.

Analysis of Alternatives

The Council supports alternatives to reduce the need for additional solar energy projects in relatively undisturbed habitats in the Mojave Desert. One such alternative is rooftop solar. The owners of large buildings should install solar panels on their roofs, and sell the power they generate back to utilities for distribution into the power grid. This approach puts the generation of electricity where the demand is greatest, in populated areas. It may also reduce transmission costs; the number of affected resources that must be analyzed under the National Environmental Policy Act (NEPA) and other environmental laws; mitigation costs for direct, indirect, and cumulative impacts; monitoring and adaptive management costs; and habitat restoration costs following decommissioning. The Draft EIS should include an analysis of where the energy generated by this Project would be sent, and how the needs for energy in those targeted areas may be satisfied by rooftop solar. We request that at least one viable alternative be analyzed in the Draft EIS where electricity generation via solar energy is located much closer to the areas where the energy use has the greatest demand, including urban/suburban areas (i.e., "rooftop solar").

In addition, BLM should include another viable alternative of locating solar projects on bladed or highly degraded tracts of land (e.g., abandoned agricultural fields) rather than destroying desert habitats and attempting to mitigate for the lost functions and values of these habitats, which is costly from an economic, environmental, and social perspective. To support the development of these additional alternatives, we note that a federal appellate court has previously ruled that in its EIS the BLM must evaluate a reasonable range of alternatives to the project including other sites and must give adequate consideration to the public's needs and objectives in balancing ecological protection with the purpose of the proposed project, along with adequately addressing the proposed project's impacts on the desert's sensitive ecological system (*National Parks & Conservation Association v. Bureau of Land Management*, Ninth Cir. Dkt Nos. 05-56814 *et seq.* (11/10/09).

The Draft EIS should consider the monitoring results of recently developed solar projects where soils have been bladed versus those facilities where the vegetation has been mowed or crushed and allowed to revegetate the area. In the latter case, it may be appropriate to allow tortoises to enter into the facilities and re-establish residency under the solar panels (i.e., repatriate) as vegetation recolonizes the area. This could be an option to the currently described Project alternative in the NOI. It should be designed/implemented as a scientific experiment to add to the limited data on this approach to determine the extent of effects on Mojave desert tortoise populations and movements/connectivity between populations, which is an important issue for this proposed Project.

Standardized Surveys for Flora and Fauna

For the Draft EIS to fully assess the effects and identify potentially significant impacts including cumulative impacts, the following surveys should be performed to determine the extent of rare plant and animal populations occurring within the area that will be affected both directly and indirectly by the proposed Project. Results of these surveys will help determine appropriate permits/authorizations that will be needed from federal and state agencies (e.g., USFWS, Nevada Department of Forestry, Nevada Department of Wildlife, etc.), avoidance and other mitigation measures, monitoring, and adaptive management.

• Prior to conducting surveys, a knowledgeable biologist should perform a records search of the Nevada Natural Heritage Program (NNHP) (http://heritage.nv.gov/get_data) for rare plant and animal species reported from the region. The results of the NNHP review would be reported in the Draft EIS with an indication of suitable and occupied habitats for all rare species reported from the region based on performing species specific surveys described below.

• Formal protocol surveys for the Mojave desert tortoise (USFWS 2017) must be conducted at the proper times of year. As per this protocol, because the impact area is larger than 500 acres, the surveys must be performed from April to May or September to October so that a statistical estimate of adult tortoise densities can be determined for all areas that may be adversely affected and reported in the Draft EIS. If any tortoise signs are found, federal authorization for incidental take must be obtained prior to ground disturbance. We strongly recommend that BLM require that only experienced biologists perform protocol surveys, which may mean that USFWS biologists review their credentials prior to conducting the surveys (USFWS 2009).

• To determine the full extent of impacts to tortoises, the Project Proponent's biologist should consult with the Las Vegas office of the USFWS to determine the action area for this Project. The USFWS defines "action area" in 50 CFR 402.2 and their Desert Tortoise Field Manual (USFWS 2009) as "all areas to be affected directly or indirectly by proposed development and not merely the immediate area involved in the action." To facilitate compliance with the Federal Endangered Species Act (FESA), it is imperative that the Project Proponent and BLM coordinate early with the USFWS to identify the action area for this Project and determine the full extent of surveys that should be performed.

• BLM should ensure that actions are implemented to comply with the Migratory Bird Treaty Act, Bald and Golden Protection Act, and associated regulations, executive orders, and policies to avoid mortality or injury to migratory birds. Because of their use of burrows for shelter and breeding, surveys for western burrowing owl (*Athene cunicularia*) should be completed. If burrowing owl sign is found, BLM and the Project Proponent should develop a science-based mitigation/monitoring/adaptive management plan with the USFWS and Nevada Department of Wildlife and ensure that this plan is implemented.

• There are likely to be special status plant species found in/near the Project Area. This information should be assessed by accessing the Nevada Natural Heritage Program (NNHP) literature review prior to conducting field surveys. Species or their habitats known to occur in/ near the Project Area should be sought during field surveys and their presence/absence discussed in the Draft EIS. Surveys should be completed at the appropriate time of year by qualified biologists (preferably botanists) using the latest acceptable methodologies. In addition, Nevada Administrative Code (NAC) 527 provides a list of species and subspecies of native plants to be critically endangered and threatened with extinction. These fully protected species may not be removed or destroyed except pursuant to a permit issued by the State Forester (NAC 527.090). The methods used to survey for special status plant species, the results, and the mitigation/monitoring/adaptive management that will be implemented to avoid or otherwise mitigation adverse effects to these species and their habitats should be included in the Draft EIS.

Direct and Indirect Impacts including the Road Effect Zone

We expect that the Draft EIS will document how many acres would be impacted directly by solar arrays, access roads to the site, administration/maintenance buildings, parking areas, transmission towers, switchyards, internal access roads, access roads along gen-tie lines, a perimeter road, perimeter fencing, substations (e.g., the Project footprint).We also request that separate calculations document how many acres of desert tortoise habitats would be temporarily and permanently impacted both directly and indirectly (e.g., "road effect zone," etc.) by the proposed Project. As given below, these acreages should be based on field surveys for tortoises rather than available models.

We request that the Draft EIS include information on the locations, sizes, and arrangements of these roads to the proposed Project and within it, who will have access to them, whether the Project area will be secured to prevent human access or vandalism, and if so, what methods would be used. The presence of roads even with low vehicle use has numerous adverse effects on the desert tortoise and its habitats that have been reported in the scientific literature. These include the deterioration/loss of wildlife habitat, hydrology, geomorphology, and air quality; increased competition and predation (including by humans); and the loss of naturalness or pristine qualities.

Please include in the Draft EIS analyses, the five major categories of primary road effects to the tortoise and special status species: (1) wildlife mortality from collisions with vehicles; (2) hindrance/barrier to animal movements thereby reducing access to resources and mates; (3) degradation of habitat quality; (4) habitat loss caused by disturbance effects in the wider environment and from the physical occupation of land by the road; and (5) subdividing animal populations into smaller and more vulnerable fractions (Jaeger et al. 2005a, 2005b, Roedenbeck et al. 2007).

Road establishment is often followed by various indirect impacts such as increased human access causing disturbance of species' behavior, increased predation, spread of invasive species that alters/degrades habitat, and vandalism and/or collection. The analysis of the impacts from road establishment and use should include cumulative effects to the tortoise with respect to nearby critical habitat, areas identified as important for connectivity between nearby critical habitat units as these linkage areas serve as corridors for maintaining genetic and demographic connectivity between populations, for the recovery unit, and range wide. These and other indirect impacts to the Mojave desert tortoise should be analyzed in the Draft EIS from Project construction, operations-and maintenance, decommissioning, and habitat restoration.

Hazardous Materials

The proposed Project would include storage of power in lithium batteries. These batteries are a potential to explode and cause fires and are not compatible with using water for fighting fires. We request that the Draft EIS include a fire prevention plan in addition to a fire management plan specifically targeting methods to deal with explosions/fires produced by these batteries as well as other sources of fuel and explosives on the Project site.

Mitigation

The mitigation that is determined to be appropriate to fully offset the direct, indirect, and cumulative impacts from the proposed Project should use the best available science in its development and implementation. It should include a commitment to implement the mitigation commensurate to impacts to the tortoise and its habitats. Mitigation should include a fully-developed desert tortoise repatriation plan (and translocation plan if repatriation is not possible) ; predator management plan; weed management plan; fire prevention and management plan; compensation plan for the degradation and loss of tortoise habitat that includes protection of the acquired, improved, and restored habitat in perpetuity for the tortoise from future development and human use with appropriate buffers; a plan to protect in perpetuity tortoise translocation area(s) from future development and human use with appropriate buffers; and a habitat restoration plan, not a reclamation plan, when the lease is terminated and the proposed Project is decommissioned. We emphasize a repatriation plan because the proposed Project may support a moderate density of desert tortoises. It may be difficult to translocate tortoises successfully to secure areas where they would survive and contribute to recruitment (Mulder et al. 2017).

The Project Proponent should monitor tortoise populations in the nearby tortoise critical habitat/conservation areas (e.g., Coyote Spring, Gold Butte, and Mormon Mesa) and the linkage areas or corridors between these areas to identify the impacts of the Project on these populations and their habitats. The Project Proponent should implement additional mitigation and/or adaptive management, as determined by monitoring results, in coordination with BLM, USFWS, and NDOW. We request this because the proposed Project is located in a linkage area for the Mojave desert tortoise (USFWS 2011).

These mitigation plans should include implementation schedules that are tied to key actions of the construction, operations and maintenance, decommissioning, and restoration phases of the Project so that mitigation occurs concurrently with or in advance of the impacts. The plans should specify success criteria, include a monitoring plan to collect data to determine whether success criteria have been met, and identify actions that would be required if the mitigation measures do not meet the success criteria (adaptive management).

The Draft EIS should analyze if this proposed Project would result in an increase in the predation of desert tortoise by common ravens, coyotes, and other predators in the region. The Moapa Solar Energy Project resulted in high (>60%) mortality of small translocated tortoises compared to control animals (Burroughs 2018 in litt.). Regardless of whether tortoise are repatriated to the Project site or translocated, management of coyote predation on tortoises should be included in the predator management plan.

Common ravens are known predators of the Mojave desert tortoise and their numbers have increased substantially because of human subsidies of food, water, and sites for nesting, roosting, and perching to hunt (Boarman 2003). Because ravens are able to fly at least 30 miles in search of food and water on a daily basis (Boarman et al. 2006) and coyotes can travel an average of 7.5 miles or more daily (Servin et al. 2003), this analysis should extend out at least 30 miles from the proposed Project site. Future operations should include provisions for monitoring and managing raven and coyote predation on tortoises because of or contributed by the proposed Project. The monitoring and management plan should include reducing/eliminating human subsidies for food, water, and sites for nesting, roosting, and perching to address local impacts (footprint of the proposed Project). The Project Proponent should participate in an effort to address regional and cumulative impacts. We request that for any of the transmission options, the Project use towers that prevent raven nesting and perching for hunting. For example, the tubular design pole with a steep-pointed apex and insulators on down-sloping cross arms is preferable to lattice towers, which should not be used.

Please ensure that all standard measures to mitigate the local, regional, and cumulative impacts of raven predation on the tortoise are included in this Draft EIS, including developing a raven management plan for this specific Project. USFWS (2010) provides a template for a project-specific management plan for common ravens. This template includes sections on construction, operation and maintenance, and decommissioning (including restoration) with monitoring and adaptive management during each Project phase. We suggest coordinating with the USFWS regarding an appropriate coyote management and monitoring plan.

We request that the Draft EIS address the effects of the proposed Project on climate change and the effects that climate change may have on the proposed Project. For the latter, we recommend including: an analysis of habitats within the Project that may provide refugia for tortoise populations; an analysis of how the proposed Project would contribute to the spread and proliferation of nonnative invasive plant species; how this spread/proliferation would affect the Mojave desert tortoise and its habitats (including the frequency and size of human-caused fires); and how the proposed Project may affect the likelihood of human-caused fires. We strongly urge the Project Proponent to develop and implement a management and monitoring plan using this analysis and other relevant data that would reduce the transport to and spread of nonnative seeds and other plant propagules within the Project area and eliminate/reduce the likelihood of human-caused fires. The plan should integrate vegetation management with fire management and fire response. We also expect that the Draft EIS will provide a detailed analysis of the "heat sink" effects of solar development on desert habitats in adjacent areas to the proposed Project and particularly the habitats of the Mojave desert tortoise, in addition to climate change.

Cumulative Effects
There are other existing, approved, and pending renewable energy projects in the area that should be included in the cumulative effects analysis of the Draft EIS. In addition, the Draft EIS should analyze the effects of other existing, approved, and pending projects and land management plans on nearby tribal lands and in Clark County (e.g., Clark County Multi-Species Habitat Conservation Plan, etc.). This analysis should include lands near the Project area that have been identified as mitigation lands for previous or ongoing actions, and the effects of the proposed Project on them. We recommend that mitigation areas be avoided and that sufficient buffers be established so that the proposed Project does not directly or indirectly impact their functions and values.

Status of Mojave Desert Tortoise
The Council has serious concerns about sources of human mortality for the tortoise given the status and trend of the species range wide and the proposed Project's location within the Northeastern Mojave Recovery Unit, and within an area identified by the USFWS as a linkage areas or corridors between critical habitat units. A few years after listing the Mojave desert tortoise under the FESA, the USFWS published a Recovery Plan for the Mojave desert tortoise (USFWS 1994a). It contained a detailed population viability analysis. In this analysis, the minimum viable density of a Mojave desert tortoise population is 10 adult tortoises per mile^2 (3.9 adult tortoises per km^2). This assumed a male-female ratio of 1:1 (USFWS 1994a, page C25). Populations of Mojave desert tortoises with densities below this amount are in danger of extinction (USFWS 1994a, page 32).

Between 2004 and 2014, 10 of 17 monitored populations of the Mojave desert tortoise declined from 26% to 64% and 11 have a density that is less than 3.9 adult tortoises per km^2 (USFWS 2015). Of the three populations of Mojave desert tortoises that are near the proposed Project, the Gold Butte population is below the minimum viable density, the Coyote Spring population is slightly above the minimum viable density (4.0 tortoises per km^2 vs. 3.9 per km^2), and the Mormon Mesa population is above the minimum viable density (USFWS 2015). While the 2015 data indicate that these populations are increasing, tortoises cannot afford additional impacts that would slow or reverse this trend. We are concerned that the proposed Project would bring additional indirect impacts to these populations and their trend would decline.

<u>Population Data on Agassiz's Desert Tortoise:</u> The Mojave desert tortoise was listed as threatened under the federal Endangered Species Act in 1990. The listing was warranted because of ongoing population declines throughout the range of the tortoise from multiple human-caused activities. Since the listing, the status of the species has changed. Population numbers and densities continue to decline substantially (see Table 1).

Table 1. Summary of 10-year trend data for 5 Recovery Units and 17 Critical Habitat Units (CHU)/Tortoise Conservation Areas (TCA) for Agassiz's desert tortoise. The table includes the area of each Recovery Unit and CHU/TCA, percent of total habitat for each Recovery Unit and CHU/TCA, density (number of breeding adults/km^2 and standard errors = SE), and the percent change in population density from 2004-2014. Populations below the viable level of 3.9 breeding individuals/km^2 (10 breeding individuals per mi^2) (assumes a 1:1 sex ratio) and showing a decline from 2004 to 2014 are in red (USFWS 2015).

Recovery Unit Designated Critical Habitat Unit/Tortoise Conservation Area	Surveyed area (km^2)	% of total habitat area in Recovery Unit & CHU/TCA	2014 density/km^2 (SE)	% 10-year change (2004–2014)
Western Mojave, CA	**6,294**	**24.51**	**2.8 (1.0)**	**–50.7 decline**
Fremont-Kramer	2,347	9.14	2.6 (1.0)	–50.6 decline
Ord-Rodman	852	3.32	3.6 (1.4)	–56.5 decline
Superior-Cronese	3,094	12.05	2.4 (0.9)	–61.5 decline
Colorado Desert, CA	**11,663**	**45.42**	**4.0 (1.4)**	**–36.25 decline**
Chocolate Mtn AGR, CA	713	2.78	7.2 (2.8)	–29.77 decline
Chuckwalla, CA	2,818	10.97	3.3 (1.3)	–37.43 decline
Chemehuevi, CA	3,763	14.65	2.8 (1.1)	–64.70 decline
Fenner, CA	1,782	6.94	4.8 (1.9)	–52.86 decline
Joshua Tree, CA	1,152	4.49	3.7 (1.5)	+178.62 increase
Pinto Mtn, CA	508	1.98	2.4 (1.0)	–60.30 decline
Piute Valley, NV	927	3.61	5.3 (2.1)	+162.36 increase
Northeastern Mojave	**4,160**	**16.2**	**4.5 (1.9)**	**+325.62 increase**
Beaver Dam Slope, NV, UT, AZ	750	2.92	6.2 (2.4)	+370.33 increase
Coyote Spring, NV	960	3.74	4.0 (1.6)	+ 265.06 increase
Gold Butte, NV & AZ	1,607	6.26	2.7 (1.0)	+ 384.37 increase
Mormon Mesa, NV	844	3.29	6.4 (2.5)	+ 217.80 increase
Eastern Mojave, NV & CA	**3,446**	**13.42**	**1.9 (0.7)**	**–67.26 decline**
El Dorado Valley, NV	999	3.89	1.5 (0.6)	–61.14 decline
Ivanpah, CA	2,447	9.53	2.3 (0.9)	–56.05 decline
Upper Virgin River	**115**	**0.45**	**15.3 (6.0)**	**–26.57 decline**
Red Cliffs Desert	115	0.45	15.3 (6.0)	–26.57 decline
Total amount of land	**25,678**	**100.00**		**–32.18 decline**

Definition of an Endangered Species: Agassiz's desert tortoise is now on the list of the world's most endangered tortoises and freshwater turtles. It is in the top 50 species. The International Union for Conservation of Nature's (IUCN) Species Survival Commission, Tortoise and Freshwater Turtle Specialist Group, now considers Agassiz's desert tortoise to be Critically Endangered (Turtle Conservation Coalition 2018).

The IUCN places a taxon in the Critically Endangered category when the best available evidence indicates that it meets one or more of the criteria for Critically Endangered.-These criteria are 1) population decline - a substantial (>80 percent) reduction in population size in the last 10 years; 2) geographic decline - a substantial reduction in extent of occurrence, area of occupancy, area/extent, or quality of habitat, and severe fragmentation of occurrences; 3) small population size with continued declines; 4) very small population size; and 5) analysis showing the probability of extinction in the wild is at least 50 percent within 10 years or three generations.

In the FESA, Congress defined an "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range…" Given the density and trend of the populations of the Mojave desert tortoise in Table 1, one may conclude that the Mojave desert tortoise is in danger of extinction throughout all or a significant portion of its range. Because most of the populations of the Mojave desert tortoise in 2014 had densities that were below the viable level of 3.9 tortoises per square kilometer, most are declining, and the threats to the Mojave desert tortoise are numerous and have not been substantially reduced throughout the species' range, the Desert Tortoise Council believes the Mojave desert tortoise should be uplisted to endangered by the USFWS.

The Draft EIS should include a thorough analysis and discussion of the status and trend of the Mojave desert tortoise in the action area, nearby TCAs, recovery unit, and range wide. Tied to this analysis should be a discussion of all likely direct and indirect sources of mortality for the tortoise and degradation and loss of habitat from implementation of leasing the area for solar energy development including construction, operations and maintenance, decommissioning, and restoration of the leased lands. We request that the above information on the status of the Mojave desert tortoise be presented and included in BLM's analysis of direct, indirect, and cumulative impacts of the proposed Project to the Mojave desert tortoise and its habitats. Our concern is that the Project area may support a moderately dense tortoise population. Moving forward with the proposed Project would likely adversely affect a large number of tortoises. The proposed Project could reverse the positive trend for the Northeast Mojave Recovery Unit.

Distribution of the Mojave Desert Tortoise and Tortoise Habitat in/near the Project Area
Relative to the Mojave desert tortoise, the Draft EIS should identify occupied versus unoccupied habitats and suitable versus unsuitable habitats throughout the action area with the help of protocol-level surveys. To derive these calculations, we expect USFWS (2017) protocol surveys to be performed in all areas within the "action area" (see above) so that an estimated number of tortoises that could be directly and indirectly impacted by the proposed Project can be determined. Based on these data, the Project Proponent will be able to include in the Draft EIS the number of tortoises that may be displaced and the number of acres of both suitable and occupied tortoise habitats that will be permanently and temporarily lost or degraded.

We request that BLM define "temporary" and "permanent" from the perspective of use by and biological needs of the Mojave desert tortoise rather than use by people. Given the lengthy time it takes for restoration of degraded or destroyed vegetation in the Mojave Desert, and even longer times for soils, we conclude that most if not all impacts will be permanent (i.e., more than a few decades for restoration). This information will be important in helping to determine appropriate types and amounts of mitigation, monitoring, and adaptive management for the tortoise. The

Draft EIS should then show how Project features would be placed to minimize or avoid loss of occupied habitats or habitats needed for connectivity and how tis avoidance includes indirect impacts.

Section 7(a)(1) of the Endangered Species Act

Section 7(a)(1) of the FESA states that all federal agencies "…shall… utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act." In section 3 of the FESA, "conserve," "conserving," and "conservation" mean "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition…" When analyzing and implementing the proposed Project, we request that BLM demonstrate how it is contributing effectively to the conservation and recovery of the Mojave desert tortoise, and how its mitigation for the proposed Project will do more than offset all direct, indirect, and cumulative impacts so that the status of the tortoise will improve.

Federal Land Policy and Management Act

In the Federal Land Policy and Management Act (FLPMA), Congress declared that is the nation's policy that "public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values;" and that public lands "will provide food and habitat for fish and wildlife." Congress furthers stated in FLPMA that "management be on the basis of multiple use and sustained yield." It defined "sustained yield" as "the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the public lands consistent with multiple use." We request that BLM analyze in the Draft EIS how its implementation of the proposed Project will comply with FLPMA with regard to the Mojave desert tortoise.

We appreciate this opportunity to provide input and trust that our comments will further protect tortoises during authorized Project activities. Herein, we ask that the Desert Tortoise Council be identified as an Affected Interest for this and all other BLM projects that may affect species of desert tortoises, and that any subsequent environmental documentation for this particular Project is provided to us at the contact information listed above.

Regards,

Edward L. LaRue, Jr., M.S.
Desert Tortoise Council, Ecosystems Advisory Committee, Chairperson

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APPENDIX E-4

Scoping Comments

Comment Letters and Forms from Individuals

From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] Fwd: Gemini Solar Project and Tortoise --Basin and Range Watch makes the news!
Date:	Tuesday, July 24, 2018 8:41:42 AM

---------- Forwarded message ----------
From: **dgandress@aol.com** <dgandress@aol.com>
Date: Sun, Jul 22, 2018 at 1:03 PM
Subject: [EXTERNAL] Fwd: Gemini Solar Project and Tortoise --Basin and Range Watch makes the news!
To: blm_nv_sndo_geminisolar@blm.gov

-----Original Message-----
From: Judy Bundorf <jbundorf@cox.net>
To: Donna & Gail Andress <dgandress@aol.com>
Sent: Sun, Jul 22, 2018 10:02 am
Subject: FW: Gemini Solar Project and Tortoise --Basin and Range Watch makes the news!

Hi, again. Here's the link to the TV clip where Laura talks about the two solar projects. These two folks (kevin and Laura) are a God-send. . . without their expertise and contacts with David Becker, Atty., and knowledge of how government agencies work, we never would have stopped Searchlight Wind. Please feel free to share the link.

Judy

From: Laura Cunningham [mailto:bluerockiguana@gmail.com]
Sent: Monday, July 16, 2018 9:59 PM
Subject: Gemini Solar Project and Tortoise --Basin and Range Watch makes the news!
We don't know how this happened, but the Las Vegas news suddenly got interested in the desert tortoise! They even kept my rooftop solar alternative in!
http://news3lv.com/news/local/southern-nevada-biologist-fears-desert-tortoises-will-pay-the-price-for-solar-project

Southern Nevada biologist fears desert tortoises will pay the price for solar project

by Kelsey Thomas

Monday, July 16th 2018

Kelsey.PNG

AA

LAS VEGAS (KSNV) — A proposed solar project north of Las Vegas could be a new source of power for our homes.

If the Gemini Solar Project is approved, the solar plant would sit on federal land near Interstate 15 and the Valley of Fire.

It is wild, open land where a car is hard to come by and the heat is hard to escape in the middle of July.

“It is a beautiful desert area and it is on a scenic route on the way to Valley of Fire State Park,” said Laura Cunningham.

Laura Cunningham is a biologist and founder of Basin and Range Watch, a non-profit organization in Southern Nevada working to conserve the Mojave Desert.

She said the open, desert area is home to a desert tortoise habitat and a proposed solar plant that would be on more than 7,000 acres.

“My first thought was, oh no, not another one,” said Cunningham.

Cunningham wants to make it clear, she supports clean energy but is worried about our four-legged desert treasures that live in the area.

“Places that have already been bulldozed, we support solar projects there. As well as on rooftops and over parking lots,” said Cunningham. “A lot of the baby juvenile tortoises will die and the adults will have to be dug up one at a time out of their burrows and then moved,” she continued.

John Asselin is a Public Affairs Specialist with the Bureau of Land Management.

He said there is no construction date because the project is not a done deal. Simply put, it is a proposal.

“This is just the beginning,” said Asselin.

According to Asselin, the BLM is looking to balance conservation and growth.

“It is a very involved process. We make sure the "I’s" are dotted and "t’s" are crossed when we go through this,” explained Asselin.

He encourages the public to comment on the proposal.

“We are looking for input from the public: Why is this a good area and why is this not a good area,” he noted.

Arevia is the power company behind the proposed project.

In a statement, the company told News 3, “Arevia has been in contact with the appropriate federal agencies for some time now and will help to address any concerns regarding desert tortoise as a part of the project’s environmental review.”

According to a statement from Investment group Quinbrook, Gemini would be one of the largest solar projects in Nevada, with a combined capacity of 690 megawatts and 7,100 acres of solar panels, along with the option to include batteries.

The first phase of the project would connect with NV Energy's Crystal Substation and provide power for the local grid, the investment group says. The second phase would be able to send power to customers in Nevada, Arizona, and California.

"Gemini is a uniquely positioned project in close proximity to both Las Vegas and export connections to California and Arizona," Jeff Hunter, senior managing director at Quinbrook, said in a statement. "Solar energy is on the rise in Nevada and is now being offered at historic low prices which is great news for retail consumers and local industry."

As for Cunningham, she is already preparing to watch more of the desert and the tortoises she loves, slowly disappear.

“It is really going to scar the landscape a lot. The tortoise may go extinct at this rate,” said Cunningham.

BLM officials say they are accepting public comment on the Gemini project through the end of August.

The agency is also hosting two public meetings to seek input from the public:

August 1st

5:00 – 7:00 PM

Suncoast Hotel & Casino - 9090 Alta Drive, Las Vegas

August 2nd

5:00 – 7:00 PM

Moapa Recreation and Community Center - 1340 East State Highway 168

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Comment on Gemini Solar Project
Date:	Tuesday, August 7, 2018 4:30:29 PM

---------- Forwarded message ----------
From: **Scott Brooks** <h1foehn7@netscape.net>
Date: Fri, Jul 27, 2018 at 2:13 PM
Subject: [EXTERNAL] Comment on Gemini Solar Project
To: blm_nv_sndo_geminisolar@blm.gov

I prefer that the proposed project not be approved, since it involves the complete destruction of such a huge tract of Mojave Desert plant and animal habitat. Industrial installations should be limited to land already damaged by past commercial use (such as mine reclamations), or applied to residential installations.

--
Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
(702) 768-6706 Cell

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Gemini Solar Project Comment
Date:	Thursday, August 23, 2018 4:08:34 PM

---------- Forwarded message ----------
From: **Andrew Church** <thekidfromkeddy@gmail.com>
Date: Tue, Aug 21, 2018 at 10:14 PM
Subject: [EXTERNAL] Gemini Solar Project Comment
To: blm_nv_sndo_geminisolar@blm.gov

To Whom it May Concern:

My name is Andrew Church, and I am writing to voice my concern regarding the proposed Gemini Solar Project, particularly in regards to the impact the project would have on the Mojave desert tortoise.

It has come to my attention that five areas surveyed within the proposed Gemini site contained an abundance of live tortoises. One-hundred-thirty-two tortoises were sighted, and based on density calculations the total tortoise population in the project area is around 208.

It is necessary to note that the Mojave desert tortoise is a threatened species and protected under the Endangered Species Act. Sadly, the tortoise population has continued to decrease due to the degradation of habitat, resulting in a 51 percent decline since 1987. Both the construction of the proposed solar project and its operations are incompatible with the tortoise habitat.

For these reasons the BLM has a duty in rejecting the construction of the Gemini Solar Project. Nevada has other options it can pursue for developing solar energy (i.e. rooftop solar), and we ought not condemn our ecosystems and public lands for the sake of private enterprises' bottom line.

Thank you.

Andrew Church
--
Andrew Church
thekidfromkeddy@gmail.com
775-388-0209

--
Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
(702) 768-6706 Cell

From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] solar plan
Date:	Tuesday, July 24, 2018 8:40:07 AM

---------- Forwarded message ----------
From: <snore1600rep@aol.com>
Date: Mon, Jul 23, 2018 at 3:21 PM
Subject: [EXTERNAL] solar plan
To: blm_nv_sndo_geminisolar@blm.gov

The first thing I see that has been omitted from the plan is there is no mitigation plan for loss of OHV recreation. The Spanish trail and bitter springs back country byway both are heavy used by OHV recreation and is currently a marked OHV trail for the historic mint 400 race. These trails will need to be left open and there will be dust. This project would be much better suited on top of the Las Vegas convention center and other buildings in Las Vegas to reduce transmission loss and public lands impact .

Ken Freeman
220 e middleton Henderson NV

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL]
Date:	Thursday, August 23, 2018 4:08:35 PM

---------- Forwarded message ----------
From: **Jared Fuller** <jgillenfuller@yahoo.com>
Date: Wed, Aug 22, 2018 at 11:12 PM
Subject: [EXTERNAL]
To: "blm_nv_sndo_geminisolar@blm.gov" <blm_nv_sndo_geminisolar@blm.gov>

The Gemini Solar Project should not be built. At 7000 acres the project would greatly impact wildlife populations and habitat, vegetation and soils, and visual resources of nearby parks and wilderness areas. Destructive projects such as this should only be built on previously disturbed areas both on and off BLM land with preference given to smaller scale and distributive designs. However, if the project is built, a full environmental impact statement should be competed. This should include considerably smaller, less destructive alternatives. These alternative should exclude undisturbed wash and wildlife migration corridors, and contain avoidance areas for any sensitive species and highway buffer zones to reduce visual impact.

To conserve vegetation and wildlife resources including potential desert tortoise populations, an adequate survey of the tortoise population should be conducted in any environmental review. This review should include surveys of all other rare or sensitive plant and animal species, including succulents, likely to occur on the site. Also, cumulative impacts of nearby solar energy projects and other development on these and other resources would be substantial and should be adequately considered.

Any building alternative which may be selected should reduce impacts to the plant and wildlife community by the use of construction methods that disturb less vegetation, such as mowing only, and less use of cut and fill or disc and roll options. Most permanently disturbed areas except access areas should be replanted with or growth encouraged of manageable native plants while eliminating weeds, in addition to rehabilitating temporary disturbance areas. Relatively rare plants that reproduce slowly such as succulents should be salvaged and transplanted on or near the site. This use of native plant cover would lessen biodiversity impacts and retain soil carbon as well as slow water and wind erosion. Disturbance areas should also be as small as possible and most all permanently disturbed areas should be filled with panels for most efficient use of the area disturbed.

Jared Fuller
102 S 980 E
American Fork, UT 84003

--
Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
(702) 768-6706 Cell

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Gemini Solar Project Comments
Date:	Tuesday, August 7, 2018 4:29:58 PM

---------- Forwarded message ----------
From: **RobG** <sledder@gmail.com>
Date: Wed, Aug 1, 2018 at 10:39 AM
Subject: [EXTERNAL] Gemini Solar Project Comments
To: blm_nv_sndo_geminisolar@blm.gov

Morning!

My comments are simple and brief... I have no problem with this project as long as whatever land is used for it is not closed off for recreational use. If there are existing trails in the area, keep as many open as possible, or provide an alternate route around the facility if necessary.

I just really hate it when some interest comes in, like forestry or mining or something, and they basically shut down a bunch of trails that used to be used by hikers, mountain bikers, ATVers, motorcyclists, etc.

Thanks for listening.

Robert Glover

--
Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
(702) 768-6706 Cell

From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] Solar
Date:	Tuesday, July 24, 2018 8:42:02 AM

---------- Forwarded message ----------
From: **Josh Hawkins Photography** <joshhawkinsphoto@gmail.com>
Date: Sat, Jul 14, 2018 at 9:43 PM
Subject: [EXTERNAL] Solar
To: blm_nv_sndo_geminisolar@blm.gov

About the Gemini solar project. Sounds good. Approve it as soon as possible. This is what Nevada needs and can do for the country.

Josh Hawkins Photography
www.joshhawkins.com
702.338.0430

(Please excuse grammar and spelling mistakes. I love my iPhone...most of the time.)

From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Protect the tortoise
Date:	Thursday, August 23, 2018 4:09:20 PM

---------- Forwarded message ----------
From: **Alex Hughes** <pamsquag@yahoo.com>
Date: Tue, Aug 21, 2018 at 8:22 AM
Subject: [EXTERNAL] Protect the tortoise
To: blm_nv_sndo_geminisolar@blm.gov

Please don't allow this project to ruin the turtle habitat

Sent from Yahoo Mail for iPhone

--
Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
(702) 768-6706 Cell

From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] Gemini Solar
Date:	Tuesday, July 24, 2018 8:41:22 AM

---------- Forwarded message ----------
From: **Lichtenfeld** <mlslal@sbcglobal.net>
Date: Sun, Jul 22, 2018 at 5:48 PM
Subject: [EXTERNAL] Gemini Solar
To: blm_nv_sndo_geminisolar@blm.gov

Dear BLM,

We think the scope of this project is too large and will be destructive of the environment and scenery in the Valley of Fire area. It would make much more sense to utilize rooftops and other available developed areas for this project and we trust this will be seriously considered as opposed to a mass development in our county's scenic area. Thank you.

Mark Lichtenfeld.

From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] Fw: public commenton federal registe killing the wild horses
Date:	Tuesday, July 24, 2018 8:45:43 AM

---------- Forwarded message ----------
From: **Jean Public** <jeanpublic1@yahoo.com>
Date: Fri, Jul 13, 2018 at 9:41 AM
Subject: [EXTERNAL] Fw: public commenton federal registe killing the wild horses
To: "blm_nv_sndo_geminisolar@blm.gov" <blm_nv_sndo_geminisolar@blm.gov>, "info@wildernesswatch.org" <info@wildernesswatch.org>, "info@returntofreedom.org" <info@returntofreedom.org>, "information@sierraclub.org" <information@sierraclub.org>, "info@earthjustice.org" <info@earthjustice.org>, "humanelnies@hsus.org" <humanelnies@hsus.org>, "info@peta.org" <info@peta.org>, "info@idausa.org" <info@idausa.org>, "info@cok.net" <info@cok.net>, "info@nyclass.org" <info@nyclass.org>, "westchester.humane@gmail.com" <westchester.humane@gmail.com>, "info@godscreaturesministry.org" <info@godscreaturesministry.org>, "contact@thedodo.com" <contact@thedodo.com>, "scoops@huffpost.com" <scoops@huffpost.com>, "info@lohv.org" <info@lohv.org>, American Wild Horse Preservation <contact@wildhorsepreservation.org>

i am totally against use of this NATIONAL LAND. THIS IS NOT COUNTY LAND, THIS IS NOT STATE LAND, BOTH OF WHICH CAN BE USED FOR THIS SOLAR PROJECT. ALSO PRIVATE LAND CAN BE BOUGHT IN THIS AREA FOR USE AS SOLAR.

WE DO NOT NEED TO TAKE NATIONAL LAND, WHICH SHOULD BE DEFINITELY BE USED TO HOLD AND LET LIVE WILD HORSES. I AM DECIMATED BY THE WAY ALL OF OUR NATIONAL LAND GETS ABUSED FOR ROBBER BAROIN CATTLE RANCHER PROFITEERS OR MINING OR THIS KIND OF STUPIDITY. PUT SOLAR ON THE TOPS OF YOUR HOTELS TO ABSORB THE ENERGY TO RUN THOSE VAST HOTELS.

BLM SHOULD NOT TAKE ONE ACRE OF THIS NATIONAL LAND FOR THIS PURPOSE. LET THOSE PROFITEERS IN LAS VEGAS THE BIG TIME PROFITERS USE THEIR LOCAL LAND IN TOWNS, THEIR COUNTRY LAND AND THEIR STATE LAND FOR SOLAR AND THEIR PRIVATELY OWNED LAND. SAVE OUR NATIONAL LAND FOR WILD. THIS COMMETN IS FOR THE PUBLIC RECORD. PLEASE RECEIPT. JEAN PUBLIEE JEAN PUBLIC1@GMAIL.COM

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[Federal Register Volume 83, Number 135 (Friday, July 13, 2018)]
[Notices]
[Pages 32681-32683]
From the Federal Register Online via the Government Publishing Office
[www.gpo.gov]
[FR Doc No: 2018-15020]

-----------------------------------------------------------------------

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLNVS01000. L51010000.PQ0000. LVRWF09F8730; N-85631; MO#4500119561]
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Notice of Intent To Prepare an Environmental Impact Statement and Land Use Plan Amendment, and a Notice of Segregation for the Proposed Gemini Solar Project in Clark County, Nevada

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of intent.

SUMMARY: As requested by Solar Partners XI, LLC, and in compliance with the National Environmental Policy Act of 1969, as amended (NEPA), the Bureau of Land Management (BLM) Las Vegas Field Office intends to prepare an

[[Page 32682]]

Environmental Impact Statement (EIS) and land use plan amendment to the 1998 Resource Management Plan (RMP) for the proposed Gemini Solar Project in Clark County, Nevada. Publication of this Notice initiates the scoping process and opens a 45-day public comment period. Publication of this Notice also segregates the public lands from appropriation under the public land laws, including location under the Mining Law, but not the mineral leasing laws or the Materials Act, subject to valid existing rights.

DATES: Written comments must be received by the BLM no later than August 27, 2018. The date(s) and location(s) of any scoping meetings will be announced at least 15 days in advance through local news media and the BLM website at: https://go.usa.gov/xntTQ.

Comments must be received prior to the close of the scoping period or 15 days after the last public meeting, whichever is later, to be included in the Draft EIS. The BLM will provide additional opportunities for public participation upon publication of the Draft EIS.

ADDRESSES: You may submit comments by any of the following methods:

Email: blm_nv_sndo_geminisolar@blm.gov.

E-planning: https://go.usa.gov/xntTQ.

Fax: 702-515-5023, Attention: Herman Pinales.

Mail: BLM, Las Vegas Field Office, Attn: Herman Pinales, 4701 North Torrey Pines Drive, Las Vegas, Nevada 89130-2301.

FOR FURTHER INFORMATION CONTACT: For further information, and/or to have your name added to the mailing list, send requests to: Herman Pinales, Energy & Infrastructure Project Manager, at telephone 702-515-5284; address 4701 North Torrey Pines Drive, Las Vegas, Nevada 89130-2301; or email blm_nv_sndo_geminisolar@blm.gov. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service (FRS) at 1-800-877-8339 to contact the above individual during normal business hours. The FRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: In 2017, Solar Partners XI, LLC filed an application with the BLM requesting authorization to construct, operate, maintain, and decommission a 690-megawatt-per-year photovoltaic (PV) solar electric generating facility and associated generation tie-line and access road facilities. The expected life of the project is 30 years. The Solar Partners XI, LLC acquired the original 44,000-acre APEX Solar Thermal Power Generation Facility right-of-way application filed in 2008 by BrightSource Energy, LLC.

The proposed Gemini Solar Project would be located approximately 25 miles northeast of Las Vegas and south of the Moapa River Indian Reservation in Clark County, Nevada.

The proposed Gemini Solar Project includes 7,115 acres of federal lands administered by the BLM. The Visual Resource Management (VRM) class in the Application Area is mostly III and some II (due to proximity to Muddy Mountain Wilderness Area and Bitter Springs Back Country Byway), which will require a land use plan amendment to a class IV in order for the project to be consistent with the land use plan. A VRM class 2 allows for activities with a low level of landscape change; a class III allows a moderate level of change that would not dominate the landscape; and a class IV allows a high level of change that would dominate the landscape.

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including alternatives, and to guide the process for developing the EIS. At present, the BLM has identified the following preliminary issues: Threatened and endangered species, biological resources, visual resources, cultural resources, tribal interests, recreation, and cumulative impacts. The Congressionally-designated Old Spanish National Historic Trail crosses the area. Habitat for the federally listed desert tortoise is also in this proposed area.

The BLM will consult with Native American tribes on a government-to-government basis in accordance with applicable laws, regulations, Executive Order 13175, and other policies. Tribal concerns will be given due consideration, including impacts on Indian Trust assets. Federal, State, and local agencies, along with other stakeholders that may be interested or affected by the BLM's decision on this project, are invited to participate in the scoping process and, if eligible, may request or be requested by the BLM to participate as a cooperating agency.

Segregation of the Public Lands

In 2013, the BLM published a Final Rule, Segregation of Lands--Renewable Energy (78 FR 25204), that amended the regulations found in 43 CFR 2090 and 2800. The provisions of the Final Rule allow the BLM to temporarily segregate public lands within a solar or wind application area from the operation of the public land laws, including the Mining Law, by publication of a Federal Register notice. The BLM uses this temporary segregation authority to preserve its ability to approve, approve with modifications, or deny proposed ROWs, and to facilitate the orderly administration of the public lands. This temporary segregation is subject to valid existing mining claims located before this segregation notice. Licenses, permits, cooperative agreements, or discretionary land use authorizations of a temporary nature which would not impact lands identified in this notice may be allowed with the approval of an authorized officer of the BLM during the segregation period. The lands segregated under this notice are legally described as follows:

Mount Diablo Meridian, Clark County, Nevada

T. 17 S., R. 64 E.,
    Sec. 10, S\1/2\;
    Sec. 11, S\1/2\;
    Secs. 12 and 13;
    Sec. 14, N\1/2\ and SE\1/4\;
    Sec. 15, N\1/2\;
    Sec. 22, E\1/2\;
    Secs. 23 thru 26;
    Sec. 27, E\1/2\;
    Sec. 34, E\1/2\;
    Secs. 35 and 36.
T. 17 S., R. 65 E.
    Secs. 7 thru 24;
    Secs. 26 thru 35.
T. 17 S., R. 66 E.,
    Secs. 7, 18 and 19.
T. 18 S., R. 64 E.,
    Secs. 1 and 2;
    Sec. 3, lots 5 and 6, S\1/2\NE\1/4\, and SE\1/4\;
    Sec. 10, E\1/2\;
    Secs. 11 thru 14;
    Sec. 15, E\1/2\;
    Sec. 22, E\1/2\;
    Secs. 23 thru 26;
    Sec. 27, E\1/2\;
    Sec. 34, E\1/2\;
    Secs. 35 and 36.
T. 18 S., R. 65 E.,
    Secs. 2 thru 9;
    Secs. 16 thru 20;
    Sec. 21, N\1/2\ and SW\1/4\;
    Sec. 30.

The areas described contain 45,165.48 acres, according to the official plats of the surveys and protraction diagrams of the lands on file with the BLM.

As provided in the Final Rule, the segregation of lands in this Notice will not exceed 2 years from the date of publication unless extended for up to 2 additional years through publication of a new notice in the Federal Register. Termination of the segregation occurs on the earliest of the following dates: Upon issuance of a decision by the authorized officer granting, granting with modifications, or denying the application for a ROW; automatically at

[[Page 32683]]

the end of the segregation; or upon publication of a Federal Register notice of termination of the segregation.

Upon termination of segregation of these lands, all lands subject to this segregation would automatically reopen to appropriation under the public land laws.

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment--including your personal identifying information--may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Authority: 40 CFR 1501.7, 43 CFR 1610.2, 43 CFR 1610.5, 43 CFR 2091.3-1(e), and 43 CFR 2804.25(f)

Gayle Marrs-Smith,
Las Vegas Field Manager.
[FR Doc. 2018-15020 Filed 7-12-18; 8:45 am]
BILLING CODE 4310-HC-P

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Augrelio Herman Pinales
E & I Project Manager
4701 North Torrey Pines Dr
Las Vegas, NV 89130
(702) 515-5284 Work
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From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Gemini Solar Comments
Date:	Tuesday, August 7, 2018 4:30:43 PM

---------- Forwarded message ----------
From: **Escalante Slim** <escalanteslim@yahoo.com>
Date: Thu, Jul 26, 2018 at 8:56 PM
Subject: [EXTERNAL] Gemini Solar Comments
To: "blm_nv_sndo_geminisolar@blm.gov" <blm_nv_sndo_geminisolar@blm.gov>

Gemini Solar Project
planning document comments
7-22-2018

The EIS should address degradation of the view-shed from the Muddy Mountains Wilderness Area. The existing NV Energy solar power facilities in Dry Lake Valley are highly visible from many locations within the Muddy Mountains Wilderness Area. The proposed project location is much closer to the wilderness area and will vastly increase degradation of the wilderness view-shed.

The planning document drawings indicate that the only two public access roads to the southwest side of the Muddy Mountains Wilderness Area would be permanently closed. Preservation of public access to public lands must be addressed in the EIS.

The planning document indicates that portions of historically significant trails would be destroyed by the proposed construction activities and adjacent trail segments not directly obliterated will be highly impacted by dramatic alteration of the view-shed. Drawing C-1 shows a dashed line labeled “(E) Old Spanish Trail”. This line appears to be roughly in the location of the wagon road generally know as the Los Angeles to Salt Lake road or the Mormon road, that was a major transportation route in this region after 1848. The existing segments of this trail on the west side of highway I-15 are not identified on the drawings. Prior to the wagon road the Old Spanish Trail was a mule and horse trail that generally followed California Wash south from the Muddy River crossing. This trail was used by pack mule trade caravans and emigrants from 1831 through 1848. Travelers on this route include many of the giants of western history (famous and infamous) such as John C. Fremont, Kit Carson, George Brewerton, Porter Rockwell, Jefferson Hunt, Miles Goodyear, Jim Beckwourth, Louis Rubidoux, Old Bill Williams, Pegleg Smith, William Workman, and John Rowland. It appears that this section of the Old Spanish National Historic Trail will be destroyed by the proposed project construction. This section of the Old Spanish National Historic Trail has been previously impacted by BLM negligence in permitting off-road vehicle racing events in California Wash. These historic trail segments are part of the Old Spanish National Historic Trail corridor and deserve full protection by the BLM. Preservation plans for these cultural resources must be addressed in the EIS.

The planning document drawings indicate that the project would also destroy portions of the historic Arrowhead Trail Highway, the first automobile route between Salt Lake City and southern California. This cultural resource must be identified on the project drawings and preservation plans documented in the EIS. Historic trails generally do not qualify for any protection under the National Register of Historic Places due to the twisted logic that most historic trails are no longer continuous from end to end due to previous segment destruction and therefore the remaining segments should not be protected. The BLM is the last resort for protecting these cultural resources. Please don't repeat the tragedy of the last known segment of Old Spanish Trail within the City of Las Vegas, which was permanently destroyed by Clark County Parks and Recreation as the land was being transferred to their jurisdiction for its preservation.

The EIS should address containment and ultimate removal of dust control chemicals applied during the life of project. Past experience indicates that all native vegetation will be destroyed by conventional site preparation activities. This level of abuse is unnecessary for this type of installation. The support structures could be installed with much less alteration of the existing surface conditions and thereby result in less dust mobility and reduce the need for dust control interventions. The use of indiscriminate herbicides such as glyphosate should not be permitted.

The EIS should address alternate methods of construction and operation that would preserve the existing desert tortoise habitat. BLM permitting of the destruction of an additional 7115 acres of critical habitat is unacceptable. The EIS should also address the restriction of free movement of other wildlife due to the proposed project fencing.

The EIS should explain the necessity of site lighting. Even the use of cut-off fixtures will highly impact the regional nighttime view-shed. If the intended purpose of the lighting is for site security, it is unlikely to be effective in an unoccupied remote location. Off-site monitoring of infra-red cameras or motion sensors would be more useful and have much lower environmental impact.

The EIS should explain why 20-foot wide solar field access ways and perimeter road are required. This level of impact seems extravagant for the stated purpose.

Section 1.3.8.1 of the planning document states that water would not be used for panel washing. The EIS should address panel washing methods, environmental impact of long term use of dust palliatives, and alternative methods of construction and operation to reduce the extent of denuded areas on site.

The EIS should include engineering estimates of energy production. Ambiguous statements like those in section 1.1.1 of the planning document are not acceptable.

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Augrelio Herman Pinales
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From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] My scoping comments in response to the Notice of Intent to prepare the Gemini Solar Project Environmental Impact Statement (EIS)
Date:	Tuesday, August 7, 2018 4:30:17 PM

---------- Forwarded message ----------
From: **Richard Spotts** <raspotts2@gmail.com>
Date: Mon, Jul 30, 2018 at 4:04 PM
Subject: [EXTERNAL] My scoping comments in response to the Notice of Intent to prepare the Gemini Solar Project Environmental Impact Statement (EIS)
To: blm_nv_sndo_geminisolar@blm.gov

July 30, 2018

U.S. Bureau of Land Management
Las Vegas Field Office
Attn: Herman Pinales
4701 N. Torrey Pines Drive
Las Vegas NV 89130
blm_nv_sndo_geminisolar@blm.gov

RE: **My scoping comments in response to the Notice of Intent to prepare the Gemini Solar Project Environmental Impact Statement (EIS).**

Dear Mr. Pinales:

Please accept this email with my scoping comments on the above-referenced matter.

Although I am not a Nevada resident, I am a frequent visitor who enjoys hiking and wildlife watching on BLM lands in Nevada. I also have a longstanding interest in the proper management of BLM lands in the West, and a strong concern about the ongoing decline of the Mojave desert tortoise and other native wildlife species.

For this EIS, it is imperative that the purpose and need for the proposed action include not only the applicant's narrow site-specific proposal but also the broader public purpose and need of advancing solar energy generation. This approach is the only way to ensure that a reasonable range of alternatives is analyzed in the EIS. Otherwise, the EIS analysis may be improperly limited to the applicant's proposed action, perhaps some modifications of it, and the required no action alternative. This limited approach would be an arbitrary contrivance that would preclude an evaluation of other feasible and reasonable alternatives to advance solar energy generation.

For example, the EIS should include an alternative that substitutes the applicant's proposed location for one or more locations on or adjacent to already disturbed areas, such as along major highways, power lines, or utility corridors, and/or on abandoned mines or proximate to expanding urban development. These alternate locations should pose less adverse economic, social, and environmental impacts because there would likely be less expense in ground clearing, less transmission loss of energy, less travel for construction and maintenance workers, less visual contrast in more remote areas, and less habitat destruction and fragmentation.

In addition, the EIS should include an alternative where solar panels are installed on existing roofs and other structures. Development in Las Vegas is growing rapidly and there are an abundance of roofs available for solar panels in residential, commercial, and industrial zones. The applicant could lease space on these roofs, install the solar panels, and easily join the local electrical grid. This would increase solar energy generation in already developed areas, and allow much of the generated electricity to be used locally.

The EIS should explain in the economic analysis of the alternatives why applicants tend to favor solar farms in remote locations on BLM lands even though other alternatives would seem to be better. Is it because BLM lands are undervalued and BLM rights-of-way fees are comparatively cheap? Do BLM related laws and policies skew free market economics and/or help subsidize or promote large solar farms in remote locations? Does the cost-benefit analysis of alternatives accurately and fairly include noneconomic factors such as impacts on scenery, solitude, recreation, and wildlife habitat? The EIS analysis should answer these questions so that the public can understand what is happening to their federal lands and why.

I am appalled that implementation of this applicant proposed action would destroy 7,115 acres of federal land, including good quality Mojave desert tortoise habitat. Since 1990, this species has been listed as a threatened species under the federal Endangered Species Act. Despite this listing, most tortoise populations continue to decline, and BLM has contributed to this decline through its cumulative approval of many projects that have destroyed and fragmented tortoise habitats. Status quo tortoise management is clearly not adequate; BLM must implement more aggressive and effective tortoise conservation and recovery measures. Like the

Physicans' Creed of "first, do no harm", BLM must start by not approving additional developments in tortoise habitat.

I am also appalled to learn that this proposal would amend the existing RMP to weaken the VRM designations, despite the proximity to a statutory federal wilderness area and scenic byway.

I hope that my scoping comments are helpful. Please include this email in the relevant EIS project file, and add me to the mailing list to receive all future notices relating to this EIS.

Thank you very much for your consideration.

Sincerely,

Richard Spotts

255 North 2790 East
Saint George UT 84790

raspotts2@gmail.com

cc: Interested parties

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Augrelio Herman Pinales
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From:	apinales@blm.gov
To:	Tania Treis
Subject:	Fwd: [EXTERNAL] Gemini Solar Project - comment
Date:	Tuesday, August 28, 2018 7:25:29 AM

---------- Forwarded message ----------
From: **timv@embarqmail.com** <timv@embarqmail.com>
Date: Fri, Aug 24, 2018 at 9:25 AM
Subject: [EXTERNAL] Gemini Solar Project - comment
To: blm_nv_sndo_geminisolar@blm.gov

Herman Pinales,

The Old Spanish Trail is identified in preliminary materials which indicate an evaluation of the Trail will be included in the EIS. The Old Spanish Trail is a unique and iconic symbol of the early (recent) exploration and crossing of this area. But more than a symbol, this trail offers a real example of trail conditions for the modern visitor to imagine and re-live those early trail crossings. To maintain the opportunity to re-live this experience the boundaries of this proposed solar facility should be maintained out-of-sight of the trail or some respectable distance such as a half a mile from the designated trail. Experiencing the Old Spanish Trail with fences and solar collectors will not allow serve the intent of the trail designation.

Thanks for the opportunity to comment.

Tim

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Augrelio Herman Pinales
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From:	apinales@blm.gov
To:	tania.treis@panoramaenv.com
Subject:	Fwd: [EXTERNAL] Solar plant
Date:	Tuesday, July 24, 2018 8:40:31 AM

---------- Forwarded message ----------
From: **Lynn Wilson** <lynnw6115@gmail.com>
Date: Mon, Jul 23, 2018 at 4:49 PM
Subject: [EXTERNAL] Solar plant
To: blm_nv_sndo_geminisolar@blm.gov

Good afternoon,

Thank you for letting me respond to this project. I was wondering if some alternatives have considered. This include installing solar panel parking covers in all BLM parking lots. These would be similar to those at Springs Preserve and while not covering all the needs, they would not need additional infrastructure created. They would also reduce the heat islands within the city and possibly make some employees a little happier. Additional small grid could be built on BLM land within the city. There are 2-3 acres sites across the county. The next idea would asking the city to change building codes to include an environmental package - could be offered as an upgrade. This could include more isolation and high energy windows. This would save both gas and electricity. In Washington, we were mandated to have 2 x 6 construction and had a window to wall ratio when built. Here, that does not exist. While these are small changes, they have a big impact. My power bill in the winter is only $28 per month. The solar company doesn't call anymore because their product would increase my bill. Perhaps, prevention instead of remediation would be the best. Thank you for your time.