APPENDIX A

NOTICE OF PREPARATION (NOP)
INITIAL STUDY
NOP COMMENT LETTERS

Imperial County
Planning & Development Services Department
NOTICE OF PREPARATION OF DRAFT EIR FOR THE DREW SOLAR PROJECT
NOTICE OF PUBLIC SCOPING MEETING

The Imperial County Planning & Development Services Department intends to prepare an Environmental Impact Report (EIR) for the proposed Drew Solar Project, as described below. A public scoping meeting for the proposed EIR will be held by the Imperial County Planning & Development Services Department at 6:00 p.m. PDT on May 24, 2018. The scoping meeting will be held at the Board of Supervisors Chambers, 2nd Floor, County Administration Center located at 940 Main Street, El Centro, CA 92243. Comments regarding the scope of the EIR will be accepted at this meeting. Additionally, comments may be sent to the Planning and Development Services Department, 801 Main Street, El Centro, California 92243, attention Jim Minnick, Director.

SUBJECT: Drew Solar Project

PLANNING COMMISSION APPROVAL: Fall 2018

PROJECT LOCATION: Drew Solar, LLC is proposing to develop the Drew Solar Project, an approximately 100-megawatt (MW) solar photovoltaic energy generation facility, including energy storage and gen-tie transmission lines, in Imperial County, California. The Project would be located on approximately 762.8 net acres in southern Imperial County, California, approximately 6.5 miles southwest of the city of El Centro, California and 7.5 miles directly west of Calexico. Specifically, the Project is located in portions of Sections 7 and 9, Township 17 South (T17S), Range 13 East (R13E), San Bernardino Base and Meridian.

PROJECT DESCRIPTION: The Project would consist of the construction, operation and reclamation of a 762.8 net acre, approximately 100-MW solar potovoltaic energy project, including energy storage and gen-tie transmission lines on six parcels that include Assessor's Parcel Number (APN) 052-170-039-000, 052-170-037-000, 052-170-031-000, 052-170-032-000, 052-170-056-000, and 052-170-067-000. The Project (General Plan Amendment #17-0006, Zone Change #17-0007, Variance #17-0003, Initial Study #17-0035, and six Conditional Use Permits #17-0031, #17-0032, #17-0033, #17-0034, #17-0035, and #18-0001) proposes seven access points off of the surrounding County roads and three off of State Route SR 98 along the southern border of the Project. The Project would also include internal access roads and infrastructure including a security fence, an Operations and Maintenance building or buildings; auxiliary facilities such as raw water/fire water storage, treated water storage, evaporation ponds, storm water retention basins, water filtration buildings and equipment, and equipment control buildings, septic system(s) and parking. The Project will connect to the existing Drew Switchyard located on APN 052-190-039-000 to the south of SR 98 via up to two 230kV Gen-ties. The project may be constructed at one time over approximately 18 months, or it may be built out over an approximately 10-year period.

DESIGNATED AREA PLAN: The project area is designated as Agriculture by the Imperial County General Plan. Project parcels are zoned A-2, A-2-R and A-3.

BOARD OF SUPERVISORS DISTRICT: District 2, Supervisor Luis A. Plancarte

ANTICIPATED SIGNIFICANT EFFECTS: The EIR will analyze potential impacts associated with the following: Aesthetics; Agriculture and Forest Resources; Air Quality; Biological Resources; Cultural Resources; Geology/Soils; Greenhouse Gas Emissions/Climate Change; Hazards and Hazardous Materials; Hydrology and Water Quality; Land Use/Planning; Noise; Public Services; Tribal Cultural Resources; Transportation/Circulation; Utilities and Service Systems and Cumulative Impacts.

COMMENTS REQUESTED: The Imperial County Planning & Development Services Department would like to know your ideas about the effects this solar power plant project might have on the environment and your suggestions as to alternatives, mitigation or ways the project may be revised to reduce or avoid any significant environmental impacts. Your comments will guide the scope and content of environmental issues to be examined in the EIR. Your comments may be submitted in writing to: Jim Minnick, Director, Imperial County Planning & Development Services Department, 801 Main Street, El Centro, CA 92243. Available project information may be reviewed at this location.

NOTICE OF PREPARATION REVIEW PERIOD: May 17, 2018 through June 21, 2018.

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Initial Study & Environmental Analysis

For:

Drew Solar Project

GPA 17-0006/ZC 17-0007/V 17-0003/IS 17-0035

CUP 17-0031/CUP 17-0032/CUP 17-0033/CUP 17-0034/CUP 17-0035/CUP 18-0001

Prepared By:

COUNTY OF IMPERIAL

Planning & Development Services Department

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May 2018

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SECTION 1 - INTRODUCTION

A. PURPOSE

This document is a ☐ policy-level, ☒ project level Initial Study for evaluation of potential environmental impacts resulting from the proposed Drew Solar Project (Refer to Exhibits "A", "B" and "C").

B. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REQUIREMENTS AND THE IMPERIAL COUNTY'S GUIDELINES FOR IMPLEMENTING CEQA

As defined by Section 15063 of the California Environmental Quality Act (CEQA) Guidelines and Section 7 of the County's "CEQA Regulations Guidelines for the Implementation of CEQA, as amended", an **Initial Study** is prepared primarily to provide the Lead Agency with information to use as the basis for determining whether an Environmental Impact Report (EIR), Negative Declaration, or Mitigated Negative Declaration would be appropriate for providing the necessary environmental documentation and clearance for any proposed project.

☒ According to Section 15065, an **EIR** is deemed appropriate for a particular proposal if the following conditions occur:

- The proposal has the potential to substantially degrade quality of the environment.
- The proposal has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
- The proposal has possible environmental effects that are individually limited but cumulatively considerable.
- The proposal could cause direct or indirect adverse effects on human beings.

☐ According to Section 15070(a), a **Negative Declaration** is deemed appropriate if the proposal would not result in any significant effect on the environment.

☐ According to Section 15070(b), a **Mitigated Negative Declaration** is deemed appropriate if it is determined that though a proposal could result in a significant effect, mitigation measures are available to reduce these significant effects to insignificant levels.

This Initial Study is prepared in conformance with the California Environmental Quality Act of 1970, as amended (Public Resources Code, Section 21000 et. seq.); Section 15070 of the State & County of Imperial's Guidelines for Implementation of the California Environmental Quality Act of 1970, as amended (California Code of Regulations, Title 14, Chapter 3, Section 15000, et. seq.); applicable requirements of the County of Imperial; and the regulations, requirements, and procedures of any other responsible public agency or an agency with jurisdiction by law.

Pursuant to the County of Imperial Guidelines for Implementing CEQA, depending on the project scope, the County of Imperial Board of Supervisors, Planning Commission and/or Planning Director is designated the Lead Agency, in accordance with Section 15050 of the CEQA Guidelines. The Lead Agency is the public agency which has the principal responsibility for approving the necessary environmental clearances and analyses for any project in the County.

C. INTENDED USES OF INITIAL STUDY

This Initial Study is an informational document which is intended to inform County of Imperial decision makers,

other responsible or interested agencies, and the general public of potential environmental effects of the proposed applications. The environmental review process has been established to enable public agencies to evaluate environmental consequences and to examine and implement methods of eliminating or reducing any potentially adverse impacts. While CEQA requires that consideration be given to avoiding environmental damage, the Lead Agency and other responsible public agencies must balance adverse environmental effects against other public objectives, including economic and social goals.

The Initial Study prepared for the project will be circulated for a period of 35 days for public and agency review and comments. At the conclusion, if comments are received, the County Planning & Development Services Department will prepare a document entitled "Responses to Comments" which will be forwarded to any commenting entity and be made part of the record within 10-days of any project consideration.

D. CONTENTS OF INITIAL STUDY

This Initial Study is organized to facilitate a basic understanding of the existing setting and environmental implications of the proposed applications.

SECTION 1

I. INTRODUCTION presents an introduction to the entire report. This section discusses the environmental process, scope of environmental review, and incorporation by reference documents.

SECTION 2

II. ENVIRONMENTAL CHECKLIST FORM contains the County's Environmental Checklist Form. The checklist form presents results of the environmental evaluation for the proposed applications and those issue areas that would have either a significant impact, potentially significant impact, or no impact.

PROJECT SUMMARY, LOCATION AND EVIRONMENTAL SETTINGS describes the proposed project entitlements and required applications. A description of discretionary approvals and permits required for project implementation is also included. It also identifies the location of the project and a general description of the surrounding environmental settings.

ENVIRONMENTAL ANALYSIS evaluates each response provided in the environmental checklist form. Each response checked in the checklist form is discussed and supported with sufficient data and analysis as necessary. As appropriate, each response discussion describes and identifies specific impacts anticipated with project implementation.

SECTION 3

III. MANDATORY FINDINGS presents Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

IV. PERSONS AND ORGANIZATIONS CONSULTED identifies those persons consulted and involved in preparation of this Initial Study.

V. REFERENCES lists bibliographical materials used in preparation of this document.

VI. FINDINGS

SECTION 4

VIII. RESPONSE TO COMMENTS (IF ANY)

IX. MITIGATION MONITORING & REPORTING PROGRAM (MMRP) (IF ANY)

E. SCOPE OF ENVIRONMENTAL ANALYSIS

For evaluation of environmental impacts, each question from the Environmental Checklist Form is summarized and responses are provided according to the analysis undertaken as part of the Initial Study. Impacts and effects will be evaluated and quantified, when appropriate. To each question, there are four possible responses, including:

1. **No Impact:** A "No Impact" response is adequately supported if the impact simply does not apply to the proposed applications.
2. **Less Than Significant Impact:** The proposed applications will have the potential to impact the environment. These impacts, however, will be less than significant; no additional analysis is required.
3. **Less Than Significant With Mitigation Incorporated:** This applies where incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact".
4. **Potentially Significant Impact:** The proposed applications could have impacts that are considered significant. Additional analyses and possibly an EIR could be required to identify mitigation measures that could reduce these impacts to less than significant levels.

F. POLICY-LEVEL or PROJECT LEVEL ENVIRONMENTAL ANALYSIS

This Initial Study will be conducted under a ☐ policy-level, ☒ project level analysis. Regarding mitigation measures, it is not the intent of this document to "overlap" or restate conditions of approval that are commonly established for future known projects or the proposed applications. Additionally, those other standard requirements and regulations that any development must comply with, that are outside the County's jurisdiction, are also not considered mitigation measures and therefore, will not be identified in this document.

G. TIERED DOCUMENTS AND INCORPORATION BY REFERENCE

Information, findings, and conclusions contained in this document are based on incorporation by reference of tiered documentation, which are discussed in the following section.

1. Tiered Documents

As permitted in Section 15152(a) of the CEQA Guidelines, information and discussions from other documents can be included into this document. Tiering is defined as follows:

"Tiering refers to using the analysis of general matters contained in a broader EIR (such as the one prepared for a general plan or policy statement) with later EIRs and negative declarations on narrower projects; incorporating by reference the general discussions from the broader EIR; and concentrating the later EIR or negative declaration solely on the issues specific to the later project."

Tiering also allows this document to comply with Section 15152(b) of the CEQA Guidelines, which discourages redundant analyses, as follows:

"Agencies are encouraged to tier the environmental analyses which they prepare for separate but related projects including the general plans, zoning changes, and development projects. This approach can eliminate repetitive discussion of the same issues and focus the later EIR or negative declaration on the actual issues ripe for decision

at each level of environmental review. Tiering is appropriate when the sequence of analysis is from an EIR prepared for a general plan, policy or program to an EIR or negative declaration for another plan, policy, or program of lesser scope, or to a site-specific EIR or negative declaration."

Further, Section 15152(d) of the CEQA Guidelines states:

"Where an EIR has been prepared and certified for a program, plan, policy, or ordinance consistent with the requirements of this section, any lead agency for a later project pursuant to or consistent with the program, plan, policy, or ordinance should limit the EIR or negative declaration on the later project to effects which:

(1) Were not examined as significant effects on the environment in the prior EIR; or

(2) Are susceptible to substantial reduction or avoidance by the choice of specific revisions in the project, by the imposition of conditions, or other means."

2. <u>Incorporation by Reference</u>

Incorporation by reference is a procedure for reducing the size of EIRs/MND and is most appropriate for including long, descriptive, or technical materials that provide general background information, but do not contribute directly to the specific analysis of the project itself. This procedure is particularly useful when an EIR or Negative Declaration relies on a broadly-drafted EIR for its evaluation of cumulative impacts of related projects (*Las Virgenes Homeowners Federation v. County of Los Angeles* [1986, 177 Ca.3d 300]). If an EIR or Negative Declaration relies on information from a supporting study that is available to the public, the EIR or Negative Declaration cannot be deemed unsupported by evidence or analysis (*San Francisco Ecology Center v. City and County of San Francisco* [1975, 48 Ca.3d 584, 595]). This document incorporates by reference appropriate information from the "Final Environmental Impact Report and Environmental Assessment for the "County of Imperial General Plan EIR" prepared by Brian F. Mooney Associates in 1993 and updates.

When an EIR or Negative Declaration incorporates a document by reference, the incorporation must comply with Section 15150 of the CEQA Guidelines as follows:

- The incorporated document must be available to the public or be a matter of public record (CEQA Guidelines Section 15150[a]). The General Plan EIR and updates are available, along with this document, at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (760) 482-4236.
- This document must be available for inspection by the public at an office of the lead agency (CEQA Guidelines Section 15150[b]). These documents are available at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (760) 482-4236.
- These documents must summarize the portion of the document being incorporated by reference or briefly describe information that cannot be summarized. Furthermore, these documents must describe the relationship between the incorporated information and the analysis in the tiered documents (CEQA Guidelines Section 15150[c]). As discussed above, the tiered EIRs address the entire project site and provide background and inventory information and data which apply to the project site. Incorporated information and/or data will be cited in the appropriate sections.
- These documents must include the State identification number of the incorporated documents (CEQA Guidelines Section 15150[d]). The State Clearinghouse Number for the County of Imperial General Plan EIR is SCH #93011023.
- The material to be incorporated in this document will include general background information (CEQA Guidelines Section 15150[f]). This has been previously discussed in this document.

SECTION II. ENVIRONMENTAL CHECKLIST

1. **Project Title**: Drew Solar Project
2. **Lead Agency**: Imperial County Planning & Development Services Department
3. **Contact person and phone number**: Diana Robinson, Planner II, (442) 265-1736 x1751
4. **Address**: 801 Main Street, El Centro CA, 92243
5. **E-mail**: DianaRobinson@co.imperial.ca.us
6. **Project location**: The proposed Project site is located on six parcels (052-170-039-000, 052-170-067-000, 052-170-031-000, 052-170-032-000, 052-170-056-000, and 052-170-037-000) approximately 6.5 miles southwest of the City of El Centro, California and 7.5 miles directly west of Calexico, California. The geographic center of the Project roughly corresponds with 32° 41' 13" North and 115° 40' 8" West, at an elevation of 19 feet below sea level. The Project site is generally located south of Kubler Road, east of the Westside Main Canal, north of State Route 98, and west of Pulliam Road.
7. **Project sponsor's name and address**: Drew Solar, LLC, PO Box 317, El Centro, CA 92244
8. **General Plan designation**: Agriculture
9. **Zoning**: A-2 (General Agricultural Zone), A-2-R (General Agricultural Zone/Rural Zone) and A-3 (Heavy Agricultural)
10. **Description of project**: The Drew Solar project (Project) is a proposed solar photovoltaic (PV) energy-generating facility being developed by Drew Solar, LLC (DS, or Project Proponent) to sell its electricity and all renewable and environmental attributes to an electric utility purchaser(s) under long-term contracts to help meet California Renewable Portfolio Standard (RPS) goals. The Project site is comprised of six assessor's parcel numbers (APNs) totaling 762.8 net acres (exclusive of roads). The Project site is designated as Agriculture by the Imperial County General Plan Land Use Element, and the Project site parcels are comprised of lands zoned as A-2 (Agricultural, General), A-2-R (General Agricultural/Rural Zone), and A-3 (Agricultural, Heavy). The Project Proponent requests a Development Agreement with Imperial County to enable and control a phased build out of the Project.
11. **Surrounding land uses and setting**: The Project site is located in the southwestern portion of Imperial County in an area characterized by agricultural and solar fields. The Project site is bordered by the existing Centinela Solar Project to the east and the south and is on the north side of State Route (SR) 98 just opposite the existing Drew Switchyard. The rest of the area is predominantly agricultural with a few residences and agricultural buildings mixed in. The nearest single-family residence is located immediately west of the intersection of Drew Road and State Route 98.
12. **Other public agencies whose approval is required** (e.g., permits, financing approval, or participation agreement.): Imperial Irrigation District (IID), Imperial County Air Pollution Control District (ICAPCD), California Department of Transportation (Caltrans), California State Water Resources Control Board (SWRCB), California Department of Fish and Wildlife (CDFW), U.S. Army Corps of Engineers (USACOE), U.S. Fish and Wildlife Service (USFWS), Native American Heritage Commission (NAHC), Environmental Evaluation Committee (EEC), Imperial County Planning Commission (PC).

13. **Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1?** Yes.

If so has consultation begun? Letters sent via certified mail May 7, 2018.

Note: Conducting consultation early in the CEQA process allows tribal governments, lead agencies, and project proponents to discuss the level of environmental review, identify and address potential adverse impacts to tribal cultural resources, and reduce the potential for delay and conflict in the environmental review process. (See Public Resources Code, Section 21083.3.2). Information may also be available from the California Native American Heritage Commission's Sacred Lands File per Public Resources Code, Section 5097.96 and the California Historical Resources Information System administered by the California Office of Historic Preservation. Please also note that Public Resources Code, Section 21082.3 (c) contains provisions specific to confidentiality.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☒ Aesthetics	☒ Agriculture and Forestry Resources	☒ Air Quality
☒ Biological Resources	☒ Cultural Resources	☒ Geology /Soils
☒ Greenhouse Gas Emissions	☒ Hazards & Hazardous Materials	☒ Hydrology / Water Quality
☒ Land Use / Planning	☐ Mineral Resources	☒ Noise
☐ Population / Housing	☒ Public Services	☐ Recreation
☒ Transportation/Traffic	☒ Tribal Cultural Resources	☒ Utilities and Services Systems
☒ Mandatory Findings of Significance		

ENVIRONMENTAL EVALUATION COMMITTEE (EEC) DETERMINATION

After Review of the Initial Study, the Environmental Evaluation Committee has:

☐ Found that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ Found that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ Found that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ Found that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ Found that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE DE MINIMIS IMPACT FINDING: ☐ Yes ☐ No

EEC VOTES	YES	NO	ABSENT
PUBLIC WORKS	☐	☐	☐
ENVIRONMENTAL HEALTH SVCS	☐	☐	☐
OFFICE EMERGENCY SERVICES	☐	☐	☐
APCD	☐	☐	☐
AG	☐	☐	☐
SHERIFF DEPARTMENT	☐	☐	☐
ICPDS	☐	☐	☐

Jim Minnick, Director of Planning/EEC Chairman Date:

PROJECT SUMMARY

A. Project Location: The proposed Project site is located approximately 6.5 miles southwest of the City of El Centro, California and 7.5 miles directly west of Calexico, California. The geographic center of the Project roughly corresponds with 32° 41' 13" North and 115° 40' 8" West, at an elevation of 19 feet below sea level. The Project site is generally located south of Kubler Road, east of the Westside Main Canal, north of State Route 98, and west of Pulliam Road (Exhibit A).

A. Project Summary: The proposed Project consists of a photovoltaic (PV) solar facility capable of producing approximately 100 megawatts (MW) alternating current (AC) energy storage and generation interconnection (gen-tie) transmission lines on 762.8 net acres. The ultimate energy output is dependent on several variables, including off-take arrangements and the evolving efficiency of PV panels, so it is possible that the Project could generate more or less than 100 MW. The Project Proponent requests a Development Agreement with Imperial County to enable and control a phased build out of the Project. The Project may be constructed at one time over approximately 18 months, or it may be built out over an approximately 10-year period. A conceptual phasing configuration is shown in Exhibit B. A Site Plan is provided in Exhibit C. The phased project would allow utilities greater flexibility in obtaining renewable energy to meet ratepayer needs. The Project Proponent is requesting that a Conditional Use Permit (CUP) be issued for each of the five phases of the Project as well as an additional sixth CUP for Phase 5 for energy storage in the area proposed to be conditionally rezoned to M-2 (Medium Industrial).

The Project Proponent has filed an application for a General Plan Amendment (GPA), a Zone Change, a Height Variance and six CUPs. Each of the six CUPs would include an Operations and Maintenance (O&M) building or buildings. The Project may also include additional auxiliary facilities such as raw water/fire water storage, treated water storage, evaporation ponds, storm water retention basins, water filtration buildings and equipment, and equipment control buildings, septic system(s) and parking. The Project will also include electric and vehicular crossings of State facilities, IID facilities and County facilities. The Project crossings will not interfere with the purpose of these Agencies' facilities (e.g. where a drain flows, the Project crossing will still allow the drain to flow). The Project will likely incorporate an energy storage component and each phase may have its own energy storage component as well as energy storage being housed within the inverters.

The construction equipment, materials, and labor involved in building the Project remain similar whether the project is constructed in phases over time or built out over an 18-month period. The 18-month buildout of the entire Project at once results in greater intensity of labor and equipment during the construction period. Each CUP of the project may have its own off-taker and operate independently from the other CUPs. The phases shown on the phasing plan are conceptual and will not be constructed in any particular order. The phases may be aggregated during construction and operations/maintenance so that multiple phases could be built at one time. All phases are anticipated to utilize proposed gen-tie lines that extend from the south end of the Project site across Drew Road and SR 98 into the existing Drew Switchyard located on APN 052-190-039. The phases are anticipated to use main Project switchyard; however, each phase may independently construct its own up to 230 kilovolt (kv) step up transformer and switchyard.

The Project also includes construction of generation interconnection (gen-tie) transmission lines extending from the south end of the Project site south across Drew Road and State Route 98 into the existing Drew Switchyard located on APN 052-190-039. The pole height of the gen-tie structures will range between 120 feet up to 180 feet.

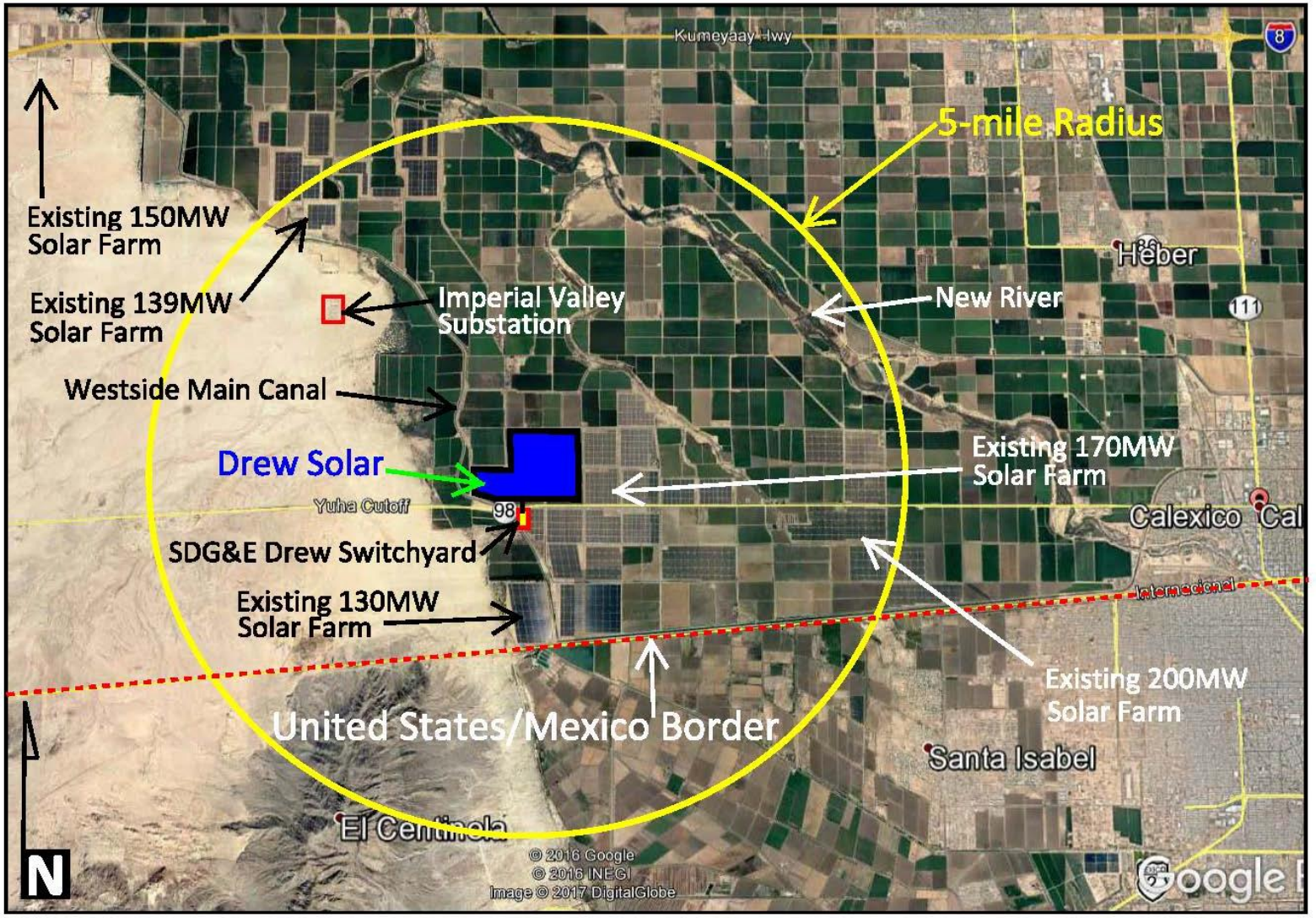
B. Environmental Setting: The Project site is in an area characterized by agricultural and solar fields. The Project site is bordered by the existing Centinela Solar Project to the east and the south and is on the north side of State Route (SR) 98 just opposite the existing Drew Switchyard. The rest of the area is predominantly agricultural with

a few residences and agricultural buildings mixed in.

D. Analysis: The project will result in potentially significant impacts with regards to aesthetics and agricultural resources. In addition, the Project is anticipated to result in potentially significant impacts unless mitigation is incorporated to the following: air quality, biological resources, cultural resources, geology and soils, greenhouse gases, hazards and hazardous materials, land use, noise, public services, tribal cultural resources, transportation/traffic, and utilities and services.

E. General Plan Consistency: The project proposes five CUPs in association with the proposed solar use and energy storage use as well as a Zone Change and a GPA. A sixth CUP is proposed in association with standalone energy storage. Approval of the requested entitlements will result in consistency of the Drew Solar Project with the General Plan.

Exhibit “A” - Vicinity Map



Date: 10/15/2017

Vicinity Map

Exhibit "B" – Phasing Plan

Date: 1/8/2018

Legend

- Project Boundary
- Project Electrical Crossing
- IID Distribution Circuit
- Access from SR 98
- Access from County road
- IID Earthen Canal
- IID Concrete Canal
- IID Drain
- IID Operational Spill

Drew Solar Project Area

Exhibit "C" – Single-Axis Tracker Photovoltaic Site Plan

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:

   a) Earlier Analysis Used. Identify and state where they are available for review.

   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

   c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9) The explanation of each issue should identify:

   a) the significance criteria or threshold, if any, used to evaluate each question; and

   b) the mitigation measure identified, if any, to reduce the impact to less than significance

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

I. *AESTHETICS* *Would the project:*

a) Have a substantial adverse effect on a scenic vista or scenic highway? ☒ ☐ ☐ ☐

Potentially Significant Impact. The Project site consists of agricultural fields historically planted with Bermuda Grass, alfalfa, kleingrass, wheat and Sudangrass. A portion of the Project site is bordered by SR 98. However, SR 98 is not a designated scenic highway. Views of Mount Signal to the southwest could be considered scenic. The Gen-Tie extending south to the Drew Switchyard would be on power poles ranging from 120 to 180 feet in height. Similar overhead infrastructure is currently visible on the horizon in the Project area. Therefore, adverse effects on a scenic vista are considered potentially significant.

b) Substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway? ☐ ☐ ☐ ☒

No Impact. The Project site includes six APNs owned by the Imperial Irrigation District (IID). The site is in agricultural production and does not contain any scenic resources including trees, rock outcroppings or historic buildings. Likewise, SR 98 is not a Scenic Highway. Therefore, no impact is anticipated and impacts to resources within a state scenic highway will not be discussed in the EIR.

c) Substantially degrade the existing visual character or quality of the site and its surrounding? ☒ ☐ ☐ ☐

Potentially Significant Impact. The Project includes development of approximately 762.8 net acres of agricultural land. The Project site is located in the southwestern portion of Imperial County in an area characterized by agricultural and solar fields. The Project site is bordered by the existing Centinela Solar Project to the east and the south and is on the north side of State Route (SR) 98 just opposite the Drew Switchyard. The rest of the area is predominantly agricultural with a few residences and agricultural buildings adjacent to the Project. The site is visible to travelers on along SR 98, Drew Road, Kubler Road, Pulliam Road and Mandrapa Road.

The Project will utilize PV modules. PV modules are generally non-reflective. Other features of the Project include and Operations and Maintenance (O&M) building or buildings; raw water/fire water storage, treated water storage, evaporation ponds, storm water retention basins, water filtration buildings and equipment, and equipment control buildings, septic system(s) and parking. The Project will include electric and vehicular crossings of State facilities, IID facilities and County facilities which could range between 120 and 180 feet in height.

The introduction of all of these features would be noticeable in varying degrees (dependent upon angle, set-back and height) to travelers along SR 98 and surrounding lands. Therefore, a potentially significant impact is identified for this issue area. Impacts to visual character and quality of the site will be addressed in the EIR.

d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area? ☐ ☐ ☒ ☐

Less than Significant Impact. The Project site is currently agricultural land with no sources of light or glare. The Project includes a lighting system that will provide illumination for operation and maintenance personnel in both normal and emergency conditions. The proposed Project may also install security lighting and the building(s) may have exterior lighting on motion sensors. All lighting will be designed to provide the minimum illumination needed to achieve safety and security objectives and will be shielded and oriented to focus illumination on the desired areas, minimizing light spillover.

While PV technologies are generally non-reflective, intermittent glare may be created when the panels are at a specific angle during a specific time of day and viewed from a specific vantage point. A Glare Study was prepared for the Project to identify potential glare issues for PV panels on single-axis solar trackers from Key Observation Points. (POWER 2018). The study found that no glare will be visible at the KOPs from the proposed solar operations due to the orientation of the PV panes and their rotation limits. Therefore, light or glare impacts are considered less than significant but will be discussed in the EIR.

II. AGRICULTURE AND FOREST RESOURCES

In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. --Would the project:

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☒	☐	☐	☐

Potentially Significant Impact. The Project site contains primarily Farmland of Statewide Importance with some Prime Farmland in the southwestern portion of the site and a small amount in along Kubler Road to the north. According to the California Farmland Mapping and Monitoring Program (FMMP), Prime Farmland is defined as having the best combination of physical and chemical features able to sustain long-term agricultural production. Prime farmland has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Farmland of Statewide Importance is similar to Prime Farmland but with minor shortcomings (e.g. as greater slopes, less ability to store soil moisture).

To be considered as "Prime Farmland" the land must have been used for production of irrigated crops at some time during the two update cycles prior to the mapping date. The California Department of Conservation (CDOC) Land Evaluation Site Assessment (LESA) model was prepared to evaluate the potential impacts from conversion of agricultural land to other purposes (RECON 2018c). Conversion of the agricultural lands to other uses may create a significant impact. This issue will be discussed in the EIR.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
b) Conflict with existing zoning for agricultural use, or a Williamson Act Contract?	☒	☐	☐	☐

Potentially Significant Impact. All of the six parcels that comprise the Project site are zoned either A-2, A-2-R or A-3. A solar project is an allowed use with a Conditional Use Permit. However, a Zone Change to M-2, Medium Industrial would be required to accommodate the proposed energy storage system. This could potentially conflict with surrounding agricultural designations. The Applicant is also seeking an amendment to the General Plan Renewable Energy and Transmission Element to allow for development of a renewable energy project that is not located adjacent to the existing RE Overlay Zone but shares a common boundary to an existing transmission source (i.e. the Drew Switchyard). The potential for conflicts with the surround agricultural uses will be considered.

None of the parcels are under a Williamson Act Contract nor are any of the parcels immediately adjacent to the Project site under Williamson Act Contract. However, there are several parcels within a half-mile to the northwest and east of the Project site that are under Williamson Act Contract. Therefore, the Project may conflict with existing zoning for agricultural use and nearby Williamson Act Contracts resulting in a potentially significant impact. This issue will be discussed in the EIR.

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?	☐	☐	☐	☒

No Impact. Based on the Imperial County General Plan, Conservation and Open Space Element, mixed chaparral, pinyon-juniper habitats, and the montane hardwood-conifer forest are located in restricted areas of the County. Mixed chaparral and pinyon-juniper habitats are located in the extreme southwestern corner of the County and montane hardwood-conifer forest is in the extreme northwestern corner of Imperial County. Thus, there are no existing forest lands, timberlands, or timberland zoned Timberland Production either on or near the Project site that would conflict with existing zoning. This issue will not be discussed in the EIR.

d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒

No Impact. There are no existing forest lands either on-site or in the immediate vicinity of the Project site. The proposed Project would not result in the loss of forest land or conversion of forest land to non-forest use. Therefore, no impact is identified for this issue area.

e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☒	☐	☐	☐

Potentially Significant Impact. The proposed Project would temporarily convert approximately 762.8 net acres of land actively cultivated farmland to a non-agricultural use. The site is bordered by a solar facility on the east and south and would represent an expansion of an existing use. However, the conversion of land designated for agriculture to a solar facility represents a potentially significant impact that will be discussed in the EIR.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

III. AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to the following determinations. Would the Project:

a) Conflict with or obstruct implementation of the applicable air quality plan? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project site is located within the Salton Sea Air Basin (SSAB) and is subject to the Imperial County Air Pollution Control District (ICAPCD) Rules and Regulations. Approximately 844.2 gross acres would be disturbed in association with construction of the Drew Solar Project. An Air Quality and Greenhouse Gas Analysis was prepared for the proposed Project that examined the potential for construction activities to create temporary emissions of dust, fumes, equipment exhaust, and other air contaminants that may conflict with the ICAPCD Rules and Regulations (RECON 2018a). The proposed Project may conflict with or obstruct implementation of an applicable air quality plan. This is considered a potentially significant impact unless mitigation is incorporated.

b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. Currently, the SSAB is either in attainment or unclassified for all federal and state air pollutant standards with the exception of O_3 (8-hour) and total suspended particulate matter less than 10 microns in diameter (PM_{10}). Air pollutants transported into the SSAB from the adjacent South Coast Air Basin (Los Angeles, San Bernardino County, Orange County, and Riverside County) and from Mexicali (Mexico) substantially contribute to the non-attainment conditions in the SSAB. Thus, a potentially significant impact is identified for this issue area. Construction of the proposed Project may result in a cumulatively considerable net increase of one or more criteria pollutants as a result of point, and non-point source emissions for which the region is in nonattainment under applicable federal and state ambient air quality standards. Thus, a potentially significant impact is identified with regard to violating an air quality standard. Temporary construction air quality emissions have the potential to result in an increase of criteria pollutants. This is considered a potentially significant impact unless mitigation is incorporated. An Air Quality and Greenhouse Gas Analysis (RECON 2018a) was prepared for the proposed Project and these potential air quality impacts will be addressed in the EIR.

c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. Refer to item "b", above.

d) Expose sensitive receptors to substantial pollutants concentrations? ☐ ☐ ☒ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project site parcels and surrounding areas are currently agricultural land with scattered rural residences and other solar developments. Sensitive

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

receptors in the vicinity of the Project site include a single-family residence immediately west of the intersection of the Drew Road and SR 98 and another single-family residence northwest of the intersection of Kubler Road and Pulliam Road. Therefore, impacts to sensitive receptors are considered potentially significant unless mitigation is incorporated. This impact will be discussed in the EIR.

e) Create objectionable odors affecting a substantial number of people? ☐ ☐ ☒ ☐

Less than Significant Impact. The proposed Project is the development of a solar facility. The nearest sensitive receptor is a single-family residence approximately 80 feet from the southern edge of the proposed grading area (50 feet form project site boundary). Any odors associated with construction activities would be transient and would cease upon completion. For these reasons, construction-related odor impacts are considered less than significant but, would be acknowledged in the EIR.

IV. ***BIOLOGICAL RESOURCES*** *Would the project:*

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project site consists of agricultural land. A Biological Resources Report has been prepared for the Project site (DUDEK 2018a) which included the results of biological surveys conducted in 2017. Based on the agricultural activities occurring on the site, it is unlikely that any special-status plant species would be present. Burrowing owl, a special-status species, was observed in the during the biological surveys. Two other special-status wildlife species, California black rail and Yuma Ridgeways' rail, have a moderate potential to occur in the proposed Project site.

The burrowing owl is a BLM Sensitive Species, a U.S. Fish and Wildlife Service Bird of Conservation Concern and a California Department of Fish and Wildlife (CDFW) Species of Special Concern. The proposed Project could result in potentially significant impacts to burrowing owls (refer to item e] below) as well as California black rail and Yuma Ridgeways' rail unless mitigation is incorporated. A full discussion of the findings of the Biological Resources Report will be provided in the EIR.

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. During construction, the proposed Project will potentially impact three sensitive vegetation communities/regulated resources: arrow weed thickets alliance, tamarisk thickets and cattail marshes alliance. Therefore, a potentially significant impact unless mitigation is incorporated is identified for impacts to riparian habitat and sensitive natural communities. These impacts will be discussed in the EIR.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. A jurisdictional delineation was prepared for the proposed Project site (DUDEK 2018a). Based on the jurisdictional delineation, there are approximately 10.2 acres of waters, wetlands and riparian habitat regulated by the U.S. Army Corps of Engineers (ACOE), Regional Water Quality Control Board, and the California Department of Fish and Wildlife (CDFW) and approximately 5.4 acres under the exclusive jurisdiction of CDFW within the Project Area. The proposed Project will potentially permanently impact federal jurisdictional wetland waters under the jurisdiction of the ACOE pending a jurisdictional determination. This is considered a potentially significant impact unless mitigation is incorporated.

d) Interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☒	☐

Less than Significant Impact. Wildlife corridors are linear features that connect large patches of natural open space and provide avenues for the migration of animals. The Project site is primarily surrounded by, and includes, extensive historical and present day agricultural practices. The Project site is also bordered on the east and south by operating solar facilities. Thus, the site has limited value as a potential wildlife corridor or habitat linkage for most wildlife species. As such, the Project site likely does not serve as an important wildlife corridor or habitat linkage for larger mammals and species that are limited to native habitats. Impacts are considered less than significant but would be acknowledged in the EIR.

e) Conflict with any local policies or ordinance protecting biological resource, such as a tree preservation policy or ordinance?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. The Imperial County General Plan Open Space and Conservation Element (Imperial County 1993) contains an Open Space Conservation Policy that requires detailed investigations to be conducted to determine the significance, location, extent, and condition of natural resources in the County, and to notify any agency responsible for protecting plant and wildlife before approving a project which would impact a rare, sensitive, or unique plant or wildlife habitat. In accordance with this policy, a Biological Resources Report was prepared for the Project site (DUDEK 2018a). The Imperial County General Plan Land Use Element Policy notes that the majority of the privately-owned land in the County is designated "Agriculture," which is also the predominate area where burrowing owls (*Athene cunicularia*) create habitats, typically in the brims and banks of agricultural fields. Consistent with these policies, focused burrowing owl surveys were conducted on-site within suitable habitat during this species' breeding season and early migration period. Potential for harm to, or damage to habitat of, burrowing

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

owl is considered a potentially significant impact unless mitigation is incorporated. The results of Biological Resources Assessment, and burrowing owl surveys will be discussed in the EIR.

f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan? ☐ ☐ ☒ ☐

Less than Significant Impact. BLM has adopted the Desert Renewable Energy Conservation Plan (DRECP), which provides protection and conservation of desert ecosystems while allowing for appropriate development of renewable energy Projects. Although the DRECP plan area includes the Project area, the DRECP currently only applies to renewable energy Projects on BLM-managed lands and therefore would not be applicable to the proposed Project. The proposed Project is not located within any other local, regional, or state conservation planning areas. Impacts of the Project on an adopted HCP, NCCP, or other approved local, regional, or state habitat conservation plan would be less than significant.

V. CULTURAL RESOURCES *Would the project:*

a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5? ☐ ☐ ☒ ☐

Less than Significant Impact. Nine newly identified historic age cultural resources were recorded during the intensive pedestrian survey conducted on November 20, 2017 and February 21, 2018 (DUDEK 2018b). These new resources consist of irrigation canals and drainages. Based on historic aerials and available date stamps, the canals are historic in age (circa 1950s). All historic age canal/drainage resources evaluated as part of the Historic Resource Evaluation (DUDEK 2108c) are recommended not eligible for the NRHP and CRHR based on a lack of historical significance, and in some cases, a lack of integrity. Therefore, impacts to historical resources would be less than significant, but would be acknowledged in the EIR.

b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The parcels that comprise the Project site have been extensively disturbed by decades of agricultural activities. Any archaeology that was present would have been disturbed by continuous agricultural activities and would no longer remain intact. However, there is a moderate potential for the inadvertent discovery of intact cultural deposits during earth moving activities related to the construction of the Project's generation interconnection (gen-tie). The gen-tie alignment is located outside of the agricultural fields on areas that have not been subject to the same extensive agricultural disturbances. Therefore, a potentially significant impact could occur to unknown archaeological resources unless mitigation is incorporated.

c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. Many paleontological fossil sites recorded in Imperial County have been discovered during construction activities. Paleontological resources are typically

impacted when earthwork activities such as mass excavation cut into geological deposits (formations) with buried fossils. The site lies near the western boundary of the old meandering shoreline of ancient Lake Cahuilla. However, it is not known if any paleontological resources are located beneath and within the boundaries of the Project site or gen-tie alignment. A potentially significant impact unless mitigation is incorporated has been identified for paleontological resources and unique geologic features. This issue will be addressed in the EIR.

d) Disturb any human remains, including those interred outside of dedicated cemeteries? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. As described in item "a)" above, it is not likely that human remains would be found on the Project site parcels based on years of disturbance associated with agricultural activities. Nevertheless, the potential exists for previously unknown human remains to be discovered during construction of proposed Project as well as the gen-tie. This is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

VI. *GEOLOGY AND SOILS* *Would the project:*

a) Expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death involving: ☐ ☒ ☐ ☐

i.) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The southwest corner of the Project site lies within the State of California Alquist-Priolo Earthquake Fault Zone. This is an unnamed fault that was mapped after the 2010 7.2 Mw El Mayor-Cucapha Earthquake (LandMark 2017). Surface fault rupture at the Project site is considered to be low to moderate. This is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

ii.) Strong Seismic ground shaking? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The primary seismic hazard at the Project site is the potential for strong groundshaking during earthquakes along the Superstition Hills, Imperial, Cerro Prieto, and Laguna Salada faults. The Project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region LandMark 2017). Therefore, exposure to strong seismic groundshaking is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

iii.) Seismic-related ground failure, including liquefaction and seiche/tsunami? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. A Preliminary Geotechnical and GeoHazards Report (LandMark 2017) was prepared for the Project site to examine the potential for seismic-related ground failure. Secondary effects of seismic activity normally considered as possible hazards to a site include several types of ground failure. Conditions conducive to liquefaction, including shallow groundwater, loosely packed cohesionless soils, and groundshaking of sufficient intensity, all exist to some degree at the Project site. Liquefaction settlement and ground fissures were noted along the Westside Main Canal in the area of the Project site after the April 4, 2010 magnitude 7.2Mw El Mayor-Cucapah Earthquake. Several liquefaction-related failures to the embankment of the Westside Main Canal were also present west of the Project site. Therefore, damage due to liquefaction is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

The Project site is not near any large bodies of water. Thus, the threat of tsunami, secihes, or other seismically-induced flooding is considered unlikely. Therefore, no impact would occur as a result of seiche or tsunami.

iv.) Landslides? ☐ ☐ ☐ ☒

No Impact. The site exhibits a generally flat topography and no landslides exist within or near the site. Based on the topography across the site, the potential for landsliding is considered negligible LandMark 2017). Thus, no impact is identified for this issue area and it will not be discussed in the EIR.

b) Result in substantial soil erosion or the loss of topsoil? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The majority of the soils within the boundaries of the Project site are Imperial Silty Clay, Wet and Imperial-Glenbar Silty Clay Loams, Wet 0 to 2 percent slopes. Other soils include Holtville Silty Clay, Wet, Meloland Very Fine Sandy Loam, Wet and Rositas Fine Sand, Wet 0 to 2 percent slopes (RECON 2018c) . Site preparation will be planned and designed to minimize the amount of earth movement required to the extent feasible. Soil erosion could result during construction in association with ground preparation activities (grading, trenching) and is considered a potentially significant impact unless mitigation is incorporated. Standard erosion control methods will be required in accordance with County standards including preparation, review and approval of a grading plan by the County Engineer. During operations, both dust and erosion would be controlled by the periodic application of chemical stabilization agents (soil binders) to exposed soil surfaces. Potential for erosion during construction and operations will be discussed in the EIR.

c) Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project site is dominantly underlain by clays that are not expected to collapse with the addition of water to the site. Regional subsidence due to geothermal resource activities has not been documented in the area west of the New River. Therefore, the risk of regional subsidence is considered low. Based on the flat topography of the Project site, landslides are

not considered a threat (refer to item "a-iv" above). However, as noted under item "a-iii", conditions conducive to liquefaction may exist to some degree on the Project site. The soils could become unstable if a seismic event were to occur triggering liquefaction on site (LandMark 2017). Therefore, potential for liquefaction is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

d) Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. Much of the near surface soils within the boundaries of the Project site consist of silty clays and clay having a moderate to high expansion potential. A site-specific geotechnical investigation will be required at the Project site to determine the extent and effect of the expansive soils. Therefore, risk of exposure to expansive soils is considered a potentially significant impact unless mitigation is incorporated and will be discussed in the EIR.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The near surface soils within the boundaries of the Project site generally consist of silty clays having a low infiltration rate (LandMark 2017). Some areas of silty sand soils may be encountered on the Project site which have moderate infiltration rates. The near surface sandy soils are considered good in supporting on-site septic systems and leach fields for wastewater disposal. Site specific studies will be required to determine if County Environmental Health Standards are met in regard to soil percolation rates and separation of leach fields from the groundwater. Thus, the capability of soils to support on-site septic systems is considered a potentially significant impact unless mitigation incorporated and will be discussed in the EIR.

VII. *GREENHOUSE GAS EMISSIONS* *Would the project:*

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment? ☐ ☐ ☒ ☐

Less than Significant Impact. The proposed Project has the potential to generate greenhouse gas (GHG) emissions during construction in association with travel required to and from the Project site by construction workers, delivery of materials, and operation of heavy equipment. In comparison, during operations, total daily trips would be few to none. In the long-term, the Project is expected to provide a benefit with respect to reduction of greenhouse gas emissions as a result of generation of renewable power in place of fossil fuels.

The Project's gross annual GHG emissions and the GHG emissions offset by the renewable energy generation of the solar facility would gradually decline as a result of federal, state, and local implementation measures (RECON 2081a). As emissions would not exceed the South Coast Air Quality Management District's (AQMD's) screening threshold, the Project would not result in a cumulatively considerable impact to GHG emissions and would not conflict with the State GHG reduction targets. However, greenhouse gas emissions will be discussed in the EIR.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
b) Conflict with an applicable plan or policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

Less than Significant Impact. Refer to item "a", above. No GHG emission significance threshold has been adopted by the Imperial County Air Pollution Control District. Project GHG emissions were evaluated against the South Coast AQMD screening level of 3,000 MT CO2E. The Project's combined gross construction, operational, and decommissioning GHG emissions would be 366 MT CO2E in 2020 (RECON 2018a). When accounting for the GHG emissions offset by the renewable energy generation of the solar facility, the Project would result in a net total reduction of 73,829 MT CO2E in 2020. Therefore, the no impact would occur with regard to conflicting with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases. However, this issue will be acknowledged in the EIR.

VIII. HAZARDS AND HAZARDOUS MATERIALS *Would the project:*

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project would not use or store any appreciable quantities of hazardous chemicals on site during normal operations. Fuel that may be used on site during construction would be stored in secondary containment. The Project proposes an energy storage system with a technology yet to be determined. Batteries are one form of energy storage that can involve the use of materials that present a hazard/potential for explosion. Therefore, creation of a hazard to the public through the routine transport, use, or disposal of hazardous materials is considered a potentially significant impact unless mitigation is incorporated.

b) Create a significant hazard to the public or the environment through reasonable foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐

Less than Significant Impact. A Phase I Environmental Site Assessment prepared for the Project (LandMark 2018) indicated that all of the parcels comprising the site have been used for agriculture since the late 1930s. During a site reconnaissance, no operations that use, treat, store, dispose of, or generated hazardous materials or petroleum products were observed on the Project site. However, residues of currently available pesticides and currently banned pesticides such as DDT/DDE may be present in near surface soils in limited concentrations. The concentrations of these pesticides found on other Imperial Valley agricultural sites are typically less than 25% of the current regulatory threshold limit and are not consider a significant environmental hazard. Low concentration pesticide residues typical to agricultural crop applications may be present in near surface soils and are considered *de mimimus.* No further environmental study is warranted at this time. Therefore, impacts associated with the release of hazardous materials are considered less than significant but will be acknowledged in the EIR.

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed	☐	☐	☐	☒

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

school?

No Impact. The Project site is not located within one-quarter mile of an existing school. No impact would occur.

d) Be located on a site, which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment? ☐ ☐ ☐ ☒

No Impact. An Agency Database Record Search was undertaken of available compiled agency database records as part of the Phase I Environmental Assessment (LandMark 2018). Based on the information available, the Project site was not found on a hazardous materials list pursuant to California Government Code Section 65962.5. No impact is identified for this issue area.

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area? ☐ ☐ ☐ ☒

No Impact. The Project site is not located within two miles of a public airport or a private airstrip. The Johnson Brothers Airport is approximately 5.75 miles east of the Project site and the Naval Air Facility El Centro is approximately 8 miles to the north. Thus, no impact is identified for these issue areas.

f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area? ☐ ☐ ☐ ☒

No Impact. See item e), above.

g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan? ☐ ☐ ☐ ☒

No Impact. As identified in the Seismic and Public Safety Element of the County of Imperial General Plan (County of Imperial, n.d.), the "Imperial County Emergency Plan" addressed the County's planned response to extraordinary emergency situations associated with natural disasters, technological incidents, and nuclear defense operations. The proposed circulation plan for the Project site will be required to provide emergency access points and safe vehicular travel. In addition, local building codes would be followed to minimize flood, seismic, and fire hazard. Thus, the proposed Project would not impair the implementation of, or physically interfere with, any adopted emergency response plans or emergency evacuation plans. No impact is identified for this issue area.

h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands? ☐ ☐ ☐ ☒

No Impact. The Project site is not characterized as an urban/wildland interface. According to the Imperial County Natural Hazard Disclosure (Fire) Map prepared by the California Department of Forestry and Fire Protection (CDF 2000), the Project site does not fall into an area characterized as either: (1) a wildland area that may contain substantial forest fire risk and hazard; or (2) a very high fire hazard severity zone. Thus, the Project site would not expose people or structures to significant risk of loss injury or death involving wildland fire. No impact is identified for this issue area.

IX. *HYDROLOGY AND WATER QUALITY* *Would the project:*

a) Violate any water quality standards or waste discharge requirements?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. Water quality violations have the potential to occur during construction and operation of the Project. Prior to construction, the Project would file a Notice of Intent with the State Water Resources Control Board (SWRCB) to comply with the general permit for construction activities. In addition, the Project would be required to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP) consistent with the requirements of the SWRCB. Once operational, panel washing activities are not anticipated to generate runoff or contain pollutants (e.g. grease, heavy metals) other than dust. Any runoff from panel washing would evaporate or percolate through the ground, as a majority of the surfaces in the solar field will remain pervious. Thus, violation of water quality standards is considered a potentially significant unless mitigation is incorporated. This issue will be discussed in the EIR.

b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐

Less than Significant Impact. The Project will require water during both construction (primarily dust control) and operation (panel washing). The Project plans to secure water rights from the IID under the IID's Interim Water Supply Policy for Non- Agricultural Projects. In the event this isn't feasible, the Project will truck water to the site for operation purposes. The water used during operation will be used for domestic use and fire protection. Water is typically procured from IID via a long term IWSP Water Supply Agreement with a service pipe connection to an adjacent IID raw water canal. The Project may also use water to wash the solar modules should it be determined to be beneficial to the Project. The Project anticipates a requirement of approximately 60 acre-feet per year during plant operation. Water for fire protection will be stored in an on-site 10,000-gallon tank onsite. The Project may also use an additional 10,000-gallon storage tank to store treated water for sanitary uses (Drew Solar 2018). Potable water will be trucked to the site.

A Water Supply Assessment (WSA) was prepared for the Drew Solar Project (Fuscoe 2018b) in accordance with SB 610 (Part 2.10 Div. 6 of the California Water Code) evaluating the amount of water supplies. The findings of the WSA with regard to water availability for the proposed Project were found to be less than significant and will be discussed in the EIR.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation is Incorporated. Although the Project site is relatively flat, the large amount of disturbed area presents potential for erosion/sediment issues. During construction, sedimentation and erosion can occur as a result of tracking from earthmoving equipment, erosion and subsequent runoff of soil and improperly designed stockpiles. Proper erosion and sediment control Best Management Practices (BMPs) are critical in preventing discharge to surface waters and drains. The Project would employ proper Stormwater Pollution Prevention Plan practices to minimize any discharges in order to meet the Best Available Technology/Best Conventional Technology (BAT/BCT) standard set forth in the Construction General Permit (CGP) (Fuscoe 2018a). Thus, potential for substantial erosion or siltation on or off-site would be potentially significant unless mitigation is incorporated.

d) Substantially alter the existing drainage patterns of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☒	☐

Less than Significant Impact. The existing drainage characteristics of the site will remain substantially the same following implementation of the Project. The majority of the site will sheet flow through the pervious native soils toward the shallow ponding areas (Fuscoe 2018a). The Project will be designed to meet County of Imperial storage requirements for storm water runoff which will result in an impoundment of runoff in excess of the anticipated volume generated by the 100-year storm event. The Project would result in less than significant impacts with regard to flooding on- or off-site but will be discussed in the EIR.

e) Create or contribute runoff water, which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☒	☐

Less than Significant Impact. The proposed Project would not generate substantial amounts of runoff as described in item b), above. Water used for panel washing will continue to percolate through the ground as a majority of the surfaces on the Project site will remain pervious. Thus, the proposed Project will not substantially alter the existing drainage pattern of the site, substantially increase the rate of runoff, or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems. Therefore, a less than significant impact is identified for these issue areas.

f) Otherwise substantially degrade water quality?	☐	☐	☒	☐

Less than Significant Impact. The Project is not anticipated to degrade water quality based on the required stormwater permit as well as Best Management Practices (BMPs). Refer to the discussion under item "a" above. This issue is considered less than significant.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
g) Place housing within a 100-year flood hazard area as mapped on a Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒

No Impact. The Project does not include a residential component. Therefore, no homes would be constructed within a 100-year flood zone. No impact would occur.

h) Place within a 100-year flood hazard area structures which would impede or redirect the flood flows?	☐	☐	☒	☐

Less than Significant Impact. The Project site is within Federal Emergency Management Agency Flood Hazard Zone X. Thus, the Project site is not subject to inundation the 100-year storm event and none of the structures placed on the Project site would impeded or redirect flows within a 100-year flood hazard zone. This issue is considered less than significant but will be acknowledged in the EIR.

i) Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☒	☐

Less than Significant Impact. The proposed Project does not propose development within the banks of the New River or Greeson Drain which are the limits of mapped flood Zone A. The Project includes detention in shallow areas of ponding under arrays (approximately 1-foot deep) or in designated detention basins (2 to 4 feet deep) (Fuscoe 2018a). The Project substation, permanent Operations and Maintenance Building and construction trailers will not be located in proposed areas of ponding or detention.

There are no dams immediately upstream of the Project. Therefore, dam breakage is not a risk concerning the Project site. Therefore, a less than significant impact is identified with regard to flooding. However, this issue will be acknowledged in the EIR.

j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒

No Impact. The Project site is approximately 28 miles from the Salton Sea which is the nearest large water body. Due to the distance, the Salton Sea does not pose a particularly significant danger of inundation from seiche or tsunami as related to the proposed Project site (Fuscoe 2018a).

The Project site is approximately four miles from Mount Signal, the nearest significantly sloped landscape. The Project site is not in any danger of inundation by mudflow. Thus, no impact is identified for these issues.

X. LAND USE AND PLANNING *Would the project:*

a) Physically divide an established community?	☐	☐	☐	☒

No Impact. The Drew Solar Project is located in Imperial County, California, approximately 6.5 miles southwest of the city of El Centro and 7.5 miles directly west of Calexico. The project represents an expansion of existing solar uses currently developed in the area. Thus, no impact is identified with regard to dividing an established community.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (include, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☒	☐	☐	☐

Potentially Significant Impact. The proposed Project site is currently zoned A-2 (General Agricultural Zone), A-2-R (General Agricultural Zone/Rural Zone), and A-3 (Heavy Agricultural). The Project will require: an Amendment to Imperial County's General Plan Land Use Element and Renewable Energy and Transmission Element; a Variance for power pole structures that are over 120 feet in height; A Zone Change to add the RE Overlay Zone to the project area and conditionally rezone Phase 5 to M-2 (Medium Industrial); five CUPs to develop solar energy generating systems including potential energy storage on lands zoned A-2, A-2-R, and A-3 per Title 9, Division 5: Zoning Areas Established, Chapter 8, Section 90508.02 and 90509.02; and one CUP to develop battery storage on lands currently zoned A-2 and A-3 proposed to be conditionally rezoned to M-2 (Medium Industrial), per Title 9, Division 5: Zoning Areas Established, Chapter 8, Section 90508.02 (A-2); and Chapter 9, Section 90509.02 (A-3).

Both the GPA and the Zone Change would be to the Renewable Energy Overlay Zone (Drew Solar 2018). Impacts associated with the allowed CUPs, GPA, Zone Change (RE Overlay and conditional zoning to M-2 on Phase 5), Initial Study and Variance would be addressed. Specifically, changing the zone within the allowed CUP for battery storage could present a conflict as it is considered "spot zoning". Therefore, conflicts with applicable land use plan, policy or regulation is considered a potentially significant impact.

c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

No Impact. Imperial County is not within the jurisdiction of any adopted habitat conservation plan (HCP) or natural community conservation plan (NCCP), or other approved local, regional or state habitat conservation plan. Therefore, no impact to an HCP or NCCP would occur and this issue will not be examined in the EIR.

XI. *MINERAL RESOURCES* *Would the project:*

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒

No Impact. The Project site has been used for agriculture since the 1930's. According to the Conservation and Open Space Element of the County of Imperial General Plan (County of Imperial 2008), no known mineral resources occur within the Project parcels nor does are there any mapped mineral resources within the boundary of the site. Thus, no impact is identified with regard to mineral resources.

b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

No Impact. Refer to item a), above.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

XII. ***NOISE*** *Would the project result in:*

a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies? ☐ ☐ ☒ ☐

Less than Significant Impact. Short-term noise levels would increase on the Project site, surrounding roadways and at nearby single-family residences during construction. The Noise Analysis prepared for the Drew Solar Project (RECON 2018d) determined that project construction noise levels would comply with the 75 dB(A) Leq(8h) noise level limit established by Imperial County General Plan Noise Element (County of Imperial 2015). In addition, operational noise levels would not exceed applicable property line noise level limits prescribed in the Noise Element. Ambient noise level increases attributable to project-generated traffic are anticipated to be less than 3 dB(A) along all roadways. Although noise level increases resulting from Project construction and operation would result in a less than significant impact with regard to the Imperial County General Plan Noise Element, these issues will be addressed in the EIR.

b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels? ☐ ☐ ☒ ☐

Less than Significant Impact. Project construction would include the use of vibration-generating construction equipment such as large bulldozers, loaded trucks, jackhammers, and mast impact pile drivers. Vibration levels at the nearest structure would be anticipated to reach up to 0.073 PPV the nearest structure (RECON 2018d). As vibration levels would not exceed the vibration level threshold of 0.2 PPV, groundborne noise and vibration impacts would be less than significant. However, this issue will be discussed in the EIR.

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project? ☐ ☐ ☒ ☐

Less than Significant Impact. Long-term operational noise levels associated with the operation of the Project would include noise generated by inverters, transformers, solar panel tracker motors, substation(s), and the gen-tie. Noise associated with Project operation would attenuate to less than 50 dB(A) Leq within the boundary of the Project site. On-site noise would attenuate to 44 dB(A) Leq at the nearest single-family residence immediately (west of the intersection of Drew Road and SR-98) (RECON 2108d). While ambient noise levels in the Project vicinity would increase above levels without the Project, noise levels would not exceed applicable property line noise level limits from limits prescribed in the Imperial County General Plan Noise Element (County of Imperial 2015). This is considered a less than significant impact. However, the change in ambient noise levels will be discussed in the EIR.

d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project? ☐ ☐ ☒ ☐

Less than Significant Impact. Short-term construction noise levels were analyzed as part of the Noise Analysis prepared for the Drew Solar Project. As noted in item "a", above, Project construction noise levels

would comply with the 75 dB(A) Leq(8h) noise level limit established by Imperial County General Plan Noise Element (County of Imperial 2015). This is considered a less than significant impact. However, temporary or periodic increase in ambient noise levels will be discussed in the EIR.

e) For a project located within an airport land use plan or where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? ☐ ☐ ☐ ☒

No Impact. The Project site is not located within two miles of a public airport or a private airstrip. Thus, the Project site would not be exposed to excessive aircraft noise. As a solar facility, the Project is industrial in nature and therefore is not a noise sensitive land use. No impacts are identified with regard to airport noise and this issue will not be discussed in the EIR.

f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels? ☐ ☐ ☐ ☒

No Impact. Refer to item e), above.

XIII. *POPULATION AND HOUSING* *Would the project:*

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and business) or indirectly (for example, through extension of roads or other infrastructure)? ☐ ☐ ☐ ☒

No Impact. The Project does not propose the development of new housing on the Project site nor does it propose construction or extension of new roads (aside from internal access roads). The Project, by its nature as solar facility, would not induce growth. No impact would occur for this issue.

b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere? ☐ ☐ ☐ ☒

No Impact. The proposed Project site is currently agricultural land with no residential structures within its boundaries. As a result, development of the proposed solar project would not displace substantial numbers of existing housing or people requiring construction of replacement housing elsewhere. No impact would occur for these issues.

c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere? ☐ ☐ ☐ ☒

No Impact. Refer to item b), above

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

XIV. PUBLIC SERVICES

a) 1) Fire Protection? ☐ ☒ ☐ ☐

Potentially Significant Unless Mitigation Incorporated. The Project site is within the jurisdiction of the Imperial County Fire Department. The PV modules and ancillary equipment are constructed of fire-resistant material. Additionally, routine weed abatement and landscape maintenance will occur and the on-site buildings will have fire alarms. Water for fire protection will be stored in an on-site 10,000-gallon tank. As such, the Project represents a negligible increase in fire potential. A Fire Management Plan will be prepared in accordance with Fire Department requirements for access. Access to the Project site as well as nearby properties will not be hindered or restricted by the Project (Drew Solar 2018). Nevertheless, the Fire Department will be consulted and impacts to fire protection are anticipated to potentially significant unless mitigation is incorporated.

2) Police Protection? ☐ ☐ ☒ ☐

Less than Significant Impact. The Project site is within the jurisdiction of the Imperial County Sheriff's Department. The Project includes a number of security features including a chain-link fence up to 7 feet in height with 3-strand barb wire placed at the top, extending to a total of up to 8 feet (Drew Solar 2018). The fence will be monitored periodically to detect any intrusion into the property. Security lighting may also be installed and signs will be posted warning against trespassing/intrusion. Access to the site will be controlled, and gates will be installed at the roads entering the property. Operations personnel will also perform security functions when present. Thus, impacts to police protection are anticipated to be less than significant. However, the Sheriff's Department will be consulted and this issue will be discussed in the EIR.

3) Schools? ☐ ☐ ☐ ☒

No Impact. The proposed Project would not result in a substantial increase in population because it neither includes a residential component nor would it generate the need for new housing to accommodate workforce population. Based on the nature of the project as a solar facility, no increase in schools, parks, or other public facilities are anticipated. As such, the proposed Project would not have an adverse physical effect on the environment resulting from construction of a new school, park or other public facility. Therefore, no impact is identified for this issue area.

4) Parks? ☐ ☐ ☐ ☒

No Impact. Refer to item "a3" above.

5) Other Public Facilities? ☐ ☐ ☐ ☒

No Impact. Refer to item "a3: above.

XV. RECREATION

a) Would the project increase the use of the existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated? ☐ ☐ ☐ ☒

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

No Impact. The proposed Project is a solar facility and would not create a demand for recreation or parks in the County. Thus, no impact is identified for these issues and recreation will not be discussed in the EIR.

b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse effect on the environment? ☐ ☐ ☐ ☒

No Impact. The proposed Project is a solar facility and does not include recreational facilities or require the construction or expansion of recreational facilities. Therefore, no impact to recreational facilities would occur and this issue will not be discussed in the EIR.

XVI. ***TRANSPORTATION / TRAFFIC*** *Would the project:*

a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit? ☐ ☐ ☒ ☐

Less than Significant Impact. The construction of the proposed Project would result in a temporary increase in traffic along area roadways including sections of Brockman Road, Forrester Road, Kubler Road, McCabe Road, and Pulliam Road. The segment of SR 98 between Drew Road and Clark Road as well as Interstate 8 between Drew Road and Imperial Avenue would also be used as construction travel routes. Once operational, the proposed Project would require very few maintenance worker trips. Additional workers would occasionally be required to access the site to clean the solar panels or to perform specific maintenance. Deliveries would occur irregularly. The Traffic Impact Study prepared for the Project examined project traffic under ten scenarios (LOS 2018). In each scenario, LOS was determined to be LOS C or better with no significant direct Project impacts. Therefore, the proposed Project is not anticipated to conflict with an applicable plan establishing measures of effectiveness for the performance of the circulation system. This impact is considered less than significant. However, traffic will be discussed in the EIR.

b) Conflict with an applicable congestion management program, including but not limited to level of service standard and travel demand measures, or other standards established by the county congestions/management agency for designated roads or highways? ☐ ☐ ☒ ☐

Less than Significant Impact. Refer to item a) above.

c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks? ☐ ☐ ☐ ☒

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

No Impact. The proposed Project would not result in changes to existing air traffic patterns through an increase in traffic levels or change in location. Thus, no impact is identified for this issue area.

d) Substantially increases hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project proposes three access points off of SR 98 along the southern boundary of the site as well as seven access points off of County Road. These include two driveways of off Drew Road on the west and one off of Drew Road on the south; two driveways off of Kubler Road on the north; and two driveways off of Pulliam road on the east. Traffic volumes in the area are currently quite low, however vehicles often travel at a high rate of speed along these roads and SR 98. Access points will be examined with regard to increasing hazards due to the design and location of the proposed driveways. The Project may also result in damage to area roadways caused by heavy trucks transporting materials and equipment to the site. Cracks in the asphalt as well as potholes can result from high volumes of heavy trucks which can create a hazard for vehicles traveling on these roadways. Therefore, increased hazards due to a design feature as well as incompatible uses are considered a potentially significant impact unless mitigation is incorporated.

e) Result in inadequate emergency access? ☐ ☐ ☒ ☐

Less than Significant Impact. The Project currently proposes seven access points. Prior to approval, the final site plan must be reviewed by the Imperial County Fire Department and the Imperial County Sheriff's Department and meet all County design requirements for emergency access. The Project is not anticipated to hinder the ability of fire or law enforcement to access nearby properties. Thus, a less than significant impact is identified for this issue area. Nevertheless, the adequacy of emergency access will be discussed in the EIR.

f) Conflicts with adopted policies, plans, programs, regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities? ☐ ☐ ☐ ☒

No Impact. The proposed Project is located in a rural, sparsely populated portion of the County void of public transit, bike lanes and pedestrian facilities. Thus, development of a solar facility would not conflict with any adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities. Thus, no impact is identified for this issue area.

XVII. *TRIBAL CULTURAL RESOURCES*

a) Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code Section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place or object with cultural value to a California Native American tribe, and that is: ☐ ☒ ☐ ☐

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

a. **Potentially Significant Impact Unless Mitigation Incorporated.** In accordance with the requirements of AB 52, tribes who have submitted requests to consult will be contacted as part of the environmental review process for this project. Tribal cultural resources impacts are considered potentially significant unless mitigation is incorporated.

1) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as define in Public Resources Code Section 5020.1(k), or	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. Refer to item "a", above.

2) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth is subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American Tribe.	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. Refer to item "a", above.

XVIII. *UTILITIES AND SERVICE SYSTEMS* *Would the project:*

a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. The Project will collect wastewater from sanitary facilities such as sinks and toilets in the O&M building(s). This waste stream will be sent to an onsite sanitary waste septic system and leach field to be installed in compliance with standards established by Imperial County Environmental Health Services (Drew Solar 2018). Alternatively, the Project may be designed to direct these waste streams to an underground tank for storage until it is pumped out, on a periodic or as-needed basis, and transported for disposal at a licensed waste treatment facility. During periodic major maintenance events, portable restroom facilities may be provided to accommodate additional maintenance workers. Nevertheless, impacts with regard to development of an on-site septic system are considered potentially significant unless mitigation is incorporated. Impacts associated with development of the sanitary system will be discussed in the EIR.

b) Require or result in the construction of new water or water treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. The Applicant plans to secure water rights from the IID under the IID's Interim Water Supply Policy for Non-Agricultural Projects. In the event this isn't feasible, the Project will truck water to the site for operation purposes. The water used during operation will be used for domestic use and fire protection. Water is typically procured from IID via a long term IWSP Water Supply Agreement with a service pipe connection to an adjacent IID raw water canal. The Project may also

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

use water to wash the solar modules should it be determined to be beneficial to the Project. An onsite water treatment facility may be constructed. The impacts of providing on-site water treatment are considered potentially significant unless mitigation is incorporated and will be discussed in the EIR.

c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? ☐ ☒ ☐ ☐

Potentially Significant Impact Unless Mitigation Incorporated. The onsite drainage patterns will be maintained to the greatest extent possible. However, it may be necessary to remove, relocate and/or fill in portions of the existing drainage ditches or delivery canals to accommodate the final panel layout for the Project. The final engineering design for these facilities will be reviewed by IID and the County to be sure that the purpose for the facilities (if still needed) will still be met. Therefore, impacts associated with construction of new storm water drainage facilities are considered potentially significant unless mitigation is incorporated.

d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed? ☐ ☐ ☒ ☐

Less than Significant Impact. The proposed Project is anticipated to result in an increase in water demand/use during construction and operation. An estimated total of 1,200-acre-feet of water will be used for the Project dust control and other construction activities during the construction phase of the Project. During operation, the Project will use water only for periodic washing of the solar panels. The Project anticipates a requirement of approximately 60 acre-feet per year during plant operation (Drew Solar 2018). A Water Supply Assessment has been prepared for the Drew Solar Project indicating that the IID has adequate supply available to meet Project demands (Fuscoe 2018b). The findings of the WSA and existing usage will be discussed in the EIR. Impacts to water supply are anticipated to be less than significant.

e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments? ☐ ☐ ☐ ☒

No Impact. The Project will generate wastewater from sanitary facilities such as sinks and toilets in the O&M building(s). This waste stream will be sent to an onsite sanitary waste septic system and leach field to be installed in compliance with standards established by Imperial County Environmental Health Services. Thus, no impact to a wastewater provider would occur.

f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs? ☐ ☐ ☒ ☐

Less than Significant Impact. Some solid waste would be generated during demolition and construction of the proposed Project. Such materials would be hauled to an appropriate disposal facility. During operations of the proposed Project, waste generation will be minor. Solid wastes will be disposed of using a locally-

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

licensed waste hauling service. Thus, a less than significant impact is identified for this issue.

g)	Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☒	☐

Less than Significant Impact. Refer to item "f", above.

Note: Authority cited: Sections 21083 and 21083.05, Public Resources Code. Reference: Section 65088.4, Gov. Code; Sections 21080(c), 21080.1, 21080.3, 21083, 21083.05, 21083.3, 21093, 21094, 21095, and 21151, Public Resources Code; Sundstrom v. County of Mendocino,(1988) 202 Cal.App.3d 296; Leonoff v. Monterey Board of Supervisors, (1990) 222 Cal.App.3d 1337; Eureka Citizens for Responsible Govt. v. City of Eureka (2007) 147 Cal.App.4th 357; Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th at 1109; San Franciscans Upholding the Downtown Plan v. City and County of San Francisco (2002) 102 Cal.App.4th 656.
Revised 2009- CEQA, Revised 2011- ICPDS, Revised 2016 – ICPDS, Revised 2017 - ICPDS

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

SECTION 3 - III. MANDATORY FINDINGS OF SIGNIFICANCE

The following are Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. Implementation of the proposed Project has the potential to result in potential to degrade the quality of the environment with regard to aesthetics, agricultural and forest resources, air quality, biological resources, cultural resources, geology and soils, hydrology and water quality, land use, transportation/traffic, public services, Tribal Cultural Resources and utilities and service systems. These issues will be further evaluated in the EIR.

b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐

Potentially Significant Impact. The proposed Project has the potential to result in a cumulatively considerable net increase of one or more criteria pollutants for which the Project region is in non-attainment under applicable federal and state ambient air quality standards. Therefore, a potentially significant cumulative impact may occur. An Air Quality Analysis has been prepared for the proposed Project and the conclusions will be discussed in the EIR.

c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐

Potentially Significant Impact Unless Mitigation Incorporated. The proposed Project has the potential to result in significant environmental effects which could directly or indirectly cause adverse effects on human beings. As demonstrated in this Initial Study, the proposed Project has the potential to result in potentially significant impacts unless mitigation is incorporated to agricultural and forest resources, air quality, biological resources, cultural resources, geology and soils, hydrology and water quality, land use, public services, transportation/traffic, Tribal Cultural Resources and utilities and service systems. These impact areas could result in direct or indirect adverse effects on human beings. Thus, these issues will be discussed in the EIR.

IV. PERSONS AND ORGANIZATIONS CONSULTED

This section identifies those persons who prepared or contributed to preparation of this document. This section is prepared in accordance with Section 15129 of the CEQA Guidelines.

A. COUNTY OF IMPERIAL

- Jim Minnick, Director of Planning & Development Services
- Michael Abraham, AICP, Assistant Director of Planning & Development Services
- Diana Robinson, Planner II
- Patricia Valenzuela, Project Planner
- Imperial County Air Pollution Control District
- Department of Public Works
- Fire Department
- Ag Commissioner
- Environmental Health Services
- Sheriff's Office

B. OTHER AGENCIES/ORGANIZATIONS

- **CDFW**
- **USFWS**
- **Cal Trans**

(Written or oral comments received on the checklist prior to circulation)

V. REFERENCES

County of Imperial 2015. County of Imperial General Plan. Noise Element. October 6, 2015. Available at Website url: http://www.icpds.com/?pid=835. Referenced in text as (Imperial County 2015).

2008. "Conservation and Open Space Element." January 29, 2008. (Imperial County 2008).

No date. Seismic and Public Safety Element. Referenced in text as (Imperial County n.d.).

California Department of Forestry and Fire Protection, 2000. Website http://www.fire.ca.gov/ab6/nhd13.pdf accessed March 15, 2011. Referenced in text as (CDF 2000).

Drew Solar LLC. 2018. "Project Description Drew Solar." January 8, 2018. Referenced in text as (Drew Solar 2018).

DUDEK 2018a. "Biological Resources Report for the Drew Solar Project Imperial County, California." April 2018. Referenced in text as (DUDEK 2018a).

2018b. "Cultural Resources Inventory Report for the Drew Solar Project, Imperial County, California." February 2018. Referenced in text as (DUDEK 2018b).

2018c. "Historic Resource Evaluation for the Drew Solar Project, Imperial County, California." January 9, 2018. Referenced in text as (DUDEK 2018c).

Fuscoe Engineering, Inc. 2018a. ''Conceptual Drainage Study and Storm Water Quality Analysis - Drew Solar". February 8, 2018. Referenced in text as (Fuscoe 2018a).

2018b. "Drew Solar Water Supply Assessment." February 2018. Referenced in text as (Fuscoe 2018b).

Landmark Consultants, Inc. 2018. "Phase I Environmental Site Assessment Report, Drew Solar Project." *January 18, 2018.* (LandMark 2018).

2017. "Preliminary Geotechnical and Geohazards Report, Drew Solar Site." November 14, 2017. Referenced in text as (LandMark 2017).

LOS Engineering. 2108. "Draft Traffic Impact Analysis, Drew Solar Farm, County of Imperial (SR-98 at Drew Road)." February 9, 2018. Referenced in text as (LOS 2018).

POWER Engineers. 2018. "Drew Solar Project Glare Study." February 8, 2018. Referenced in text as (POWER 2018).

RECON Environmental, Inc. 2018a. "Air Quality and Greenhouse Gas Analysis for the Drew Solar Project, Imperial County, California," February 14, 2018. Referenced in text as (RECON 2018a)

2018b. "Results of Burrowing Owl Survey Conducted for the Drew Solar Project, City of Calexico, Imperial County, California." April 10, 2018. Referenced in text as (RECON 2018b).

2018c. "Land Evaluation and Site Assessment Analysis for the Drew Solar Project, Imperial County, California". February 12, 2018. Referenced in text as (RECON 2018c).

2018d. "Noise Analysis for the Drew Solar Project, Imperial County, California.' February 13, 2018. Referenced in text as (RECON 2018d).

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NOP COMMENT LETTERS

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STATE OF CALIFORNIA

GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

Notice of Preparation

May 17, 2018

To: Reviewing Agencies

Re: Drew Solar Project
SCH# 2018051036

Attached for your review and comment is the Notice of Preparation (NOP) for the Drew Solar Project draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

Diana Robinson
Imperial County
801 Main Street
El Centro, CA 92243

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Attachments
cc: Lead Agency

1400 10th Street P.O. Box 3044 Sacramento, California 95812-3044
1-916-322-2318 FAX 1-916-558-3184 www.opr.ca.gov

Document Details Report
State Clearinghouse Data Base

SCH# 2018051036
Project Title Drew Solar Project
Lead Agency Imperial County

Type NOP Notice of Preparation

Description The Drew Solar Project is a proposed approx 100 mw solar pv energy-generating facility including energy storage on six parcels totaling 762.8 net acres. The project includes a GPA, height variance, zone change, development agreement and six CUP. The project includes construction of generation interconnection (gen-tie) transmission lines extending south across Drew Rd and SR 98 into the existing Drew Switchyard. The project may be constructed at one time over approx 18 months, or it may be built out over an approx 10-year period.

Lead Agency Contact

Name Diana Robinson
Agency Imperial County
Phone 442-265-1736 x 1751 **Fax**
email
Address 801 Main Street
City El Centro **State** CA **Zip** 92243

Project Location

County Imperial
City El Centro
Region
Cross Streets Pulliam Rd and SR 98
Lat / Long 32° 41' 13" N / 115° 40' 8" W
Parcel No. 052-170-039, 067, 031, 032, 056, 037
Township 17S **Range** 13E **Section** 7, 8 **Base** SBBM

Proximity to:

Highways SR 98
Airports
Railways
Waterways Westside Main Canal
Schools
Land Use PLU/GP: Ag; Z: A-2, A-2-R, A-3

Project Issues Aesthetic/Visual; Agricultural Land; Air Quality; Archaeologic-Historic; Biological Resources; Flood Plain/Flooding; Geologic/Seismic; Noise; Public Services; Septic System; Soil Erosion/Compaction/Grading; Toxic/Hazardous; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wetland/Riparian; Landuse; Cumulative Effects; Other Issues

Reviewing Agencies Resources Agency; Department of Conservation; Department of Parks and Recreation; Department of Water Resources; Office of Emergency Services, California; Department of Fish and Wildlife, Region 6; Native American Heritage Commission; Public Utilities Commission; California Energy Commission; State Lands Commission; California Highway Patrol; Air Resources Board, Major Industrial Projects; Caltrans, District 11; State Water Resources Control Board, Division of Drinking Water; State Water Resources Control Board, Division of Drinking Water, District 14; Regional Water Quality Control Board, Region 7; Colorado River Board

Date Received 05/17/2018 **Start of Review** 05/17/2018 **End of Review** 06/15/2018

Note: Blanks in data fields result from insufficient information provided by lead agency.

Print Form

Appendix C

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH# 2018051036

Project Title: Drew Solar Project

Lead Agency: Imperial County | Contact Person: Diana Robinson
Mailing Address: 801 Main Street | Phone: (442)265-1736 Extension 1751
City: El Centro | Zip: 92243 | County: Imperial

Project Location: County: Imperial | City/Nearest Community: El Centro
Cross Streets: Pulliam Road and State Route 98 | Zip Code: 92243
Longitude/Latitude (degrees, minutes and seconds): 32 ° 41 ′ 13 ″ N / 115 ° 40 ′ 8 ″ W | Total Acres: 844.3 gross 762.8 net
Assessor's Parcel No.: 052-170-039,067,031,032,056,037 | Section: 7 & 8 | Twp.: 17S | Range: 13E | Base: SBBM
Within 2 Miles: State Hwy #: SR 98 | Waterways: Westside Main Canal
Airports: None | Railways: None | Schools: None

Document Type:

CEQA: ☒ NOP ☐ Draft EIR | NEPA: ☐ NOI | Other: ☐ Joint Document
☐ Early Cons ☐ Supplement/Subsequent EIR ☐ EA ☐ Final Document
☐ Neg Dec (Prior SCH No.) ☐ Draft EIS ☐ Other:
☐ Mit Neg Dec Other: ☐ FONSI

Local Action Type:

Governor's Office of Planning & Research
MAY 17 2018
STATE CLEARINGHOUSE

☐ General Plan Update ☐ Specific Plan ☒ Rezone ☐ Annexation
☒ General Plan Amendment ☐ Master Plan ☐ Prezone ☐ Redevelopment
☐ General Plan Element ☐ Planned Unit Development ☒ Use Permit ☐ Coastal Permit
☐ Community Plan ☐ Site Plan ☐ Land Division (Subdivision, etc.) ☒ Other: Height Variance

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☒ Industrial: Sq.ft. ____ Acres 762.8 Employees 6
☐ Educational:
☐ Recreational:
☐ Water Facilities: Type ____ MGD ____
☐ Transportation: Type
☐ Mining: Mineral
☒ Power: Type Solar MW 100
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type
☐ Other:

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☐ Fiscal ☐ Recreation/Parks ☒ Vegetation
☒ Agricultural Land ☒ Flood Plain/Flooding ☐ Schools/Universities ☒ Water Quality
☒ Air Quality ☐ Forest Land/Fire Hazard ☒ Septic Systems ☒ Water Supply/Groundwater
☒ Archeological/Historical ☒ Geologic/Seismic ☐ Sewer Capacity ☒ Wetland/Riparian
☒ Biological Resources ☐ Minerals ☒ Soil Erosion/Compaction/Grading ☐ Growth Inducement
☐ Coastal Zone ☒ Noise ☐ Solid Waste ☒ Land Use
☐ Drainage/Absorption ☐ Population/Housing Balance ☒ Toxic/Hazardous ☒ Cumulative Effects
☐ Economic/Jobs ☒ Public Services/Facilities ☒ Traffic/Circulation ☒ Other: Cultural Resources

Present Land Use/Zoning/General Plan Designation:

Present Land Use/General Plan: Agriculture; Zoning: A-2 (General Agricultural)A-2-R (General Agricultural/Rural)A-3(Heavy Ag)

Project Description: *(please use a separate page if necessary)*

The Drew Solar Project is a proposed approximately 100 megawatt solar photovoltaic energy-generating facility including energy storage on six parcels totaling 762.8 net acres. The Project includes a General Plan Amendment, height Variance, Zone Change, Development Agreement and six Conditional Use Permits. The Project includes construction of generation interconnection (gen-tie) transmission lines extending south across Drew Road and State Route 98 into the existing Drew Switchyard. The project may be constructed at one time over approximately 18 months, or it may be built out over an approximately 10-year period.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

NOP Distribution List

County: Imperial **SCH#** 2018051036

Resources Agency

- [■] **Resources Agency** Nadell Gayou
- [ ] **Dept. of Boating & Waterways** Denise Peterson
- [ ] **California Coastal Commission** Allyson Hitt
- [ ] **Colorado River Board** Lisa Johansen
- [▨] **Dept. of Conservation** Crina Chan
- [ ] **Cal Fire** Dan Foster
- [ ] **Central Valley Flood Protection Board** James Herota
- [▨] **Office of Historic Preservation** Ron Parsons
- [■] **Dept of Parks & Recreation** Environmental Stewardship Section
- [ ] **S.F. Bay Conservation & Dev't. Comm.** Steve Goldbeck
- [▨] **Dept. of Water Resources** Resources Agency Nadell Gayou

Fish and Game

- [ ] **Depart. of Fish & Wildlife** Scott Flint Environmental Services Division
- [ ] **Fish & Wildlife Region 1** Curt Babcock
- [ ] **Fish & Wildlife Region 1E** Laurie Harnsberger
- [ ] **Fish & Wildlife Region 2** Jeff Drongesen
- [ ] **Fish & Wildlife Region 3** Craig Weightman
- [ ] **Fish & Wildlife Region 4** Julie Vance
- [ ] **Fish & Wildlife Region 5** Leslie Newton-Reed Habitat Conservation Program
- [■] **Fish & Wildlife Region 6** Tiffany Ellis Habitat Conservation Program
- [ ] **Fish & Wildlife Region 6 I/M** Heidi Calvert Inyo/Mono, Habitat Conservation Program
- [ ] **Dept. of Fish & Wildlife M** William Paznokas Marine Region

Other Departments

- [ ] **California Department of Education** Lesley Taylor
- [▨] **OES (Office of Emergency Services)** Monique Wilber
- [ ] **Food & Agriculture** Sandra Schubert Dept. of Food and Agriculture
- [ ] **Dept. of General Services** Cathy Buck Environmental Services Section
- [ ] **Housing & Comm. Dev.** CEQA Coordinator Housing Policy Division

Independent Commissions,Boards

- [ ] **Delta Protection Commission** Erik Vink
- [ ] **Delta Stewardship Council** Anthony Navasero
- [▨] **California Energy Commission** Eric Knight
- [■] **Native American Heritage Comm.** Debbie Treadway
- [▨] **Public Utilities Commission** Supervisor
- [ ] **Santa Monica Bay Restoration** Guangyu Wang
- [▨] **State Lands Commission** Jennifer Deleong
- [ ] **Tahoe Regional Planning Agency (TRPA)** Cherry Jacques

Cal State Transportation Agency CalSTA

- [ ] **Caltrans - Division of Aeronautics** Philip Crimmins
- [ ] **Caltrans – Planning HQ LD-IGR** Christian Bushong
- [▨] **California Highway Patrol** Suzann Ikeuchi Office of Special Projects

Dept. of Transportation

- [ ] **Caltrans, District 1** Rex Jackman
- [ ] **Caltrans, District 2** Marcelino Gonzalez
- [ ] **Caltrans, District 3** Susan Zanchi - North
- [ ] **Caltrans, District 4** Patricia Maurice
- [ ] **Caltrans, District 5** Larry Newland
- [ ] **Caltrans, District 6** Michael Navarro
- [ ] **Caltrans, District 7** Dianna Watson
- [ ] **Caltrans, District 8** Mark Roberts
- [ ] **Caltrans, District 9** Gayle Rosander
- [ ] **Caltrans, District 10** Tom Dumas
- [■] **Caltrans, District 11** Jacob Armstrong
- [ ] **Caltrans, District 12** Maureen El Harake

Cal EPA

Air Resources Board

- [ ] **Airport & Freight** Jack Wursten
- [ ] **Transportation Projects** Nesamani Kalandiyur
- [▨] **Industrial/Energy Projects** Mike Tollstrup
- [ ] **California Department of Resources, Recycling & Recovery** Sue O'Leary
- [ ] **State Water Resources Control Board** Regional Programs Unit Division of Financial Assistance
- [▨] **State Water Resources Control Board** Cindy Forbes – Asst Deputy Division of Drinking Water
- [▨] **State Water Resources Control Board Div. Drinking Water #** 14
- [ ] **State Water Resources Control Board** Student Intern, 401 Water Quality Certification Unit Division of Water Quality
- [ ] **State Water Resouces Control Board** Phil Crader Division of Water Rights
- [ ] **Dept. of Toxic Substances Control Reg. #**_____ CEQA Tracking Center
- [ ] **Department of Pesticide Regulation** CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

- [ ] **RWQCB 1** Cathleen Hudson North Coast Region (1)
- [ ] **RWQCB 2** Environmental Document Coordinator San Francisco Bay Region (2)
- [ ] **RWQCB 3** Central Coast Region (3)
- [ ] **RWQCB 4** Teresa Rodgers Los Angeles Region (4)
- [ ] **RWQCB 5S** Central Valley Region (5)
  - [ ] **RWQCB 5F** Central Valley Region (5) Fresno Branch Office
  - [ ] **RWQCB 5R** Central Valley Region (5) Redding Branch Office
- [ ] **RWQCB 6** Lahontan Region (6)
  - [ ] **RWQCB 6V** Lahontan Region (6) Victorville Branch Office
- [▨] **RWQCB 7** Colorado River Basin Region (7)
- [ ] **RWQCB 8** Santa Ana Region (8)
- [ ] **RWQCB 9** San Diego Region (9)

[▨] **Other** Colorado River Board

[ ] _____ Conservancy

Last Updated 2/01/18

STATE OF CALIFORNIA
NATIVE AMERICAN HERITAGE COMMISSION
Cultural and Environmental Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
Phone (916) 373-3710

Edmund G. Brown Jr., Governor

May 22, 2018

Diana Robinson
Imperial County
801 Main Street
El Centro, CA 92243

Also sent via e-mail: dianarobinson@co.imperial.ca.us

RE: SCH# 2018051036, Drew Solar Project, City of El Centro; Imperial County, California

Dear Ms. Robinson:

The Native American Heritage Commission has received the Notice of Preparation (NOP) for Draft Environmental Impact Report for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code § 21000 et seq.), specifically Public Resources Code section 21084.1, states that a project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, § 15064.5 (b) (CEQA Guidelines Section 15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an environmental impact report (EIR) shall be prepared. (Pub. Resources Code § 21080 (d); Cal. Code Regs., tit. 14, § 15064 subd. (a)(1) (CEQA Guidelines § 15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources with the area of project effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a **separate category of cultural resources**, "tribal cultural resources" (Pub. Resources Code § 21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment (Pub. Resources Code § 21084.2). Please reference California Natural Resources Agency (2016) "Final Text for tribal cultural resources update to Appendix G: Environmental Checklist Form," http://resources.ca.gov/ceqa/docs/ab52/Clean-final-AB-52-App-G-text-Submitted.pdf. Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code § 21084.3 (a)). **AB 52 applies to any project for which a notice of preparation or a notice of negative declaration or mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements**. If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. § 800 et seq.) may also apply.

The NAHC recommends **lead agencies consult with all California Native American tribes** that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments. **Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws**.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a **lead agency** shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:
    a. A brief description of the project.
    b. The lead agency contact information.
    c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code § 21080.3.1 (d)).
    d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code § 21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A **lead agency** shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code § 21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or environmental impact report. (Pub. Resources Code § 21080.3.1(b)).
    a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code § 65352.4 (SB 18). (Pub. Resources Code § 21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:
    a. Alternatives to the project.
    b. Recommended mitigation measures.
    c. Significant effects. (Pub. Resources Code § 21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:
    a. Type of environmental review necessary.
    b. Significance of the tribal cultural resources.
    c. Significance of the project's impacts on tribal cultural resources.
    d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code § 21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code sections 6254 (r) and 6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code § 21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:
    a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
    b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code section 21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code § 21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:
    a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
    b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code § 21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code section 21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code section 21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code § 21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code section 21084.3 (b). (Pub. Resources Code § 21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
    a. Avoidance and preservation of the resources in place, including, but not limited to:
        i. Planning and construction to avoid the resources and protect the cultural and natural context.
        ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
    b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
        i. Protecting the cultural character and integrity of the resource.
        ii. Protecting the traditional use of the resource.
        iii. Protecting the confidentiality of the resource.
    c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
    d. Protecting the resource. (Pub. Resource Code § 21084.3 (b)).
    e. Please note that a federally recognized California Native American tribe or a nonfederally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code § 815.3 (c)).
    f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code § 5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An environmental impact report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:
    a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code sections 21080.3.1 and 21080.3.2 and concluded pursuant to Public Resources Code section 21080.3.2.
    b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
    c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code section 21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code § 21082.3 (d)).

    This process should be documented in the Cultural Resources section of your environmental document.

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires **local governments** to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code § 65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code § 65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code section 65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code sections 5097.9 and 5097.993 that are within the city's or county's jurisdiction. (Gov. Code § 65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have been already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.

b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
   a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
   b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
   a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, section 15064.5(f) (CEQA Guidelines section 15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
   b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
   c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code section 7050.5, Public Resources Code section 5097.98, and Cal. Code Regs., tit. 14, section 15064.5, subdivisions (d) and (e) (CEQA Guidelines section 15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

Please contact me if you need any additional information at gayle.totton@nahc.ca.gov.

Sincerely,

Gayle Totton

Gayle Totton, M.A., PhD.
Associate Governmental Program Analyst
(916) 373-3714

cc: State Clearinghouse

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ADAMS BROADWELL JOSEPH & CARDOZO
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FAX (916) 444-6209

May 24, 2018

Via Email and U.S. Mail

Jim Minnick, Director
Imperial County Planning & Development Services
801 Main Street
El Centro, CA 92243
Email: JimMinnick@co.imperial.ca.us

Blanca Acosta, Clerk of the Board
Imperial County
940 West Main Street, Suite 209
El Centro, CA 92243
Email: BlancaAcosta@co.imperial.ca.us

Via Email Only

Diana Robinson, Planner II
Email: DianaRobinson@co.imperial.ca.us

Patricia Valenzuela, Planner IV
Email: PatriciaValenzuela@co.imperial.ca.us

Maria Scoville, Office Assistant III
Email: Mariascoville@co.imperial.ca.us

Re: Public Records Act Request – Drew Solar Project (SCH No. 2018051036)

Dear Mr. Minnick, Ms. Acosta, Ms. Robinson, Ms. Valenzuela, and Ms. Scoville:

We are writing on behalf of California Unions for Reliable Energy ("CURE") to request a copy of any and all records related to the Drew Solar Project (SCH No. 2018051036) ("Project"), proposed by Drew Solar, LLC, *since the date of our last request on January 2, 2017*. The Project includes construction, operation, and reclamation of an approximately 100-megawatt (MW) solar photovoltaic (PV) energy

generation facility in the County of Imperial, California. This request includes, but is not limited to, any and all materials, applications, correspondence, resolutions, memos, notes, analyses, electronic mail messages, files, maps, charts, and/or any other documents related to the Project.

This request is made pursuant to the California Public Records Act. (Government Code §§ 6250, et seq.) This request is also made pursuant to Article I, section 3(b) of the California Constitution, which provides a Constitutional right of access to information concerning the conduct of government. Article I, section 3(b) provides that any statutory right to information shall be broadly construed to provide the greatest access to government information and further requires that any statute that limits the right of access to information shall be narrowly construed.

We will pay for any direct costs of duplication associated with filling this request up to $200. However, please contact me at (650) 589-1660 with a cost estimate before copying/scanning the materials.

Pursuant to Government Code Section 6253.9, if the requested documents are in electronic format and are 10 MB or less (or can be easily broken into sections of 10 MB or less), please email them to me as attachments.

My contact information is:

U.S. Mail
Sheila Sannadan
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080-7037

Email
ssannadan@adamsbroadwell.com

Please call me at (650) 589-1660 if you have any questions. Thank you for your assistance with this matter.

Sincerely,

Sheila M. Sannadan
Legal Assistant

SMS:acp

3813-003acp

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DEPARTMENT OF TRANSPORTATION
DISTRICT 11
4050 TAYLOR STREET, MS-240
SAN DIEGO, CA 92110
PHONE (619) 688-6960
FAX (619) 688-4299
TTY 711
www.dot.ca.gov

Making Conservation a California Way of Life.

May 24, 2018

11-IMP-98
PM 22.19
Drew Road Project
NOP/DEIR
SCH# 2018051036

Ms. Diana Robinson, Planner IV
Imperial County Planning and Development Services
801 Main Street
El Centro, CA 92243

Dear Ms. Robinson:

The California Department of Transportation (Caltrans) has reviewed the Notice of Preparation (NOP) for the Drew Solar Project (SCH# 2018051036) adjacent to State Route 98 (SR-98) at Drew Road, west of Calexico and southeast of El Centro. The mission of Caltrans is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability. The Local Development-Intergovernmental Review (LD-IGR) Program reviews land use projects and plans to ensure consistency with our mission and state planning priorities.

Caltrans has the following comments:

Traffic Impact Study

A focused traffic analysis may be required as part of the project construction.

Access Point(s) on SR-98

For any access to a state highway, applicant must demonstrate there are no other reasonable alternatives.

A Traffic Management Plan (TMP) or construction traffic impact study may be required by the developer for approval by Caltrans prior to construction for any access to SR-98. The plans shall be prepared in accordance with Caltrans's *Manual of Traffic Controls for Construction and Maintenance Work Zones*. Traffic restrictions and pedestrian / bicycle detours may also need to be addressed. All work proposed within the (R/W) requires lane and shoulder closure charts. All roadway features (e.g., signs, pavement delineation, roadway surface, etc.) within the State R/W must be protected, maintained in a temporary condition, and/or restored. For more information, contact the District Traffic Manager, Camille Abou-Fadel, at (619) 718-7833.

If it is determined that traffic restrictions and detours are needed on or affecting State highways, a TMP or construction Traffic Impact Study may be required of the developer for approval by Caltrans prior to construction. TMPs must be prepared in accordance with Caltrans' *Manual on Uniform Traffic Control Devices.* Further information is available for download at the following web address:
http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd2012/Part6.pdf

Hydrology

Any modification to the existing drainage and increase runoff to State facilities will not be allowed.

Glint Glare Analysis

Visual aspects of the project, including glint and glare, should be documented not to have any potential impacts to motorists driving on SR-98. Please provide the analysis to Caltrans when it becomes available.

Utilities Encroachment

The NOP identifies that the project is proposing construction of two (2) generation interconnection (gen-tie) transmission lines extending south across Drew Road and SR-98 into the existing Drew Switchyard. The following statements are general information for transmission line crossings on State highways. Please refer to Caltrans Encroachment Permits Manual (http://www.dot.ca.gov/hq/traffops/developserv/permits/encroachment_permits_manual/index.html) for guidance on utility encroachment.

Any traffic control for utility work will need to be addressed as part of Caltrans permit approval. Stoppage of traffic for placement of aerial lines, installation or removal of overhead conductors crossing a highway requires traffic control in accordance with policy shown in the Caltrans Standard Plans and the California Manual on Uniform Traffic Control Devices (MUTCD).

Transportation Permit for Hauling

Caltrans may, upon application and if good cause appears, issue a special permit to operate or move a vehicle or combination of vehicles or special mobile equipment of a size or weight of vehicle or load exceeding the maximum limitations specified in the California Vehicle Code. The Caltrans Transportation Permits Issuance Branch is responsible for the issuance of these special transportation permits for oversize/overweight vehicles on the State Highway System.

Please contact the Caltrans Transportation Permits Issuance Branch, Sacramento, CA (916) 322-1297. Additional information is provided online at:
http://www.dot.ca.gov/trafficops/permits/index.html

Right-of-Way

Any work performed within Caltrans R/W will require discretionary review and approval by Caltrans and an encroachment permit will be required for any work within the Caltrans R/W prior to construction. As part of the encroachment permit process, the applicant must provide an approved final environmental document including the CEQA determination addressing any environmental impacts within the Caltrans's R/W, and any corresponding technical studies.

Additional information regarding encroachment permits may be obtained by contacting the Caltrans Permits Office at (619) 688-6158. Early coordination with Caltrans is strongly advised for all encroachment permits.

If you have any questions, please contact Mark McCumsey at (619) 688-6802 or by email at mark.mccumsey@dot.ca.gov

Sincerely,

JACOB ARMSTRONG, Branch Chief
Local Development and Intergovernmental Review Branch

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State of California • Natural Resources Agency
Department of Conservation
Division of Land Resource Protection
801 K Street • MS 14-15
Sacramento, CA 95814
(916) 324-0850 • FAX (916) 327-3430

Edmund G. Brown Jr., *Governor*
Kathryn M. Lyddan, *Division Director*

June 1, 2018

VIA EMAIL: DIANAROBINSON@CO.IMPERIAL.CA.US
Ms. Diana Robinson
Imperial County
Planning and Development Services Department
801 Main Street,
El Centro CA, 92243

Dear Ms. Robinson:

NOTICE OF PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT FOR THE DREW SOLAR PROJECT, SCH# 2018051036

The Department of Conservation's (Department) Division of Land Resource Protection (Division) has reviewed the Notice of Preparation submitted by Imperial County (County) for the Drew Solar Project. The Division monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act and other agricultural land conservation programs. We offer the following comments and recommendations with respect to the proposed project's potential impacts on agricultural land and resources.

Project Description

The proposed project consists of a photovoltaic solar facility capable of producing approximately 100 megawatts of alternating current energy storage and generation interconnection transmission lines on 762.8 net acres. Generation interconnection transmission lines will extend from the south end of the project site south across Drew Road and State Route 98 into the existing Drew Switchyard. The project site is located on six parcels approximately 6.5 miles southwest of the City of El Centro, California and 7.5 miles directly west of Calexico, California.

The project site is: zoned agriculture, currently under agricultural production and is designated as Prime Farmland and Farmland of Statewide Importance according to the most recent Important Farmland Map produced by the Department of Conservation's Farmland Mapping and Monitoring Program[1].

Department Comments

The conversion of agricultural land represents a permanent reduction and significant impact to the State's agricultural land resources. Under CEQA, a lead agency should not approve a project if there are feasible alternatives or feasible mitigation measures available that would lessen the

[1] Department of Conservation, Farmland Mapping and Monitoring Program, California Important Farmland Finder, 2014, https://maps.conservation.ca.gov/DLRP/CIFF/

significant effects of the project.[2] All mitigation measures that are potentially feasible should be included in the Draft Environmental Impact Report (DEIR). A measure brought to the attention of the lead agency should not be left out unless it is infeasible based on its elements.

The Department advocates the use of permanent agricultural conservation easements on land of at least equal quality and size as mitigation for the loss of agricultural land. Conservation easements will protect remaining land resources and mitigate the project impacts in accordance with CEQA Guideline § 15370. The Department highlights agricultural conservation easements because of their acceptance and use by lead agencies as an appropriate mitigation measure under CEQA. Agricultural conservation easements are an available mitigation tool and should always be considered; however, the use of conservation easements is only one form of mitigation that should be considered. Any other feasible mitigation measures should also be considered.

Conclusion

The Department recommends the following discussion under the Agricultural Resources section of the DEIR:

- Type, amount, and location of farmland conversion resulting directly and indirectly from implementation of the proposed project.
- Impacts on any current and future agricultural operations in the vicinity; e.g., land-use conflicts, increases in land values and taxes, loss of agricultural support infrastructure such as processing facilities, etc.
- Incremental impacts leading to cumulative impacts on agricultural land. This would include impacts from the proposed project, as well as impacts from past, current, and likely future projects.
- Proposed mitigation measure for all impacted agricultural lands within the proposed project area.

Thank you for giving us the opportunity to comment on the Notice of Preparation of an Environmental Impact Report for the Drew Solar Project. Please provide this Department with notices of any future hearing dates as well as any staff reports pertaining to this project. If you have any questions regarding our comments, please contact Farl Grundy, Environmental Planner at (916) 324-7347 or via email at Farl.Grundy@conservation.ca.gov.

Sincerely,

Monique Wilber
Conservation Program Support Supervisor

[2] California Environmental Quality Act Statute and Guidelines, Association of Environmental Professionals, 2017, Section 21002, page 2.

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June 18, 2018

RECEIVED
JUN 18 2018
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Ms. Diana Robinson
Planner II
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: NOP of a Draft EIR for the Drew Solar Project

Dear Ms. Robinson:

Pursuant to the Imperial County Planning & Development Services Department's Notice of Preparation of a Draft Environmental Impact Report for the Drew Solar Project, where the applicant, Drew Solar, LLC; proposes to develop a 100 MW solar energy-generating project, and potentially include a stand-alone battery energy storage facility, on six parcels totaling approximately 762 acres (Conditional Use Permit applications 17-0031 through 17-0035), located at the northwest intersection of Pulliman Road and State Route 98 in Imperial County, CA; The IID has reviewed the project information and and finds that the comments provided in the January 19, 2018 district letter (see attached letter) continue to apply.

Should you have any questions, please do not hesitate to contact me at 760-482-3609 or at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,

Donald Vargas
Compliance Administrator II

Kevin Kelley – General Manager
Mike Pacheco – Manager, Water Dept.
Enrique B. Martinez – Manager, Energy Dept.
Charles Allegranza – Manager, Energy Dept., Operations
Jamie Asbury – Deputy Manager, Energy Dept., Operations
Carlos Vasquez – Deputy Manager, Energy Dept., Planning & Engineering
Vance Taylor – Asst. General Counsel
Robert Laurie – Asst. General Counsel
Carlos Vasquez - Planning and Engineering Manager, Energy Dept.
Enrique De Leon – Asst. Mgr., Energy Dept., Distr., Planning, Eng. & Customer Service
Michael P. Kemp – Superintendent, Regulatory & Environmental Compliance
Harold Walk Jr. – Supervisor, Real Estate
Randy Gray – ROW Agent, Real Estate
Jessica Lovecchio – Environmental Project Mgr. Sr., Water Dept.

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January 19, 2018

Mr. Richard Cabanilla
Planner IV
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: Drew Road Solar Project CUP Applications Nos.17-0031 through 17-0035

Dear Mr. Cabanilla:

On January 11, 2018, the Imperial irrigation District received from the Imperial County Planning & Development Services Department, a request for agency comments on Conditional Use Permit applications nos. 17-0031 through 17-0035. The applicant, Drew Solar, LLC, proposes to develop a 100 MW solar energy-generating project in five phases, and potentially include a stand-alone battery energy storage facility, on six parcels owned by the IID totaling approximately 762 acres, located at the northwest intersection of Pullman Road and State Route. The generation interconnection transmission line proposed will run from the south end of the site traversing Drew Road and SR 98 into the existing Drew switching station.

The IID has reviewed the project information and has the following comment:

1. For temporary construction electrical service and permanent electrical service to the on-site substation and the battery storage facility, the applicant should contact the IID Customer Project Development Office at (760) 482-3300 and speak with the area's project manager. In addition to submitting a formal application for electrical service (available at the IID website http://www.iid.com/home/showdocument?id=12923), the applicant will be required to submit electrical loads, plan & profile drawings (hard copy and CAD files), project schedule, estimated in-service date and project's Conditional Use Permit. All associated fees, rights of way and environmental documentation is the responsibility of the applicant.

2. Please note that a circuit study may be required prior to IID committing to serve the project.

3. The IID water facilities that may be impacted include the Westside Main Canal, Wormwood Canal, Wormwood Lateral 1, Woodbine Lateral 7, Mt Signal Drain, Mt. Signal Drain No. 1A, Mt. Signal Drain No. 1, Carr Drain, and Carpenter Drain.

4. Taking into account that the project may impact IID drains with site runoff flows and discharge from proposed storm water detention facilities, a comprehensive IID hydraulic drain system analysis will be required to determine impacts and mitigation if the project discharges into IID's drain system. IID's hydraulic drainage system analysis includes an associated drain impact fee.

5. To ensure there are no impacts to IID water facilities, County of Imperial approved grading, drainage and fencing plans should be submitted to the IID Water Engineering Section prior to final project design as well as the projects' Storm Water Pollution Prevention Plan. IID Water Engineering can be contacted at (760) 339-9265 for further information.

6. To obtain water for the construction phase of the projects, the applicant should be advised to contact IID South End Division at (760) 482-9800.

7. The IID Water Department will require that the applicant secure with the district the necessary Water Supply Agreements for industrial use.

8. All new non-agricultural water supply requests are processed in accordance with the IID's Interim Water Supply Policy and Temporary Land Conversion Fallowing Policy. Policy documents are posted at http://www.iid.com/water/municipal-industrial-and-commercial-customers. For additional information regarding these water supply policies, applicant should contact the IID Water Supply Planning section at (760) 339-9755.

9. IID's canal or drain banks may not be used to access the project sites. Any abandonment of easements or facilities shall be approved by IID based on systems (Irrigation, Drainage, Power, etc.) needs.

10. Any construction or operation on IID property or within its existing and proposed right of way or easements including but not limited to: surface improvements such as proposed new streets, driveways, parking lots, landscape; and all water, sewer, storm water, or any other above ground or underground utilities; requires an encroachment permit, or encroachment agreement (depending on the circumstances). The permit application and its instructions are available at http://www.iid.com/home/showdocument?id=271. Additional information regarding encroachment permits or agreements can be provided by the IID Real Estate Section, which can be contacted at (760) 339-9239.

11. In addition to IID's recorded easements, IID claims, at a minimum, a prescriptive right of way to the toe of slope of all existing canals and drains. Where space is limited and depending upon the specifics of adjacent modifications, the IID may claim additional secondary easements/prescriptive rights of ways to ensure operation and maintenance of IID's facilities can be maintained and are not impacted and if impacted mitigated. Thus, IID should be consulted prior to the installation of any facilities adjacent to IID's facilities. Certain conditions may be placed on adjacent facilities to mitigate or avoid impacts to IID's facilities.

12. Any new, relocated, modified or reconstructed IID facilities required for and by the project (which can include but is not limited to electrical utility substations, electrical transmission and distribution lines, etc.) need to be included as part of the project's CEQA and/or NEPA documentation, environmental impact analysis and mitigation. Failure to do so will result in postponement of any construction and/or modification of IID facilities until such time as the environmental documentation is amended and environmental impacts are fully

mitigated. **Any and all mitigation necessary as a result of the construction, relocation and/or upgrade of IID facilities is the responsibility of the project proponent.**

13. Electrical service is a public utility of utmost importance in the implementation and success of a project and not assessing a project's potential impact on this environmental factor could adversely affect the project as well as the capability of the Imperial Irrigation District to provide electrical service in an efficient and timely manner. Hence, the IID suggests that electrical service be included under the Environmental Factor titled "Utilities/Service Systems" of the checklist. It is important to note that per CEQA Statute and Guidelines the Environmental Checklist under Appendix G is a sample form and may be tailored to satisfy individual agencies' needs and project circumstances and substantial evidence of potential impacts that are not listed on this form must also be considered. The sample questions in the checklist are intended to encourage thoughtful assessment of impacts, and do not necessarily represent thresholds of significance, thus the inclusion of the items we suggest would lead to a more thorough evaluation of a project.

Should you have any questions, please do not hesitate to contact me at 760-482-3609 or at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,

Donald Vargas
Compliance Administrator II

Kevin Kelley – General Manager
Mike Pacheco – Manager, Water Dept.
Vicken Kasarjian – Manager, Energy Dept.
Charles Allegranza – Manager, Energy Dept., Operations
Jamie Asbury – Deputy Manager, Energy Dept., Operations
Vance Taylor – Asst. General Counsel
Robert Laurie – Asst. General Counsel
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Enrique De Leon – Asst. Mgr., Energy Dept., Distr., Planning, Eng. & Customer Service
Michael P. Kemp – Superintendent, Real Estate & Environmental Compliance
Harold Walk Jr. – Supervisor, Real Estate
Randy Gray – ROW Agent, Real Estate
Jessica Lovecchio – Environmental Project Mgr. Sr., Water Dept.

150 SOUTH NINTH STREET
EL CENTRO, CA 92243-2850

TELEPHONE: (442) 265-1800
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AIR POLLUTION CONTROL DISTRICT

May 29, 2018

RECEIVED
JUN 20 2018
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Mr. Jim Minnick
Planning Director
801 Main Street
El Centro, CA 92243

SUBJECT: Notice of Preparation (NOP) of a Draft Environmental Impact Report (DEIR) for the Drew Solar Project

Dear Mr. Minnick,

The NOP to prepare a Draft EIR for the Drew Solar Project has been reviewed by the Imperial County Air Pollution Control District (Air District). As you know, the Air District's established programs help to keep the quality of air in Imperial County from declining. The programs and the Rules and Regulations of the Air District in conjunction with the California Environmental Quality Act (CEQA), the most current CEQA Air Quality Handbook for Imperial County (CEQA Handbook), the Air Districts State Implementation Plans (SIP's) for Ozone, $PM_{2.5}$ and PM_{10} work together to assure air quality improves or does no degrade. Currently, the non-attainment status of "moderate" for ozone, "serious" for PM_{10}, and "moderate" for $PM_{2.5}$ are the driving criteria in establishing the thresholds for NOx, ROG, PM_{10}, SOx and CO. These thresholds and their significance are explained under Section 6 of the CEQA handbook, which describes the preparation of an Air Quality Analysis for an Environmental Impact Report (EIR) for nonrenewable projects.

When exploring the impacts of renewable projects, it is a common misconception to believe that these types of projects are not a significant source of air pollution. While it is true that renewable projects are typically cleaner projects during their operational phases, in most cases construction and cumulative impacts still exist. PM_{10} and NO_x emissions are the primary pollutants of concern for the construction and operational phases of these types of projects. This is due to the shorter construction periods of these types of renewable projects, which tend to cause high levels of NO_x emissions because of the use of large amounts of construction equipment, as well as high levels of PM_{10} during earthmoving activities.

Therefore, a **Tier I Preliminary Analysis** should be conducted in order to assess the level of significance of potential impacts. This analysis should include an overview containing a complete description of the project in its current existing conditions, what the proposed development will be, how that will change the existing conditions, and

should also provide answers to the questions in the **White Paper**. These questions are designed to assess the project's level of significance before and after proposed mitigation, (White paper attached for your reference). Additionally, in order to identify NO_x emissions created during the construction phase of the renewable project, a **Construction Equipment List** detailing the equipment type, make, model, year, horsepower, hours of daily operation, date arrived onsite, and date removed from site should be provided to the Air District in Excel format. This is to ensure NO_x emissions during the construction period remained under the CEQA thresholds of significance.

In regards to cumulative impacts, which occur during the operational phase of renewable projects, PM_{10} is of main concern. Therefore, an **Operational Dust Control Plan (ODCP)** is required detailing how dust emissions will be controlled and maintained during the operational phase of the project. An initial site visit is required to confirm the elements of any draft ODCP before it can be finalized by the Air District. After this, continual site visits will typically occur on a yearly basis. Please note that an ODCP is intended to provide pertinent information specific to your operation for the reduction of fugitive dust emissions created by the ongoing operations at your facility.

Additionally, compliance with Regulation VIII is required for all construction activities, as well as notification 10 days prior to the commencement of all construction activities. Our rules and regulations can be found on our website at www.co.imperial.ca.us/AirPollution under the planning section. If any questions arise, please feel free to contact our office at (442) 265-1800.

Sincerely,

Axel Salas
APC Environmental Coordinator

Stephan C. Volker
Alexis E. Krieg
Stephanie L. Clarke
Jamey M.B. Volker (Of Counsel)

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Tel: (510) 496-0600 ❖ Fax: (510) 845-1255
svolker@volkerlaw.com

10.631.01

June 18, 2018

VIA EMAIL
JimMinnick@co.imperial.ca.us

Jim Minnick, Director
Imperial County Planning and Development Services
801 Main Street
El Centro, CA 92243

Re: Scoping Comments of Farms for Farming, Danny Robinson, Robco Farms, Inc., Joe Tagg and West-Gro Farms, Inc. on the Drew Solar Project (SCH# 2018051036)

Dear Mr. Minnick:

On behalf of Farms for Farming, Danny Robinson, Robco Farms, Inc., Joe Tagg and West-Gro Farms, Inc. (collectively, "Farms for Farming"), and pursuant to the California Environmental Quality Act ("CEQA"), Public Resources Code ("PRC") section 21000 *et seq*., and Imperial County's (the "County's") Notice of Preparation of Draft EIR for the Drew Solar Project ("NOP"), we respectfully submit the following scoping comments identifying issues that must be analyzed in the environmental impact report ("EIR") for the Drew Solar Project ("Drew Solar" or the "Project"), and opposing the Project as currently proposed. Please include these comments in the public record for Imperial County's (the "County's") consideration and decision on Drew Solar, LLC's permitting applications for the Project.

The Project would industrialize approximately 763 acres of farmland – *all* of which is either prime farmland or farmland of statewide importance – with a 100-megawatt ("MW") solar photovoltaic ("PV") electrical generation facility, an (undefined) energy storage system, an on-site substation, electrical gen-tie lines, inverters, transformers, new roads, fencing, retention basins, evaporation ponds, operations and maintenance buildings and other infrastructure. Those industrial facilities would remain, and preclude agricultural use of the Project parcels, for at least 35 years. Farms for Farming opposes this Project as an unnecessary industrialization of the County's irreplaceable farmland. The County has already allowed tens of thousands of acres of farmland to be converted to electrical generation and transmission uses, and is entertaining proposals for even more farmland-to-industry conversions, like the Big Rock Cluster Solar Project and the Citizens Imperial Solar Project. Enough is enough.

Farms for Farming urges the County to maintain the renewable energy overlay boundaries it set in October 2015, boundaries that *exclude* the proposed Project site. Farms for Farming

encourages the County to analyze and adopt an alternative to the proposed Project programs to develop or incentivize the development of distributed PV generation projects in *already-disturbed areas*, particularly near energy demand centers. The County should abide by its own policy prescriptions and not approve any further renewable energy developments outside the overlay zone, especially not projects that would destroy productive and irreplaceable farmland or "result in any [other] significant environmental impacts." Imperial County General Plan, Renewable Energy and Transmission Element, Section IV(D), p. 35.

In further expression of these major concerns and others, Farms for Farming submits the following comments on the proposed Project and its required environmental review under CEQA.

I. THE PROPOSED SOLAR ENERGY GENERATION, TRANSMISSION AND STORAGE USES ARE FORBIDDEN BY THE IMPERIAL COUNTY GENERAL PLAN LAND USE ELEMENT.

A. The County May Not Approve a Conditional Use that Is Forbidden by the County General Plan.

The Project is inconsistent with the County General Plan, and thus its approval would violate the Planning and Zoning Law. As acknowledged in *Neighborhood Action Group v. County of Calaveras* ("*Neighborhood*") (1984) 156 Cal.App.3d 1176, 1184, the requirement that use permits be consistent with a county's general plan

> is necessarily to be implied from the hierarchical relationship of the land use laws. To view them in order: a use permit is struck from the mold of the zoning law ([Government Code section] 65901); the zoning law must comply with the adopted general plan (§ 65860); the adopted general plan must conform with state law (§§ 65300, 65302). The validity of the permit process derives from compliance with this hierarchy of planning laws. *These laws delimit the authority of the permit issuing agency to act and establish the measure of a valid permit*. . . . A permit action taken without compliance with the hierarchy of land use laws is *ultra vires* as to any defect implicated by the uses sought by the permit.

Id. (emphasis added).

Because Imperial County is a general law county, the foregoing settled law is dispositive. Since, as shown below, the proposed solar energy generation, storage and transmission uses are specifically forbidden under the Imperial County General Plan, the County lacks authority to approve those uses in contravention of the General Plan. Any "permit action taken without compliance with the hierarchy of land use laws is *ultra vires*." *Id*.

B. The Imperial County General Plan Forbids the Proposed Solar Energy Generation, Storage and Transmission Uses.

The Imperial County General Plan's Land Use Element specifically *forbids* the proposed solar uses within the "Agriculture" plan designation that applies to the entire Project site. May 2018 Initial Study & Environmental Analysis ("Initial Study"), p. 7 ("The Project site is designated as Agriculture by the Imperial County General Plan Land Use Element, and the Project site parcels are comprised [sic] of lands zoned as A-2 [Agricultural, General], A-2-R]General Agricultural/Rural Zone], and A-3 [Agricultural, Heavy]"). The Land Use Element directs that lands designated as "Agriculture" may not be developed with uses that do not preserve and protect agricultural production and related activities. It states in pertinent part as follows:

> **1. Agriculture.**
>
> This category is intended to preserve lands for agricultural production and related industries including aquaculture (fish farms), ranging from light to heavy agriculture. Packing and processing of agricultural products may also be allowed in certain areas, and other uses necessary or supportive of agriculture. . . .
>
> *Where this designation is applied, agriculture shall be promoted as the principal and dominant use to which all other uses shall be subordinate. Where questions of land use compatibility arise, the burden of proof shall be on the non-agricultural use to clearly demonstrate that an existing or proposed use does not conflict with agricultural operations and will not result in the premature elimination of such agricultural operations. No use should be permitted that would have a significant adverse effect on agricultural production*, including food and fiber production, horticulture, floraculture, or animal husbandry. . . .

Imperial County General Plan, Land Use Element (Revised 2015), page 48 (emphasis added).

It is clear from the foregoing language that lands designated as "Agriculture" in the General Plan must be used *only* for agriculture and related industries that support agricultural production. "Where questions of land use compatibility arise, the burden of proof shall be on the non-agricultural use to *clearly demonstrate* that an existing or proposed use does not conflict with agricultural operations and will not result in the premature elimination of such agricultural operations." *Id.* (emphasis added).

Here, it is undisputed that the proposed industrial-scale solar facility uses would eliminate and indefinitely prevent all agricultural use on nearly 800 acres of prime farmland and farmland of statewide importance. Initial Study, p. 11. As the California Department of Conservation has determined in both the Williamson Act and CEQA contexts, and reiterated in its November 1,

2011, and July 16, 2010 letters (attached hereto as Exhibits 1 and 2) to the Imperial County Planning and Development Services Department regarding other solar projects previously proposed for lands designated for Agriculture on the County General Plan, commercial solar uses are *completely incompatible* with agricultural uses.

Furthermore, the Project could impede agricultural operations elsewhere in the County and reduce employment, income, sales and tax revenue. As former Imperial County Agricultural Commissioner Valenzuela noted in her February 25, 2011 comments (attached hereto as Exhibit 3) on the DEIR for a similar solar project, "removal of any farmland out of production would have a *direct negative impact on employment, income, sales and tax revenue*" (emphasis added). As these projects convert more and more agricultural land to non-agricultural uses, more and more agriculture-serving businesses will be forced to close. And as the quantity and quality of agriculture-serving businesses decreases in the County, more and more farmers will find it uneconomical or impractical to keep farming and sell, lease or use their lands for non-agriculture purposes.

Because the proposed solar energy generation, storage and transmission uses would eliminate the potential for farming on the Project sites for at least 35 years[1] and "have a" potentially "significant adverse effect on agricultural production" elsewhere in the County, the Project is specifically forbidden by the General Plan.

II. THE PROPOSED ZONING CHANGE IS FORBIDDEN BY THE IMPERIAL COUNTY GENERAL PLAN LAND USE ELEMENT.

The Project would rezone from A-2 and A-3 to M-2 (Medium Industrial) the two Project parcels proposed for the energy storage component of the Project. Initial Study, pp. 7, 11. Such rezoning is explicitly prohibited by Imperial County's General Plan. Table 4 on page 64 of the Land Use Element – the Compatibility Matrix – shows that M-2 zoning is incompatible with the Agriculture land use designation. "[T]he zoning law must comply with the adopted general plan (§ 65860)." *Neighborhood*, 156 Cal.App.3d at 1184. "A permit action taken without compliance with the hierarchy of land use laws," such as proposed here, "is *ultra vires*." *Id.*

III. THE PROPOSED PROJECT CONTRAVENES THE IMPERIAL COUNTY GENERAL PLAN AGRICULTURAL ELEMENT.

Objective 1.8 of the County General Plan Agricultural Element "[a]llow[s] conversion of agricultural land to non-agricultural uses including renewable energy *only* where a *clear* and *immediate need can be demonstrated*, based on economic benefits, population projections and lack of other available land (including land within incorporated cities) for such non-agricultural

[1] See page 9 of the January 8, 2018 Project Description attached to the Initial Study.

uses." Imperial County General Plan, Agricultural Element (Revised 2015), page 30 (emphasis added). "Such conversion shall also be allowed only where such uses have been identified for non-agricultural use in . . . the County General Plan, and are *supported by a study to show a lack of alternative sites*." *Id* (emphasis added).

Here, as discussed, the County General Plan *forbids* the proposed non-agricultural uses on the Project parcels. Furthermore, in designating a renewable energy overlay zone, the County has already determined that alternative – and indeed, *preferable* – sites *do exist* for the proposed solar energy facilities.[2] Additionally, at least two circumstances render the proposed Project not only unnecessary, but plainly harmful.

First, statewide, Californians are "using less electricity."[3] As reported by the *Los Angeles Times*, and as evidenced by data compiled by the U.S. Energy Information Administration ("EIA") and California Energy Commission ("CEC"), California's "power plants are on track to be able to produce at least 21% more electricity than it needs by 2020." Exhibit 4 at 2 (quote); EIA, 2017, California Electricity Profile 2015;[4] CEC, 2017, Installed In-State Electric Generation Capacity by Fuel Type (MW).[5] With California's electricity usage flatlining, and rooftop solar and other distributed generation capacity increasing rapidly, there is less need than ever for industrial-scale projects like the proposed Drew Solar Project – and much less justification for the Project's massive environmental impacts. *Id*.

Second, wildfire risk in southern California is higher than previously estimated, and getting worse with global warming. This risk would both impact and be exacerbated by the Project, which would be located primarily in a "Moderate" fire hazard severity zone, as designated by the California Department of Forestry and Fire Protection ("CAL FIRE").[6] For example, as reported in the August 2017 Climate Change Vulnerability Assessment for adjacent

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[2] Less harmful renewable energy production alternatives to the Project also exist outside Imperial County, as demonstrated below in Section VI of these comments.

[3] Penn, I. and R. Menezes, February 5, 2017, "Californians are paying billions for power they don't need," *Los Angeles Times* (attached hereto as Exhibit 4, and also available here: http://www.latimes.com/projects/la-fi-electricity-capacity/).

[4] Available here: https://www.eia.gov/electricity/state/california/

[5] Available here: http://www.energy.ca.gov/almanac/electricity_data/electric_generation_capacity.html/

[6] CAL FIRE, September 19, 2007, Imperial County Draft Fire Hazard Severity Zone in LRA (attached hereto as Exhibit 5, and also available here: http://www.fire.ca.gov/fire_prevention/fhsz_maps_imperial)

San Diego County,[7] CalAdapt's wildfire tool estimates that under both a low-GHG-emissions scenario and a high-emissions scenario, substantially more land in the County will burn due to wildfire by 2099. San Diego County, Draft Climate Action Plan, Appendix D, p. 12. Under the low-emissions scenario, over 3,500 more acres are expected to burn *every year* by 2099. *Id.* Under a high-emissions scenario, the additional annual acreage scorched by wildfire increases to nearly 8,500. *Id*.

IV. THE EIR MUST PROVIDE A FULL AND ACCURATE PROJECT DESCRIPTION.

"An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR." *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 193. In addition, "[t]he data in an EIR must not only be sufficient in quantity, it must be presented in a manner calculated to adequately inform the public and decision makers, who may not be previously familiar with the details of the project." *Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* ("*Vineyard*") (2007) 40 Cal.4th 412, 431.

The EIR must cure the Initial Study's failure to fully describe the project. For example, the Initial Study fails to identify the type of energy storage system proposed for the Project. To the contrary, it states that the "Project proposes an energy storage system with a technology to be determined." Initial Study, p. 27. The Initial Study also fails to clarify whether the proposed General Plan amendment would be to both the Land Use Element *and* the Renewable Energy and Transmission Element, or just the latter. *Compare* Initial Study, p. 32 ("The Project will require: an Amendment to Imperial County's General Plan Land Use Element and Renewable Energy and Transmission Element") *with* Initial Study, p. 32 ("Both the GPA and the Zone Change would be to the Renewable Energy Overlay Zone"). CEQA requires more in the EIR. *Vineyard*, 40 Cal.4th at 434.

V. THE EIR MUST ANALYZE THE FULL RANGE OF PROJECT IMPACTS.

The EIR must analyze the full range of potentially significant environmental impacts from the Project, including the following:

Fire Impacts: As discussed above, the Project site is in an area of moderate and increasing fire risk. The Project would add many known fire risks to the area, exacerbating that risk further. The EIR must fully analyze the Project's wildland fire impacts, including whether the local firefighting services, as well as on-site fire protection measures, are equipped for the type of

[7] Available here: http://www.sandiegocounty.gov/content/dam/sdc/pds/advance/cap/publicreviewdocuments/CAPfilespublicreview/Appendix%20D%20Climate%20Change%20Vulnerability%20Assessment.pdf

electrical and chemical fires the Project could cause, with electrical generation, transmission and battery storage components all on site.

Agricultural Impacts: As discussed above, the Project would eliminate and preclude agricultural operations on nearly 800 acres for at least 35 years. The EIR must analyze that direct impact, as well as the cumulative impact of destroying tens of thousands of acres of farmland over the past decade, along with any planned future farmland conversion. This persistent farmland elimination may well be the death knell for farming in County. As utility-scale energy projects convert more and more agricultural land to non-agricultural uses, more and more agriculture-serving businesses will be forced to close, due to both declining revenues and logistical problems. And as the quantity and quality of agriculture-serving businesses decrease in the County, more and more farmers will find it uneconomical or impractical to keep farming and be forced to sell, lease or use their lands for non-agriculture purposes, creating a vicious circle of shrinking farmbase and shrinking farm support services.

Greenhouse Gas Emissions: The EIR must analyze not only the greenhouse gas emissions from Project construction and operation, but also its life-cycle emissions. Without a lifecycle emissions analysis, the EIR could not support the Initial Study's assertion that in "the long-term, the Project is expected to provide a benefit with respect to reduction of greenhouse gas emissions." Initial Study, p. 26.

Biological Resource Impacts: The proposed Project site is potentially home to many sensitive plants and animals, including the burrowing owl and other bird species. The County and its consultants must thoroughly survey the area for these and other species and analyze the Project's impacts on them in the EIR. Among other impacts, the EIR must analyze the "pseudo-lake effect," which occurs when solar projects' reflective panels resemble water from above, and attract birds – especially migratory birds – searching for water. Once tricked, the birds can – and often do – dive into the solar panels as if they were water. This "pseudo-lake effect" is suspected to be a primary cause of migratory bird trauma and death at the Desert Sunlight PV facility in Riverside County.[8]

Land Use and Planning Impacts: As discussed, the Project would violate the Imperial County General Plan in at least three different ways, each of which is a significant impact requiring CEQA analysis. Initial Study at 2-22. The EIR must analyze these impacts.

[8] Kagan, R.A, T.C. Vimer, P.W. Trail, and E.O. Espinoza, "Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis," Report of the National Fish and Wildlife Forensics Laboratory (attached hereto as Exhibit 6).

VI. THE EIR MUST ANALYZE A FULL RANGE OF ALTERNATIVES.

CEQA requires EIRs to "describe a range of reasonable alternatives to the project . . . which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives." Guidelines § 15126.6(a). Alternatives that would lessen significant effects should be considered even if they "would impede to some degree the attainment of the project objectives, or be more costly." *Id*. § 15126.6(b). The range of alternatives considered must "foster informed decisionmaking and public participation." *Id*. § 15126.6(a). Alternatives may only be eliminated from "detailed consideration" when substantial evidence in the record shows that they either (1) "fail[] to meet most of the basic project objectives," (2) are "infeasibl[e]," or (3) do not "avoid significant environmental impacts." *Id*. § 15126.6(c).

Among other alternatives, the EIR should analyze programs to develop or incentivize the development of distributed photovoltaic ("PV") generation projects *near energy demand centers in already-disturbed areas*. These alternatives are not only feasible, they could generate far more energy than the Project, and with far fewer environmental impacts. For example, a recent study shows that installing PV and concentrating solar power ("CSP") technologies throughout California's built environment could substantially exceed the state's forecasted 2020 energy needs.[9] Another recent study estimates that deploying PV and CSP solely on developed land (built environment), land with salt-affected soils, and contaminated land and reservoirs in California's Central Valley "could meet [California's] projected 2025 needs for electricity consumption between 10-13 times over" (for PV technologies) and "over two times over with CSP technologies."[10] Exhibit 8 at 14479. Before the County could approve the Project, it would need to consider less-impactful alternatives like these in an EIR. CEQA § 21100; Guidelines § 15126.6.

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[9] Hernandez, R.R., M.K. Hoffacker, M.L. Murphy-Mariscal, G. Wu, and M.F. Allen, 2015, "Solar Energy Development Impacts on Land-Cover Change and Protected Areas," *Proceedings of the National Academy of Sciences*, 112(44) (attached hereto as Exhibit 7).

[10] Hoffacker, M.L., M.F. Allen, and R.R. Hernandez, 2017, "Land-Sparing Opportunities for Solar Energy Development in Agricultural Landscapes: A Case Study of the Great Central Valley, CA, United States," *Environmental Science & Technology* 51:14472-14482 (attached hereto as Exhibit 8).

For each of these reasons, Farms for Farming opposes the Project as currently proposed, and requests that the EIR analyze all of the impacts and alternatives discussed above.

Respectfully submitted,

Stephan C. Volker
Attorney for Farms for Farming, *et al.*

SCV:taf

Attachments: Exhibit 1 - John M. Lowrie, California Department of Conservation, Letter to Armando Villa re: Cancellation of Land Conservation (Williamson Act) Contract No. 2001-00706, November 1, 2011.

Exhibit 2 - Dan Otis, California Department of Conservation, Letter to Patricia Valenzuela re: Notice of Preparation for a DEIR for Imperial Solar Energy Center South, July 16, 2010.

Exhibit 3 - Connie L. Valenzuela, Imperial County Agricultural Commissioner, Letter to Armando Villa re: CUP 10-0035 8 Minutenergy Renewables, LLC, Calipatria Solar Farm II, February 25, 2011.

Exhibit 4 - Penn, I. and R. Menezes, February 5, 2017, "Californians are paying billions for power they don't need," *Los Angeles Times*.

Exhibit 5 - CAL FIRE, September 19, 2007, Imperial County Draft Fire Hazard Severity Zone in LRA, also available here: http://www.fire.ca.gov/fire_prevention/fhsz_maps_imperial.

Exhibit 6 - Kagan, R.A., T.C. Viner, P.W. Trail, and E.O. Espinoza, "Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis," Report for the National Fish and Wildlife Forensics Laboratory, also available here: here: http://docketpublic.energy.ca.gov/PublicDocuments/09-AFC-07C/TN201977_20140407T161504_Center_Supplemental_Opposition_to_Motion.pdf.

Exhibit 7 - Hernandez, R.R., M.K. Hoffacker, M.L. Murphy-Mariscal, G. Wu, and M.F. Allen, 2015, "Solar Energy Development Impacts on Land-Cover Change and Protected Areas," *Proceedings of the National Academy of Sciences*, 112(44).

Exhibit 8 - Hoffacker, M.L., M.F. Allen, and R.R. Hernandez, 2017, "Land-Sparing Opportunities for Solar Energy Development in Agricultural Landscapes: A Case Study of the Great Central Valley, CA, United States," *Environmental Science & Technology* 51:14472-14482.

EXHIBIT 1

DEPARTMENT OF CONSERVATION

Managing California's Working Lands

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

November 1, 2011

Mr. Armando G. Villa, Director
Imperial County
Department of Planning and Development Services
801 Main Street
El Centro, CA 92243

Dear Mr. Villa:

SUBJECT: Cancellation of Land Conservation (Williamson Act) Contract No. 2001-00706; Landowner: James R. & Barbara A. Smith; Applicant: 8 Minute Energy (Calipatria Solar Farm II); APN 022-170-005

The Department of Conservation (Department) monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act. The Department has reviewed the application submitted by the Imperial County Department of Planning and Development Services (County) regarding the referenced cancellation and offers the following recommendations.

Project Description

The petition proposes to cancel 563 acres of agricultural land subject to Williamson Act Contract in order to build a photovoltaic energy facility (Project) which will generate a total of 50 megawatts. The Project Site is located approximately one mile north of Calipatria, California within Imperial County and is bounded by Blair Road to the east, E. Peterson Road to the north, W. Lindsey Road to the south and the Southern Pacific Railroad to the west. The Calipatria State Prison is located to eth northeast of the project site. According to the petition, the applicant has submitted a Conditional Use Permit for a 40 year term.

Cancellation Findings

Government Code (GC) section 51282 states that tentative approval for cancellation may be granted only if the local government makes ***either*** one of the following findings:

1) Cancellation is **consistent** with purposes of the Williamson Act, (not addressed by the cancellation petition) ***or***
2) Cancellation is in the **public interest.**

The following are the requirements for the public interest findings required under GC section 51282 (above):

2) Cancellation is in the Public Interest

For the cancellation to be in the public interest, the Board must make both of the following findings:

a. Other public concerns substantially outweigh the objectives of the Williamson Act, and

b. There is no *proximate, noncontracted land*[1] which is available and *suitable*[2] for the use proposed on the contracted land, or, development of the contracted land would provide more contiguous patterns of urban development than development of proximate noncontracted land.

Department Comments on the Public Interest Cancellation Findings

The Department has reviewed the petition and additional information supplied by the applicant, and offers the following comments with regards to the submitted public interest findings:

a) Other public concerns substantially outweigh the objectives of the Williamson Act:

Renewable energy is energy generated from sources such as the sun, wind, the ocean, and the earth's core. Solar photovoltaic electricity qualifies as a renewable energy source for the purposes of California's Renewables Portfolio Standards. In April, Governor Brown signed Senate Bill 2 (First Extraordinary Session) which extends the current 20% renewables portfolio standard target in 2010 to a 33% renewables portfolio standard by December 31, 2020. Through a number of legislative actions and/or policies, the State has placed an importance on renewable energy as well as preserving farmland.

There are many factors in determining whether the production of solar energy is of a higher public interest than the pre-existing agricultural use of the land. Some factors may include the quality of the soil, current agricultural production and the availability of reliable irrigation water. The Department has no comment regarding this particular finding.

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[1] "Proximate, noncontracted land" means land not restricted by contract, which is sufficiently close to land which is so restricted that it can serve as a practical alternative for the use which is proposed for the restricted land. (GC section 51282).

[2] "Suitable" for the proposed use means that the salient features of the proposed use can be served by the land not restricted by contract. Such nonrestricted land may be a single parcel or may be a combination of contiguous or discontiguous parcels. (GC section 51282).

b) *There is no available and suitable proximate non-contracted land for the use proposed on the contracted land:*
According to the petition, the property was chosen due to its close proximity to the electrical grid which has the capacity for the solar facility. The Department has no comment regarding this particular finding.

Cancellation Findings Conclusion
Imperial County Board of Supervisors could approve the cancellation application based on the required public interest findings only if the Board feels it has adequate amount of information and has built the record to meet the statuary requirements.

Compatible Use
The Department has determined that commercial solar facilities are an industrial use of the land and inconsistent with the intent of the Williamson Act and its protection of open space and agricultural resources. The suggestion that a solar facility is a compatible use as defined by the Williamson Act is misguided. The footprint of a solar facility and the fact that it does not allow for the continuation of agricultural operations or open space activities as the main operation of the land, make it inconsistent with many different sections of the Act. The Department views GC §51238, which cites the compatibility of gas, electric, water, communication, or agricultural labor housing facilities in an *agricultural preserve*, as referring to those structures which have minimal impact on the land, and which are necessary for the needs of a community. The Department has consistently interpreted this section to describe overhead power lines, electrical substations, underground communication lines, and water lines, all of which take up a minimal amount of land.

Additionally, the Williamson Act provides a preferential tax assessment on contracted land in exchange for limiting the land to agricultural or open space uses. Agricultural use means the use of the land for the purpose of producing an agricultural commodity for commercial purposes (GC§51201(a)). Open space is the use or maintenance of land in a manner that preserves its natural characteristics, beauty, or openness for the benefit and enjoyment of the public or for wildlife habitat (GC§51201(o)). A commercial solar facility does not meet the definition of an agricultural use and solar energy does not meet the definition of an agricultural commodity, which means any and all plant and animal products produced in this State for commercial purposes. Nor is it consistent with the definition of an open space use. In addition, GC§51242 requires that land enrolled in a Williamson Act contract be devoted to agricultural use. When a solar project displaces all of the agriculture, and replaces it with a use that has no agricultural utility, the land clearly ceases to be devoted to agriculture.

Neither the Legislature nor City Councils or Boards of Supervisors can override the restrictions included within the Williamson Act or the Constitutional provision enabling the Act. The construction of solar facilities removes and replaces agriculture or open space uses to have a significant impact on agricultural and open space lands, including grazing land. After a review of the proposal, the Department does not believe that the County can consider commercial solar facilities compatible with the Williamson Act contract.

Site Restoration Plan

Since solar technology is advancing rapidly over time, the amount of open land that is needed for the same amount of solar energy production may decrease significantly in the future. That same land may also one day be needed again for the production of food.

It is important that proposals for the conversion of agricultural land to solar energy projects include a detailed site restoration plan describing how the project proponents will restore the land back to its current condition including irrigation supplies if and when some or all of the solar panels are removed. This type of plan would be similar to SMARA-required restoration plans on proposed mining sites. The Department recommends that an acceptable site restoration plan be required by the County for the proposed project.

Thank you for the opportunity to provide comments on the proposed cancellation. Please provide our office with a copy of the Notice of Public Hearing on this matter ten (10) working days before the hearing and a copy of the published notice of the Board's decision within thirty (30) days of the tentative cancellation pursuant to GC section 51284. If you have any questions concerning our comments, please contact Sharon Grewal, Environmental Planner at (916) 327-6643.

Sincerely,

John M. Lowrie
Program Manager
Williamson Act Program

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EXHIBIT 2

NATURAL RESOURCES AGENCY ARNOLD SCHWARZENEGGER, GOVERNOR

DEPARTMENT OF CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • **FAX** 916 / 327-3430 • **TDD** 916 / 324-2555 • **WEBSITE** conservation.ca.gov

July 16, 2010

VIA FACSIMILE (760) 353-8338
Ms. Patricia Valenzuela, Planner III
Imperial County Planning & Development Services
801 main Street
El Centro, CA 92243

Subject: Notice of Preparation for a DEIR for Imperial Solar Energy Center South - SCH# 2010061038

Dear Ms. Valenzuela:

The Department of Conservation's (Department) Division of Land Resource Protection (Division) has reviewed the Notice of Preparation (NOP) for a DEIR for Imperial Solar Energy Center South. The Division monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act and other agricultural land conservation programs. We offer the following comments and recommendations with respect to the proposed project's potential impacts on agricultural land and resources.

Project Description:

The project is located on Pullman Road and Anza Road in an unincorporated part of Imperial County on the US/Mexico Border. The project site is 903 acres of agricultural land. The site is designated Prime Farmland and Farmland of Statewide Importance per the Imperial County Farmland Mapping and Monitoring Program maps. The existing General Plan designation is Agriculture and the zoning is General Agriculture Rural Zone and Heavy Agriculture.

The project proposes the development of a solar energy center and would consist of ground mounted photovoltaic solar power generation system, supporting structures, an operations and maintenance building, substation, water treatment facility, plant control system, meteorological station, roads and fencing. The project also plans a 120-foot wide Right-of-Way from the project site, along BLM land, within BLM's designated Utility Corridor "N" to the Imperial Valley Substation.

Division Comments:

The initial study for the NOP stated that because solar generation facilities are an allowed use within the zone district and subject to a conditional use permit, they do not conflict with existing zoning for agriculture and thus no impact is identified. However, the entire purpose of going through the conditional use permit process is to trigger a thorough CEQA review of a project's potential impacts. The development of 903 acres of Prime Farmland and Farmland of Statewide Importance is a substantial amount of development and displacement of agricultural resources.

The Department of Conservation considers the construction of a solar facility that removes and replaces agriculture on agricultural lands to have a significant impact on those agricultural lands, including grazing land. While solar panels may be an allowed use under the County zoning and General Plan, they can and should be considered an impact under CEQA to the project site's agricultural resources.

Although direct conversion of agricultural land is often an unavoidable impact under California Environmental Quality Act (CEQA) analysis, mitigation measures must be considered. A principal purpose of an EIR is to present a discussion of mitigation measures in order to fully inform decision-makers and the public about ways to lessen a project's impacts. In some cases, the argument is made that mitigation cannot reduce impacts to below the level of significance because agricultural land will still be converted by the project, and, therefore, mitigation is not required. However, reduction to a level below significance is not a criterion for mitigation. Rather, the criterion is feasible mitigation that lessens a project's impacts. Pursuant to CEQA Guideline §15370, mitigation includes measures that "avoid, minimize, rectify, reduce or eliminate, or compensate" for the impact. For example, mitigation includes *"Minimizing impacts by limiting the degree or magnitude of the action and its implementation (§15370(b))"* or *"Compensating for the impact by replacing or providing substitute resources or environments (§15370(e))."*

All measures allegedly feasible should be included in the DEIR. Each measure should be discussed, as well as the reasoning for selection or rejection. A measure brought to the attention of the Lead Agency should not be left out unless it is infeasible based on its elements.

Finally, when presenting mitigation measures in the DEIR, it is important to note that mitigation should be specific, measurable actions that allow monitoring to ensure their implementation and evaluation of success. A mitigation consisting only of a statement of intention or an unspecified future action may not be adequate pursuant to CEQA.

Project Impacts on Agricultural Land

When determining the agricultural value of the land, the value of a property may have been reduced over the years due to inactivity, but it does not mean that there is no longer any agricultural value. The inability to farm the land, rather than the choice not to do so, is what could constitute a reduced agricultural value. The Division recommends the following discussion under the Agricultural Resources section of the Draft EIR:

- Type, amount, and location of farmland (Prime, Unique, and Farmland of Statewide Importance) conversion that may result directly and indirectly from project implementation and growth inducement, respectively.
- Impacts on current and future agricultural operations; e.g., land-use conflicts, increases in land values and taxes, etc.
- Incremental project impacts leading to cumulative impacts on agricultural land. This would include impacts from uses allowed with the proposed solar facility, as well as impacts from past, current, and likely projects in the future.

Under California Code of Regulations Section 15064.7, impacts on agricultural resources may also be both quantified and qualified by use of established thresholds of significance. As such, the Division has developed a California version of the USDA Land Evaluation and Site Assessment (LESA) Model. The California LESA model is a semi-quantitative rating system for establishing the environmental significance of project-specific impacts on farmland. The model may also be used to rate the relative value of alternative project sites. The LESA Model is available on the Division's website at:

http://www.consrv.ca.gov/DLRP/qh_lesa.htm

Solar Facility Mitigations and Reclamation Plan

If the solar facility is considered a temporary displacement of agricultural resources, then there should be some assurances that it will be temporary and will be removed in the future. Hence the need for a reclamation plan. The loss of agricultural land (even temporary) represents a reduction in the State's agricultural land resources. The Division has witnessed the negative impacts of non-operational wind power generation facilities and related equipment that have been left to deteriorate on agricultural land. For that reason, the Division offers a variety of permitting conditions the County might use for energy projects on agricultural land:

- Require a reclamation plan suited for solar facilities, based on the principles of the Surface Mining and Reclamation Act (SMARA). As part of this plan, a performance bond or other similar measure may be used.
  - A typical requirement would be for the soil to be restored to the same condition it was in prior to the solar facility's construction. Whatever project-related materials have been brought in, or changes made to the land (i.e. graveling, roads, compaction, equipment), would be removed once the solar facility (or portions of) is no longer active.
- Solar projects are generally considered to be "temporary". The County could require that a new permit must be applied for after a certain period of time. Because this is a new and unprecedented use for agricultural land, this would allow the County more flexibility in determining what conditional uses or conditions may be most appropriate in the longer term.
- Require permanent agricultural conservation easements on land of at least equal quality and size as partial compensation for the direct loss of agricultural land.
  - Conservation easements will protect a portion of those remaining agricultural land resources and lessen project impacts in accordance with California Environmental Quality Act (CEQA) Guideline §15370. The Department highlights this measure because of its acceptance and use by lead agencies as an appropriate mitigation measure under CEQA and because it follows an established rationale similar to that of wildlife habitat mitigation.

Mitigation via agricultural conservation easements can be implemented by at least two alternative approaches: the outright purchase of easements or the donation of mitigation fees to a local, regional or statewide organization or agency whose purpose includes the acquisition and stewardship of agricultural conservation easements. The proposed conversion of agricultural land should be deemed an impact of at least regional significance. Hence, the search for replacement lands can be conducted regionally or statewide, and need not be limited strictly to lands within the project's surrounding area. Mitigation for the loss of Prime Farmland

is suggested at a 2:1 ratio due to its importance in the State of California. The use of conservation easements is only one form of mitigation, and any other feasible mitigation measures should also be considered. Mitigations for temporary solar projects can also be flexible, especially in cases where there is a reclamation plan in place that requires the land to be returned to an agricultural state.

The Department also has available a listing of approximately 30 "conservation tools" that have been used to conserve or mitigate project impacts on agricultural land. This compilation report may be requested from the Division at the address or phone number at the conclusion of this letter. Of course, the use of conservation easements is only one form of mitigation that should be considered. Any other feasible mitigation measures should also be considered.

Thank you for giving us the opportunity to comment on the Notice of Preparation for a DEIR for Imperial Solar Energy Center South project. Please provide this Department with a copy of the DEIR, the date of any hearings for this particular action, and any staff reports pertaining to it. If you have questions regarding our comments, or require technical assistance or information on agricultural land conservation, please contact Meri Meraz, Environmental Planner, at 801 K Street, MS 18-01, Sacramento, California 95814, or by phone at (916) 445-9411.

Sincerely,

Dan Otis
Program Manager
Williamson Act Program

cc: State Clearinghouse

Imperial County Farm Bureau
1000 Broadway
El Centro, CA 92243
FAX (760) 352-0232

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EXHIBIT 3

Connie L. Valenzuela
Agricultural Commissioner
Sealer of Weights and Measures

Linda S. Evans
Assistant Agricultural Commissioner/
Asst. Sealer of Weights and Measures

IMPERIAL COUNTY
AGRICULTURAL COMMISSIONER
SEALER OF WEIGHTS AND MEASURES
CALIFORNIA

852 Broadway
El Centro, CA 92243

(760) 482-4314
Fax: (760) 353-9420

E-mail: agcom@co.imperial.ca.us

February 25, 2011

Armando G. Villa
Planning & Development Services Director
801 Main Street
El Centro, CA 92243

RE: CUP 10-0035 8 Minutenergy Renewables, LLC, Calipatria Solar Farm II

The project entails the construction, development and operation of a ground mounted 50 MW Photovoltaic solar energy facility. The proposed solar plant will convert approximately 563 acres of privately owned farmland to non-farm use. The project will be located approximately one mile north of Calipatria, California in Imperial County and is bounded by Blair Road to the east, E. Peterson Road to the north, W. Lindsey Road to the south, and the Southern Pacific Railroad to the west. Agricultural lands lie to the immediate north, south, east and west of the project. The Calipatria State Prison is located to the northeast of the project site. An algae farm (Earthrise Farms) is located adjacent to the northwest corner of the site across the Southern Pacific Railroad tracks.

The California Department of Conservation has classified the property as Farmland of Statewide Importance. This farmland supports crops that contribute directly to Imperial County's $1.45 billion gross agricultural production value. Temporary or permanent removal of any farmland out of production would have a direct negative impact on employment, income, sales and tax revenue.

During the construction phase and perhaps afterwards depending on whether this project will have some level of permanent staffing, neighboring agricultural operations would be impacted and restricted in their ability to use some pesticides or some pesticide application methods. Also, any complaints received by the construction site regarding nearby agricultural operations would need to be investigated; costs incurred to conduct investigations into incidents and complaints are not directly reimbursed by the state.

Since the project will be surrounded by farmland it will be exposed to higher than normal levels of dust and potential pesticide drift which will likely increase the cleaning requirements of the panels.

The land under the solar panels could harbor pests including noxious weeds, plant diseases, insects, and vertebrates which are detrimental to agriculture and could cause damage to adjacent fields and crops. This could be a problem if a cover crop is used for dust control and needs to be addressed or mitigated. In addition to direct crop damage caused by pests, if these solar panels are located next to or near any produce or organic fields, they could create food safety issues (i.e. E. coli in spinach caused by animal dropping getting into the field). Many produce growers today have to comply with Leafy Greens Agreements to ensure produce safety.

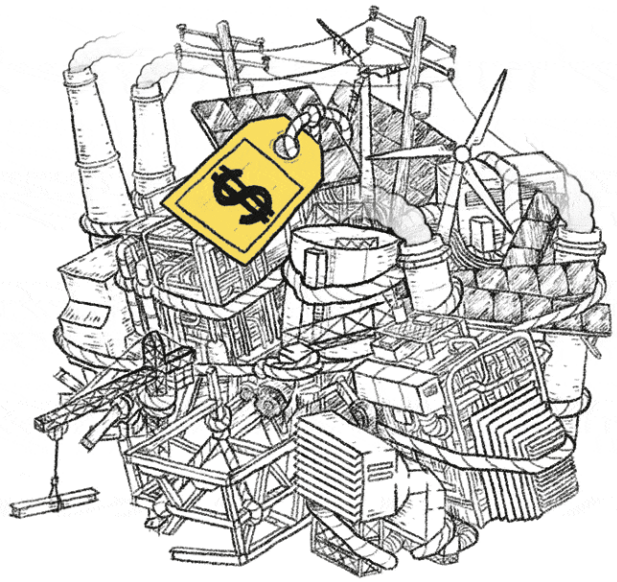
Sincerely,

Linda S. Evans for

Connie L. Valenzuela
Agricultural Commissioner
Sealer of Weights and Measures

EXHIBIT 4

Los Angeles Times (HTTP://WWW.LATIMES.COM/)



Californians are paying billions for power they don't need

We're using less electricity. Some power plants have even shut down. So why do state officials keep approving new ones?

By IVAN PENN (HTTP://WWW.LATIMES.COM/LA-BIO-IVAN-PENN-STAFF.HTML) and RYAN MENEZES (HTTP://WWW.LATIMES.COM/LA-BIO-RYAN-MENEZES-STAFF.HTML) | Reporting from Yuba City, Calif.

FEB. 5, 2017

Read the story

View the graphic (/projects/la-fi-electricity-capacity-graphic/)

The bucolic orchards of Sutter County north of Sacramento had never seen anything like it: a visiting governor and a media swarm — all to christen the first major natural gas power plant in California in more than a decade.

At its 2001 launch, the Sutter Energy Center was hailed as the nation's cleanest power plant. It generated electricity while using less water and natural gas than older designs.

A year ago, however, the $300-million plant closed indefinitely, just 15 years into an expected 30- to 40-year lifespan. The power it produces is no longer needed — in large part because state regulators approved the construction of a plant just 40 miles away in Colusa that opened in 2010.

"We are building more power plants in California than ever before. Our goal is to make California energy self-sufficient." - Gov. Gray Davis at the opening of Sutter Energy Center in 2001. (Carolyn Cole / Los Angeles Times)

Sutter Energy Center has been offline since 2016, after just 15 years of an expected 30- to 40-year lifespan. (David Butow / For The Times)

Two other large and efficient power plants in California also are facing closure decades ahead of schedule. Like Sutter, there is little need for their electricity.

California has a big — and growing — glut of power, an investigation by the Los Angeles Times has found. The state's power plants are on track to be able to produce at least 21% more electricity than it needs by 2020, based on official estimates. And that doesn't even count the soaring production of electricity by rooftop solar panels that has added to the surplus.

To cover the expense of new plants whose power isn't needed — Colusa, for example, has operated far below capacity since opening — Californians are paying a higher premium to switch on lights or turn on electric stoves. In recent years, the gap between what Californians pay versus the rest of the country has nearly doubled to about 50%.

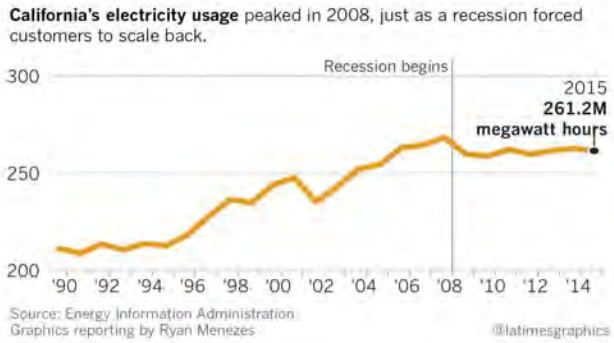
This translates into a staggering bill. Although California uses 2.6% less electricity annually from the power grid now than in 2008, residential and business customers together pay $6.8 billion more for power than they did

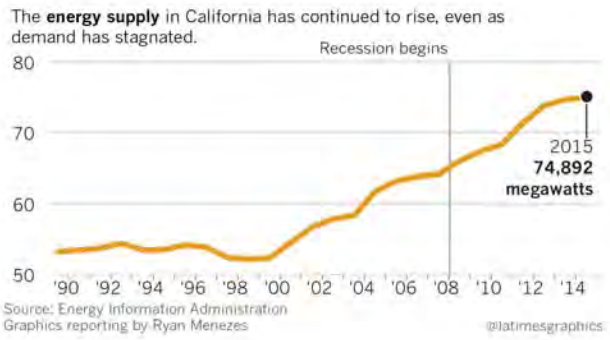
then. The added cost to customers will total many billions of dollars over the next two decades, because regulators have approved higher rates for years to come so utilities can recoup the expense of building and maintaining the new plants, transmission lines and related equipment, even if their power isn't needed.

How this came about is a tale of what critics call misguided and inept decision-making by state utility regulators, who have ignored repeated warnings going back a decade about a looming power glut.

"In California, we're blinding ourselves to the facts," said Loretta Lynch, a former president of the California Public Utilities Commission, who along with consumer advocacy groups has fought to stop building plants. "We're awash in power at a premium price."

California regulators have for years allowed power companies to go on a building spree, vastly expanding the potential electricity supply in the state. Indeed, even as electricity demand has fallen since 2008, California's new plants have boosted its capacity enough to power all of the homes in a city the size of Los Angeles — six times over. Additional plants approved by regulators will begin producing more electricity in the next few years.





The missteps of regulators have been compounded by the self-interest of California utilities, Lynch and other critics contend. Utilities are typically guaranteed a rate of return of about 10.5% for the cost of each new plant regardless of need. This creates a major incentive to keep construction going: Utilities can make more money building new plants than by buying and reselling readily available electricity from existing plants run by competitors.

Regulators acknowledge the state has too much power but say they are being prudent. The investment, they maintain, is needed in case of an emergency — like a power plant going down unexpectedly, a heat wave blanketing the region or a wildfire taking down part of the transmission network.

"We overbuilt the system because that was the way we provided that degree of reliability," explained Michael Picker, president of the California Public Utilities Commission. "Redundancy is important to reliability."

Some of the excess capacity, he noted, is in preparation for the retirement of older, inefficient power plants over the next several years. The state is building many new plants to try to meet California environmental standards requiring 50% clean energy by 2030, he said.

In addition, he said, some municipalities — such as the Los Angeles Department of Water and Power — want to maintain their own separate systems, which leads to inefficiencies and redundancies. "These are all issues that people are willing to pay for," Picker said.

Critics agree that some excess capacity is needed. And, in fact, state regulations require a 15% cushion. California surpasses that mark and is on pace to exceed it by 6 percentage points in the next three years, according to the Western Electricity Coordinating Council, which tracks capacity and reliability. In the past, the group has estimated the surplus would be even higher.

Michael Picker, current president of California's Public Utilities Commission, said the state's excess power supply is a strategic decision to ensure reliability. Loretta Lynch, who held the same position from 2002 to 2005, has been a critic of overbuilding since she chaired the regulatory agency. (Associated Press)

Even the 15% goal is "pretty rich," said Robert McCullough of Oregon-based McCullough Research, who has studied California's excess electric capacity for both utilities and regulators. "Traditionally, 10% is just fine. Below 7% is white knuckle. We are a long way from white-knuckle time" in California.

Contrary to Picker's assertion, critics say, customers aren't aware that too

much capacity means higher rates. "The winners are the energy companies," Lynch said. "The losers are businesses and families."

The over-abundance of electricity can be traced to poorly designed deregulation of the industry, which set the stage for blackouts during the energy crisis of 2000-2001.

Lawmakers opened the state's power business to competition in 1998, so individual utilities would no longer enjoy a monopoly on producing and selling electricity. The goal was to keep prices lower while ensuring adequate supply. Utilities and their customers were allowed to buy electricity from new, unregulated operators called independent power producers.

The law created a new exchange where electricity could be bought and sold, like other commodities such as oil or wheat.

Everyone would benefit. Or so the thinking went.

In reality, instead of lowering electricity costs and spurring innovation, market manipulation by Enron Corp. and other energy traders helped send electricity

prices soaring.

That put utilities in a bind, because they had sold virtually all their natural gas plants. No longer able to produce as much of their own electricity, they ran up huge debts buying power that customers needed. Blackouts spread across the state.

State leaders, regulators and the utilities vowed never to be in that position again, prompting an all-out push to build more plants, both utility-owned and independent.

"They were not going to allow another energy crisis due to a lack of generation," said Alex Makler, a senior vice president of Calpine, the independent power producer that owns the Sutter Energy plant not far from Sacramento.

But the landscape was starting to change. By the time new plants began generating electricity, usage had begun a decline, in part because of the economic slowdown caused by the recession but also because of greater energy efficiency.

The state went from having too little to having way too much power.

"California has this tradition of astonishingly bad decisions," said McCullough, the energy consultant. "They build and charge the ratepayers. There's nothing dishonest about it. There's nothing complicated. It's just bad planning."

> California has this tradition of astonishingly bad decisions.
>
> — Robert McCullough, energy consultant

The saga of two plants — Sutter Energy and Colusa — helps explain in a microcosm how California came to have too much energy, and is paying a high price for it.

Sutter was built in 2001 by Houston-based Calpine, which owns 81 power plants in 18 states.

Sutter Energy Center, now closed, made money only if Calpine Corp. found customers for the plant's power. Other large, natural gas plants in the state also face early closures. (David Butow / For The Times)

Colusa Generating Station opened in 2010. Pacific Gas & Electric will charge ratepayers more than $700 million over the plant's lifespan, to cover its operating costs and the profit guaranteed to public utility companies. (Rich Pedroncelli / AP)

Independents like Calpine don't have a captive audience of residential customers like regulated utilities do. Instead, they sell their electricity under contract or into the electricity market, and make money only if they can find customers for their power.

Sutter had the capacity to produce enough electricity to power roughly 400,000 homes. Calpine operated Sutter at an average of 50% of capacity in its early years — enough to make a profit.

But then Pacific Gas & Electric Co., a regulated, investor-owned utility, came along with a proposal to build Colusa.

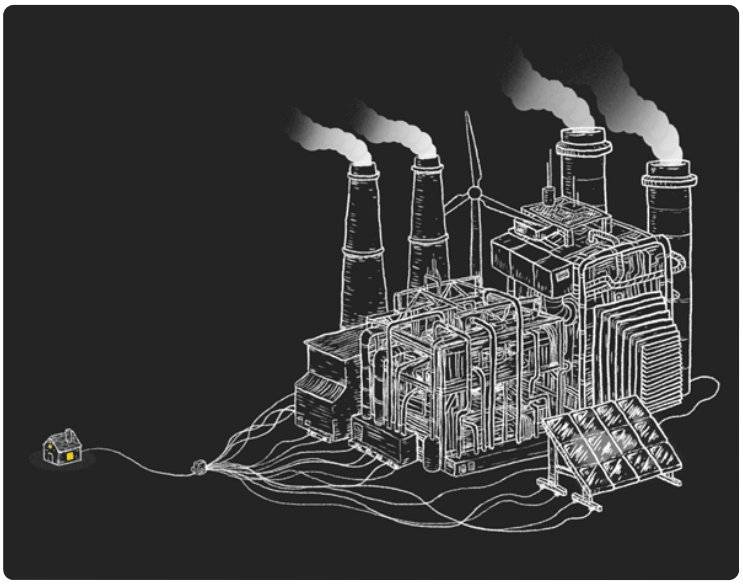
It was not long after a statewide heat wave, and PG&E argued in its 2007 request seeking PUC approval that it needed the ability to generate more power. Colusa — a plant almost identical in size and technology to Sutter — was the only large-scale project that could be finished quickly, PG&E said.

More than a half-dozen opponents, including representatives of independent power plants, a municipal utilities group and consumer advocates filed objections questioning the utility company. Wasn't there a more economical alternative? Did California need the plant at all?

They expressed concern that Colusa could be very expensive long-term for customers if it turned out that its power wasn't needed.

That's because public utilities such as PG&E operate on a different model.

If electricity sales don't cover the operating and construction costs of an independent power plant, it can't continue to run for long. And if the independent plant closes, the owner — and not ratepayers — bears the burden of the cost.



(/projects/la-fi-electricity-capacity-graphic/) (/projects/la-fi-electricity-capacity-graphic/) (/projects/la-fi-electricity-capacity-graphic/) California's energy supply: From blackouts to glut (/projects/la-fi-electricity-capacity-graphic/)

View the interactive graphic (/projects/la-fi-electricity-capacity-graphic/)

In contrast, publicly regulated utilities such as PG&E operate under more accommodating rules. Most of their revenue comes from electric rates approved by regulators that are set at a level to guarantee the utility recovers all costs for operating the electric system as well as the cost of building or buying a

power plant — plus their guaranteed profit.

Protesters argued Colusa was unnecessary. The state's excess production capacity by 2010, the year Colusa was slated to come online, was projected to be almost 25% — 10 percentage points higher than state regulatory requirements.

The looming oversupply, they asserted, meant that consumers would get stuck with much of the bill for Colusa no matter how little customers needed its electricity.

And the bill would be steep. Colusa would cost PG&E $673 million to build. To be paid off, the plant will have to operate until 2040. Over its lifetime, regulators calculated that PG&E will be allowed to charge more than $700 million to its customers to cover not just the construction cost but its operating costs and its profit.

Pacific Gas & Electric's Colusa Generating Station has operated at well below its generating capacity — just 47% in its first five years. (Rich Pedroncelli / AP)

The urgent push by PG&E "seems unwarranted and inappropriate, and potentially costly to ratepayers," wrote Daniel Douglass, a lawyer for industry groups that represent independent power producers.

The California Municipal Utilities Assn. — whose members buy power from public utilities and then distribute that power to their customers — also complained in a filing that PG&E's application appeared to avoid the issue of how Colusa's cost would be shared if it ultimately sat idle. PG&E's "application is confusing and contradicting as to whether or not PG&E proposes to have the issue of stranded cost recovery addressed," wrote Scott Blaising, a lawyer representing the association. ("Stranded cost" is industry jargon for investment in an unneeded plant.)

The arguments over Colusa echoed warnings that had been made for years by Lynch, the former PUC commissioner.

A pro-consumer lawyer appointed PUC president in 2000 by Gov. Gray Davis, Lynch consistently argued as early as 2003 against building more power plants.

"I was like, 'What the hell are we doing?' " recalled Lynch.

She often butted heads with other commissioners and utilities who pushed for more plants and more reserves. Midway though her term, the governor replaced her as president — with a former utility company executive.

One key battle was fought over how much reserve capacity was needed to guard against blackouts. Lynch sought to limit excess capacity to 9% of the

state's electricity needs. But in January 2004, over her objections, the PUC approved a gradual increase to 15% by 2008.

"We've created an extraordinarily complex system that gives you a carrot at every turn," Lynch said. "I'm a harsh critic because this is intentionally complex to make money on the ratepayer's back."

With Lynch no longer on the PUC, the commissioners voted 5-0 in June 2008 to let PG&E build Colusa. The rationale: The plant was needed, notwithstanding arguments that there was a surplus of electricity being produced in the market.

PG&E began churning out power at Colusa in 2010. For the nearby Sutter plant, that marked the beginning of the end as its electricity sales plummeted.

In the years that followed, Sutter's production slumped to about a quarter of its capacity, or just half the rate it had operated previously.

Calpine, Sutter's owner, tried to drum up new business for the troubled plant, reaching out to shareholder-owned utilities such as PG&E and other potential buyers. Calpine even proposed spending $100 million to increase plant efficiency and output, according to a letter the company sent to the PUC in February 2012.

PG&E rejected the offer, Calpine said, "notwithstanding that Sutter may have been able to provide a lower cost."

Asked for comment, PG&E said, "PG&E is dedicated to meeting the state's clean energy goals in cost-effective ways for our customers. We use competitive bidding and negotiations to keep the cost and risk for our customers as low as possible." It declined to comment further about its decision to build Colusa or on its discussions with Calpine.

Without new contracts and with energy use overall on the decline, Calpine had little choice but to close Sutter.

During a 2012 hearing about Sutter's distress, one PUC commissioner, Mike Florio, acknowledged that the plant's troubles were "just the tip of the proverbial iceberg." He added, "Put simply, for the foreseeable future, we have more power plants than we need."

Colusa, meanwhile, has operated at well below its generating capacity — just 47% in its first five years — much as its critics cautioned when PG&E sought approval to build it.

Sutter isn't alone. Other natural gas plants once heralded as the saviors of California's energy troubles have found themselves victims of the power glut. Independent power producers have announced plans to sell or close the 14-year-old Moss Landing power plant at Monterey Bay and the 13-year-old La Paloma facility in Kern County.

> Put simply, for the foreseeable future, we have more power plants than we need.
>
> — Mike Florio, former PUC commissioner

Robert Flexon, chief executive of independent power producer Dynegy Inc., which owns Moss Landing, said California energy policy makes it difficult for normal market competition. Independent plants are closing early, he said, because regulators favor utility companies over other power producers.

"It's not a game we can win," Flexon said.

Since 2008 alone — when consumption began falling — about 30 new power plants approved by California regulators have started producing

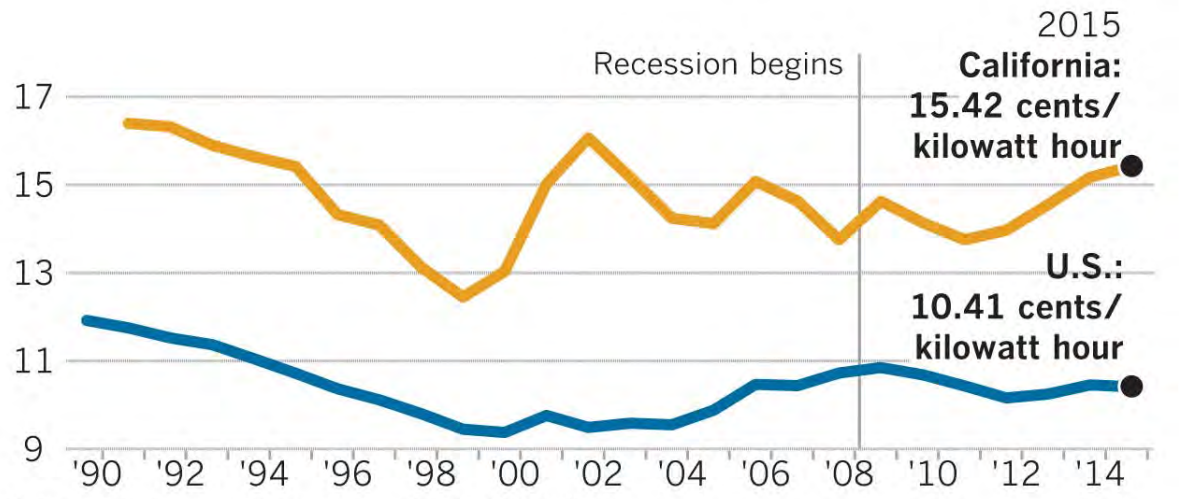
electricity. These plants account for the vast majority of the 17% increase in the potential electricity supply in the state during that period.

Hundreds of other small power plants, with production capacities too low to require the same level of review by state regulators, have opened as well.

Most of the big new plants that regulators approved also operate at below 50% of their generating capacity.

So that California utilities can foot the bill for these plants, the amount they are allowed by regulators to charge ratepayers has increased to $40 billion annually from $33.5 billion, according to data from the U.S. Energy Information Administration. This has tacked on an additional $60 a year to the average residential power bill, adjusted for inflation.

Another way of looking at the impact on consumers: The average cost of electricity in the state is now 15.42 cents a kilowatt hour versus 10.41 cents for users in the rest of the U.S. The rate in California, adjusted for inflation, has increased 12% since 2008, while prices have declined nearly 3% elsewhere in the country.



Note: cost of power figures are adjusted for inflation.
Source: Energy Information Administration
Graphics reporting by Ryan Menezes

@latimesgraphics

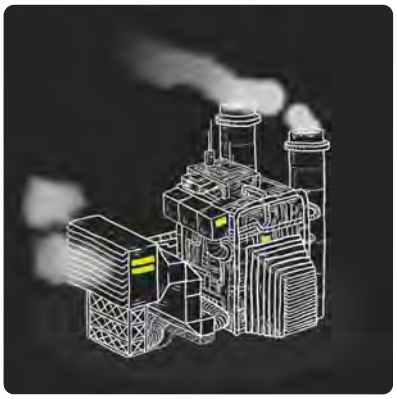
California utilities are "constantly crying wolf that we're always short of power and have all this need," said Bill Powers, a San Diego-based engineer and consumer advocate who has filed repeated objections with regulators to try to stop the approval of new plants. They are needlessly

trying to attain a level of reliability that is a worst-case "act of God standard," he said.

Even with the growing glut of electricity, consumer critics have found that it is difficult to block the PUC from approving new ones.

In 2010, regulators considered a request by PG&E to build a $1.15-billion power plant in Contra Costa County east of San Francisco, over objections that there wasn't sufficient demand for its power. One skeptic was PUC commissioner Dian Grueneich. She warned that the plant wasn't needed and its construction would lead to higher electricity rates for consumers — on top of the 28% increase the PUC had allowed for PG&E over the previous five years.

The PUC was caught in a "time warp," she argued, in approving new plants as electricity use fell. "Our obligation is to ensure that our decisions have a legitimate factual basis and that ratepayers' interest are protected."



(/projects/la-fi-electricity-capacity-graphic/)
California's energy supply: From blackouts to glut (/projects/la-fi-electricity-capacity-graphic/)

View the interactive graphic (/projects/la-fi-electricity-capacity-graphic/)

Her protests were ignored. By a 4-to-1 vote, with Grueneich the lone dissenter, the commissioners approved the building of the plant.

Consumer advocates then went to court to stop the project, resulting in a rare victory against the PUC. In February 2014, the California Court of Appeals overturned the commission, ruling there was no evidence the plant was needed.

Recent efforts to get courts to block several other PUC-approved plants have failed, however, so the projects are moving forward.

Contact the reporters (mailto:ivan.penn@latimes.com; ryan.menezes@latimes.com?subject=The Power Boom). For more coverage follow @ivanlpenn (https://twitter.com/ivanlpenn) and @ryanvmenezes (https://twitter.com/ryanvmenezes)

Times data editor Ben Welsh contributed to this report. Illustrations by Eben McCue. Graphics by Priya Krishnakumar and Paul Duginski. Produced by Lily Mihalik

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More from the Los Angeles Times

(http://www.latimes.com/business/la-fi-dwp-solar-deserts-20161122-story.html)
The DWP is expanding its rooftop panel program to the 'solar desert' to meet its energy goals
(http://www.latimes.com/business/la-fi-dwp-solar-deserts-20161122-story.html)

(http://www.latimes.com/business/la-fi-eight-mile-leak-20161015-snap-story.html)
A gas leak in affluent Porter Ranch got national attention. This poor Alabama town has smelled like rotten eggs for eight years
(http://www.latimes.com/business/la-fi-eight-mile-leak-20161015-snap-story.html)

(http://www.latimes.com/business/la-fi-gas-prices-20161011-snap-story.html)
Wholesale gasoline prices surge after power outage shuts down Torrance refinery
(http://www.latimes.com/business/la-fi-gas-prices-20161011-snap-story.html)

(http://www.latimes.com/business/la-fi-energy-crisis-ruling-20160908-snap-story.html)
Federal appeals court upholds $200-million penalty for California energy crisis
(http://www.latimes.com/business/la-fi-energy-crisis-ruling-20160908-snap-story.html)

EXHIBIT 5

IMPERIAL COUNTY

DRAFT FIRE HAZARD SEVERITY ZONES IN LRA

CAL FIRE FRAP
Fire and Resource Assessment Program
California Department of Forestry and Fire Protection

RIVERSIDE COUNTY
ARIZONA
SAN DIEGO COUNTY
MEXICO
SALTON SEA
Colorado River

Pope
Truckhaven
Niland
Calipatria
Kane Spring
Westmorland
Hovley
Brawley
Orita
Imperial
Imperial Gables
Glamis
Holtville
Anza
El Centro
Seeley
Ocotillo
Calexico
Ross Corner
Araz Junction

33°36'0"N
33°30'0"N
33°24'0"N
33°18'0"N
33°12'0"N
33°6'0"N
33°0'0"N
32°54'0"N
32°48'0"N
32°42'0"N
116°6'0"W
116°0'0"W
115°54'0"W
115°48'0"W
115°42'0"W
115°36'0"W
115°30'0"W
115°24'0"W
115°18'0"W
115°12'0"W
115°6'0"W
115°0'0"W
114°54'0"W
114°48'0"W
114°42'0"W
114°36'0"W
114°30'0"W
114°24'0"W

Projection Albers, NAD 1927
Scale 1: 150,000
at 46" x 35.5"
September 19, 2007

FIRE HAZARD SEVERITY ZONES

- LRA Very High
- LRA High
- LRA Moderate
- LRA Unzoned
- Other Very High
- Other High
- Other Moderate
- Other Unzoned
- Incorporated Cities

Government Code 51175-89 direct the California Department of Forestry and Fire Protection (CAL FIRE) to map areas of very high fire hazard within Local Responsibility Areas (LRA). Mapping of the areas, referred to as Very High Fire Hazard Severity Zones (VHFHSZ), is based on relevant factors such as fuels, terrain, and weather. VHFHSZ maps were initially developed in the mid-1990s but are now being updated based on improved science, mapping techniques, and data.

The California Building Commission adopted the Wildland-Urban Interface codes in late 2005 to be effective in 2008. These new codes include provisions to improve the ignition resistance of buildings, especially from firebrands. The updated fire hazard severity zones will be used by building officials to determine appropriate construction materials for new buildings in the Wildland-Urban Interface. The updated zones will also be used by property owners to comply with natural hazards disclosure requirements at time of property sale and 100 foot defensible space clearance. It is likely that the fire hazard severity zones will be used for updates to the safety element of general plans.

This map has been created by CAL FIRE's Fire and Resource Assessment Program (FRAP) using data and models describing development patterns, **potential** fuels over a 30-50 year time horizon, expected fire behavior, and expected burn probabilities to quantify the likelihood and nature of vegetation fire exposure (including firebrands) to new construction. Details on the project and specific modeling methodology can be found at http://frap.cdf.ca.gov/projects/hazard/methods.htm.

The version dated September 17, 2007 of the map shown here represents draft VHFHSZs within LRA, for review and comment by local government.

An interactive system for viewing map data is hosted by the UC Center for Fire at http://firecenter.berkeley.edu/fhsz/

Questions can be directed to;

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Arnold Schwarzenegger, Governor,
State of California
Mike Chrisman, Secretary for Resources,
The Resources Agency
Ruben Grijalva, Director,
Department of Forestry and Fire Protection

MAP ID: FHSZL06_1_MAP
DATA SOURCES
CAL FIRE Fire Hazard Severity Zones (FHSZL06_1)
CAL FIRE State Responsibility Areas (SRA05_4)
CAL FIRE Incorporated Cities (Incorp07_2)
PLSS (1:100,000 USGS, Land Grants with CAL FIRE grid)

EXHIBIT 6

Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis

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Executive Summary

This report summarizes data on bird mortality at three solar energy facilities in southern California: Desert Sunlight, Genesis, and Ivanpah. These facilities use different solar technologies, but avian mortality was documented at each site. Desert Sunlight is a photovoltaic facility, Genesis employs a trough system with parabolic mirrors, and Ivanpah uses a power tower as a focal point for solar flux.

FINDINGS

Trauma was the leading cause of death documented for remains at the Desert Sunlight and Genesis sites. Trauma and solar flux injury were both major causes of mortality at the Ivanpah site. Exposure to solar flux caused singeing of feathers, which resulted in mortality in several ways. Severe singeing of flight feathers caused catastrophic loss of flying ability, leading to death by impact with the ground or other objects. Less severe singeing led to impairment of flight capability, reducing ability to forage and evade predators, leading to starvation or predation. Our examinations did not find evidence for significant tissue burns or eye damage caused by exposure to solar flux.

Cause of Death	Ivanpah	Genesis	Desert Sunlight	Total
Solar Flux	47	0	0	47
Impact trauma	24	6	19	49
Predation trauma	5	2	15	22
Trauma of undetermined cause	14	0	0	14
Electrocution	1	0	0	1
Emaciation	1	0	0	1
Undetermined (remains in poor condition)	46	17	22	85
No evident cause of death	3	6	5	14
Total	141	31	61	233

These solar facilities appear to represent “equal-opportunity” hazards for the bird species that encounter them. The remains of 71 species were identified, representing a broad range of ecological types. In body size, these ranged from hummingbirds to pelicans; in ecological type from strictly aerial feeders

(swallows) to strictly aquatic feeders (grebes) to ground feeders (roadrunners) to raptors (hawks and owls). The species identified were equally divided among resident and non-resident species, and nocturnal as well as diurnal species were represented. Although not analyzed in detail, there was also significant bat and insect mortality at the Ivanpah site, including monarch butterflies. It appears that Ivanpah may act as a **"mega-trap,"** attracting insects which in turn attract insect-eating birds, which are incapacitated by solar flux injury, thus attracting predators and creating an entire food chain vulnerable to injury and death.

			Foraging Zone			Residency Status	
SITE	No. Remains	Identifiable Remains	Air	Terr	Water	Resident	Migrant
Ivanpah	141	127	28	85	14	63	64
Genesis	31	30	12	12	6	20	10
Desert Sun	61	56	7	22	27	18	38
TOTALS	233	213	47	119	47	101	112

CONCLUSIONS AND RECOMMENDATIONS

In summary, three main causes of avian mortality were identified at these facilities: impact trauma, solar flux, and predation. Birds at all three types of solar plants were susceptible to impact trauma and predators. Predation was documented mostly at the photovoltaic site, and in many cases appeared to be associated with stranding or nonfatal impact trauma with the panels, leaving birds vulnerable to resident predators. Solar flux injury, resulting from exposures to up to 800º F, was unique to the power tower facility. Our findings demonstrate that a broad ecological variety of birds are vulnerable to morbidity and mortality at solar facilities, though some differential mortality trends were evident, such as waterbirds at Desert Sunlight, where open water sources were present; and insectivores at Ivanpah, where insects are attracted to the solar tower.

Specific hazards were identified, including vertically-oriented mirrors or other smooth reflective panels; water-like reflective or polarizing panels; actively fluxing towers; open bodies of water; aggregations of insects that attracted insectivorous birds; and resident predators. Making towers, ponds and panels less attractive or accessible to birds may mitigate deaths. Specific actions should include:

Monitoring/detection measures:

1) Install video cameras sufficient to provide 360 degree coverage around each tower to record birds (and bats) entering and exiting the flux

2) For at least two years (and in addition to planned monitoring protocol), conduct daily surveys for birds (at all three facilities), as well as insects and bats (in the condenser building at Ivanpah) around each tower at the base of and immediately adjacent to the towers in the area cleared of vegetation. Timing of daily surveys can be adjusted to minimize scavenger removal of carcasses as recommended by the TAC. Surveys in the late afternoon might be optimal for bird carcasses, and first light for bat carcasses.

3) Use dogs for monitoring surveys to detect dead and injured birds that have hidden themselves in the brush, both inside and outside the perimeter of the facility

4) To decrease removal of carcasses, implement appropriate raven deterrent actions

Bird Mortality Avoidance Measures*:*

1) Increase cleared area around tower at Ivanpah to decrease attractive habitat; at least out to fence

2) Retrofit visual cues to existing panels at all three facilities and incorporate into new panel design. These cues should include UV-reflective or solid, contrasting bands spaced no further than 28 cm from each other

3) Suspend power tower operation during peak migration times for indicated species

4) Avoid vertical orientation of mirrors whenever possible, for example tilt mirrors during washing

5) Properly net or otherwise cover ponds

6) Place perch deterrent devices where indicated, eg. on tower railings near the flux field

7) Employ exclusionary measures to prevent bats from roosting in and around the condenser facility at Ivanpah.

It must be emphasized that we currently have a very incomplete knowledge of the scope of avian mortality at these solar facilities. Challenges to data collection include: large facilities which are difficult to efficiently search for carcasses; vegetation and panels obscuring ground visibility; carcass loss due to scavenging; rapid degradation of carcass quality hindering cause of death and species determination; and inconsistent documentation of carcass history.

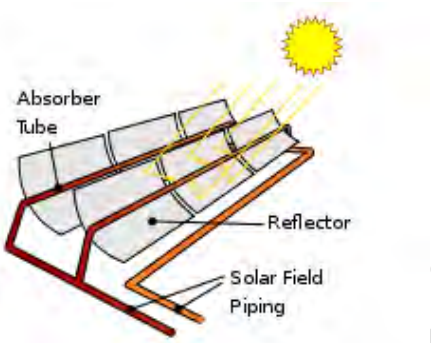
To rectify this problem, video cameras should be added to the solar towers to record bird mortality and daily surveys of the area at the base of and immediately adjacent to the towers should be conducted. At all the facilities, a protocol for systematic, statistically-rigorous searches for avian remains should be developed, emphasizing those areas where avian mortality is most likely to occur. Investigation into bat and insect mortalities at the power tower site should also be pursued.

Finally, there are presently little data available on how solar flux affects birds and insects. Studies of the temperatures experienced by objects in the flux; of the effects of high temperatures on feather structure and function; and of the behavior of insects and birds in response to the flux and related phenomena (e.g. “light clouds”) are all essential if we are to understand the scope of solar facility effects on wildlife.

Introduction

The National Fish and Wildlife Forensics Laboratory was requested to determine cause of death for birds found at facilities that generate electricity from solar energy. Solar generating facilities can be classified into three major types: photovoltaic sites, trough systems and solar power towers. There is much written about these systems so this report will not include any technical details, but simply mention the differences and their potential impact on birds.

1) **Photovoltaic systems** directly convert the sun's light into electricity. The perceived threat to birds is associated with the presence of water ponds which attract birds and from traumatic impact with the photovoltaic cells. An example of this type of solar power plant is Desert Sunlight Solar Farm (AKA First Solar).



2) **Trough systems** are composed of parabolic mirrors which focus and reflect the sun to a tube that converts the heat from the sun into electricity. The perceived threat to birds is associated with the presence of water ponds which attract birds and from traumatic impact with the trough structures. An example of this type of solar power plant is Genesis Solar Energy Project.

3) **Solar power tower**s use thousands of mirrors to reflect the solar energy to a tower, where water in a boiler is converted to steam, generating the electricity. The perceived threat to birds is associated traumatic impact with the mirrors and the danger associated with the heat produced by the mirrors. An example of this type of solar power plant is Ivanpah Solar Electric Generating System.

Methods

Carcasses were collected at the different solar power plant sites by either US Fish and Wildlife Service employees or by energy company staff. The collection of the carcasses was opportunistic; that is, not according to a pre-determined sampling schedule or protocol. There was no attempt to quantify the number of carcasses that scavengers or predators removed from the solar facilities' grounds, or to compare the distribution of carcasses inside and outside the boundaries of the solar facility sites.

Additionally, three USFWS/-OLE staff, including two Forensics Lab staff (EOE and RAK), visited the Ivanpah Solar plant from October 21 – 24, 2013. Their on-site observations are included in this report.

A total of 233 birds collected from three different facilities were examined; 141 from a solar thermal power tower site (Ivanpah, Bright Source Inc.), 31 from a parabolic trough site (Genesis, NextEra Energy Inc.) and 61 from a photovoltaic (PV) panel site (Desert Sunlight, First Solar Inc.). Nine of the Ivanpah birds were received fresh; 7 of those were necropsied during a site visit by a Forensics Laboratory pathologist (RAK). The rest of the birds were received frozen and allowed to thaw at room temperature prior to species identification and necropsy. Species determination was made by the Forensics Laboratory ornithologist (PWT) for all birds either prior to necropsy or, for those necropsied on-site, from photos and the formalin-fixed head. All data on carcass history (location of the carcass, date of collection and any additional observations) were transcribed, although these were not available for all carcasses.

As part of the gross pathological examination, whole carcasses were radiographed to help evaluate limb fractures and identify any metal foreign bodies. Alternate light source examination using an Omnichrome Spectrum 9000+ at 570 nm with a red filter helped rule in or out feather burns by highlighting subtle areas of feather charring (Viner et al., 2014). All birds or bird parts from Ivanpah without obvious burns were examined with the alternate light source, as well as any bird reportedly found near a power line and a random sub-sample of the remaining birds from Genesis and Desert Sunlight (Viner, T. C., R. A. Kagan, and J. L. Johnson, 2014, Using an alternate light source to detect electrically singed feathers and hair in a forensic setting. Forensic Science International, v. 234, p. e25-e29).

Carcass quality varied markedly. If carcasses were in good post mortem condition, representative sections of heart, lung, kidney, liver, brain and gastrointestinal tract as well as any tissues with gross lesions were collected and fixed in 10% buffered formalin. Full tissue sets were collected from the fresh specimens. Formalin-fixed tissues were routinely processed for histopathology, paraffin-embedded, cut at 4 µm and stained with hematoxylin and eosin. Tissues from 63 birds were examined microscopically: 41 from Ivanpah, 1 from Genesis and 21 from Desert Sunlight.

Birds with feather burns were graded based on the extent of the lesions. Grade 1 birds had curling of less than 50% of the flight feathers. Grade 2 birds had curling of 50% or more of the flight feathers. Grade 3 birds had curling and visible charring of contour feathers (Figure 1).

Figure 1: Three grades of flux injury based on extent and severity of burning. Grade 1 (top); Yellow-rumped Warbler with less than 50% of the flight feathers affected (note sparing of the yellow rump feathers). Grade 2 (middle); Northern Rough-winged Swallow initially found alive but unable to fly, with greater than 50% of the flight feathers affected. Grade 3 (bottom); MacGillivray's Warbler with charring of feathers around the head, neck, wings and tail.

Bird Species Recovered at Solar Power Facilities

Tables 1-4 and Appendix 1 summarize 211 identifiable bird remains recovered from the three solar facilities included in this study. These birds constitute a taxonomically diverse assemblage of 71 species, representing a broad range of ecological types. In body size, these species ranged from hummingbirds to pelicans; in ecological type from strictly aerial feeders (e.g. swifts and swallows) to strictly aquatic feeders (pelicans and cormorants) to ground feeders (roadrunners) to raptors (hawks and owls). The species identified were equally divided among resident and non-resident species. Nocturnal as well as diurnal species were represented.

In Tables 1-4 and Appendix 1, bird species are categorized into very general ecological types by foraging zone and residency status. Foraging Zones were "air" (a significant portion of foraging activity performed in the air), "terrestrial" (including foraging both in vegetation and on the ground), and "water" (foraging associated with water, including waders as well as aquatic birds). Residency Status was "resident" (for breeding or year-round residents) and "migrant" (for both passage migrants and non-breeding-season residents). For a number of species, the appropriate classification for residency status was uncertain, due to a lack of detailed knowledge of the sites. The present classification is based on published range maps, and is subject to revision as more information becomes available.

This dataset is not suitable for statistical analysis, due to the opportunistic and unstandardized collection of avian remains at the facilities, and the lack of baseline data on bird diversity and abundance at each site. Nevertheless, a few conclusions can be noted. First, these data do not support the idea that these solar facilities are attracting particular species. Of the 71 bird species identified in remains, only five species were recovered from all three sites. These five were American Coot, Mourning Dove, Lesser Nighthawk, Tree Swallow, and Brown-headed Cowbird, again emphasizing the ecological variety of birds vulnerable to mortality at the solar facilities. Over two-thirds (67%) of the species were found at only a single site

(Appendix 1). That being said, the Desert Sunlight facility had particularly high mortality among waterbirds, suggesting a need to render the ponds at that site inaccessible or unattractive to these species.

The diversity of birds dying at these solar facilities, and the differences among sites, suggest that there is no simple "fix" to reduce avian mortality. These sites appear to represent "equal-opportunity" mortality hazards for the bird species that encounter them. Actions to reduce or mitigate avian mortality at solar facilities will need to be designed on a site-specific basis, and will require much more data on the bird communities at each site, and on how mortality is occurring. Carefully-designed mortality studies might reveal significant patterns of vulnerability that are not evident in these data.

Table 1. Summary data on avian mortality at the three solar sites included in this study. See summary for discussion of Foraging Zone and Residency Status categories.

				Foraging Zone			Residency Status	
SITE	**No. Species**	**No. Remains**	**Identifiable Remains**	**Air**	**Terr**	**Water**	**Resident**	**Migrant**
Ivanpah	49	141	127	26	85	14	63	64
Genesis	15	31	30	12	12	6	20	10
Desert Sun	33	61	56	7	22	27	18	38
TOTALS	71	233	213	47	119	47	101	112

Table 2. Species identified from avian remains at the Desert Sunlight photovoltaic solar facility. MNI = minimum number of individuals of each species represented by the identifiable remains. In some cases (e.g. Cinnamon/Blue-winged Teal), closely related species could not be distinguished based on the available remains, but the Foraging Zone and Residency Status could still be coded, due to the ecological similarities of the species involved. Total identified birds = 56.

DESERT SUNLIGHT		Zone	Residency	MNI
Pied-billed Grebe	*Podilymbus podiceps*	water	migrant	1
Eared Grebe	*Podiceps nigricollis*	water	migrant	3
Sora	*Porzana carolina*	water	migrant	1
American Avocet	*Recurvirostra americana*	water	migrant	1
Cinnamon/Blue-winged Teal	*Anas discors/clypeata*	water	migrant	1
Western Grebe	*Aechmophorus occidentalis*	water	migrant	9
Brown Pelican	*Pelecanus occidentalis*	water	migrant	2
Double-crested Cormorant	*Phalacrocorax auritus*	water	migrant	2
Black-crowned Night-Heron	*Nycticorax nycticorax*	water	migrant	1
Yuma Clapper Rail	*Rallus longirostris*	water	resident	1
American Coot	*Fulica americana*	water	migrant	5
Mourning Dove	*Zenaida macroura*	terr	resident	3
White-winged Dove	*Zenaida asiatica*	terr	resident	1
Lesser Nighthawk	*Chordeiles acutipennis*	air	resident	2
Common Poorwill	*Phalaenoptilus nuttallii*	air	resident	1
Costa's Hummingbird	*Calypte costae*	air	resident	1
Ash-throated Flycatcher	*Myiarchus cinerascens*	air	resident	1
Black-throated/Sage Sparrow	*Amphispiza sp.*	terr	resident	1
Black Phoebe	*Sayornis nigricollis*	air	resident	1
Loggerhead Shrike	*Lanius ludovicianus*	terr	resident	2
Common Raven	*Corvus corax*	terr	resident	1
Horned Lark	*Eremophila alpestris*	terr	migrant	1
Tree Swallow	*Tachycineta bicolor*	air	migrant	1
Townsend's Warbler	*Setophaga townsendi*	terr	migrant	2
Common Yellowthroat	*Geothlypis trichas*	terr	migrant	1
Savannah Sparrow	*Passerculus sandwichensis*	terr	migrant	1
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	terr	migrant	1
Wilson's Warbler	*Cardellina pusilla*	terr	migrant	2
Western Tanager	*Piranga ludoviciana*	terr	migrant	2
Black-headed Grosbeak	*Pheucticus melanocephalus*	terr	migrant	1
Great-tailed Grackle	*Quiscalus mexicanus*	terr	resident	2
Brown-headed Cowbird	*Molothrus ater*	terr	resident	1

Table 3. Species identified from avian remains at the Genesis trough system solar facility. Total identified birds = 30.

GENESIS		Zone	Residency	MNI
Eared Grebe	*Podiceps nigricollis*	water	migrant	2
Great Blue Heron	*Ardea herodias*	water	migrant	1
American Kestrel	*Falco sparverius*	air	resident	1
Ring-billed Gull	*Larus delawarensis*	water	migrant	2
California Gull	*Larus californianus*	water	resident	1
White-winged Dove	*Zenaida asiatica*	terr	resident	1
Lesser Nighthawk	*Chordeiles acutipennis*	air	resident	2
Say's Phoebe	*Sayornis saya*	air	resident	2
Tree Swallow	*Tachycineta bicolor*	air	migrant	2
Cliff Swallow	*Petrochelidon pyrrhonota*	air	resident	5
Hermit Warbler	*Setophaga occidentalis*	terr	migrant	1
Black-headed Grosbeak	*Pheucticus melanocephalus*	terr	migrant	1
Chipping Sparrow	*Spizella passerina*	terr	resident	1
Bullock's Oriole	*Icterus bullockii*	terr	resident	2
Brown-headed Cowbird	*Molothrus ater*	terr	resident	6

Table 4. Species identified from avian remains at the Ivanpah power tower solar facility. Total identified birds = 127

IVANPAH		Zone	Residency	MNI
Cinnamon Teal	*Anas cyanoptera*	water	migrant	4
Cooper's Hawk	*Accipiter cooperii*	air	migrant	1
Red-shouldered Hawk	*Buteo lineatus*	terr	migrant	1
American Kestrel	*Falco sparverius*	air	resident	1
Peregrine Falcon	*Falco peregrinus*	air	resident	1
American Coot	*Fulica americana*	water	migrant	7
Sora	*Porzana carolina*	water	migrant	1
Spotted Sandpiper	*Actitis maculatus*	water	migrant	2
Greater Roadrunner	*Geococcyx californianus*	terr	resident	5
Yellow-billed Cuckoo	*Coccyzus americanus*	terr	migrant	1
Mourning Dove	*Zenaida macroura*	terr	resident	11
Barn Owl	*Tyto alba*	terr	resident	1
Lesser Nighthawk	*Chordeiles acutipennis*	air	resident	3
Common Poorwill	*Phalaenoptilus nuttallii*	air	resident	1
White-throated Swift	*Aeronautes saxatalis*	air	resident	1
Allen's/Rufous Hummingbird	*Selasphorus sp.*	air	migrant	1
Northern Flicker	*Colaptes auratus*	terr	resident	1
Ash-throated Flycatcher	*Myiarchus cinerascens*	air	resident	1
Loggerhead Shrike	*Lanius ludovicianus*	terr	resident	3
Warbling Vireo	*Vireo gilvus*	terr	migrant	1
Common Raven	*Corvus corax*	terr	resident	2
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	air	migrant	2
Tree Swallow	*Tachycineta bicolor*	air	migrant	2
Verdin	*Auriparus flaviceps*	terr	resident	3
Blue-gray Gnatcatcher	*Polioptila caerulea*	terr	resident	1
Northern Mockingbird	*Mimus polyglottos*	terr	resident	1
American Pipit	*Anthus rubescens*	terr	migrant	4
Orange-crowned Warbler	*Oreothlypis celata*	terr	migrant	1
Lucy's Warbler	*Oreothlypis luciae*	terr	resident	1
Black-throated Gray Warbler	*Setophaga nigrescens*	terr	migrant	1
Yellow-rumped Warbler	*Setophaga coronata*	air	migrant	14
Townsend's Warbler	*Setophaga townsendi*	terr	migrant	2
Yellow Warbler	*Setophaga petechia*	terr	migrant	1
Black-and-white Warbler	*Mniotilta varia*	terr	migrant	1
Wilson's Warbler	*Cardellina pusilla*	terr	migrant	2
MacGillivray's Warbler	*Oporornis tolmei*	terr	migrant	1
Western Tanager	*Piranga ludoviciana*	terr	migrant	2
Lazuli Bunting	*Passerina amoena*	terr	migrant	1
Blue Grosbeak	*Passerina caerulea*	terr	resident	1
Green-tailed Towhee	*Pipilo chlorurus*	terr	migrant	1
Brewer's Sparrow	*Spizella breweri*	terr	resident	3
Chipping Sparrow	*Spizella passerina*	terr	resident	3
Black-throated Sparrow	*Amphispiza bilineata*	terr	resident	3
Savannah Sparrow	*Passerculus sandwichensis*	terr	migrant	2
White-crowned Sparrow	*Zonotrichia leucophrys*	terr	migrant	6

IVANPAH		Zone	Residency	MNI
Pine Siskin	*Spinus pinus*	terr	migrant	1
House Finch	*Carpodacus mexicanus*	terr	resident	13
Brown-headed Cowbird	*Molothrus ater*	terr	resident	1
Great-tailed Grackle	*Quiscalus mexicanus*	terr	resident	3

Cause of Death of Birds Found at the Solar Power Plants

Photovoltaic facility (Desert Sunlight):

Sixty-one birds from 33 separate species were represented from Desert Sunlight. Due to desiccation and scavenging, a definitive cause of death could not be established for 22 of the 61 birds (see Table 5). Feathers could be examined in all cases, however, and none of the 61 bird remains submitted from the PV facility had visible evidence of feather singeing, a clear contrast with birds found at Ivanpah.

Blunt force impact trauma was determined to have been the cause of death for 19 Desert Sunlight birds including two Western Grebes (*Aechmophorus occidentalis*) and one each of 16 other species. Impact (blunt force) trauma is diagnosed by the presence of fractures and internal and/or external contusions. In particular, bruising around the legs, wings and chest are consistent with crash-landings while fractures of the head and/or neck are consistent with high-velocity, frontal impact (such as may result from impacting a mirror).

Predation was the immediate cause of death for 15 birds. Lesions supporting the finding of predation included decapitation or missing parts of the body with associated hemorrhage (9/15), and lacerations of the skin and pectoral muscles. Eight of the predated birds from Desert Sunlight were

Figure 2: Predation trauma (top) resulting in traumatic amputation of the head and neck (American Avocet) and impact trauma (bottom) causing bruising of the keel ridge of the sternum (Brown Pelican).

grebes, which are unable to easily take off from land. This suggests a link between predation and stranding and/or impact resulting from confusion of the solar panels with water (see Discussion).

Parabolic trough facility (Genesis):

Thirty-one birds were collected from this site. There were 15 species represented. Those found in the greatest numbers were Brown-headed Cowbirds and Cliff Swallows, though no more than 6 individuals from any given species were recovered. Overall, carcass quality was poor and precluded definitive cause of death determination in 17/31 birds (Table 5). Identifiable causes of death consisted of impact trauma (6/31) and predation trauma (2/31). Necropsy findings were similar to those at Desert Sunlight with fractures and hemorrhage noted grossly. Predation trauma was diagnosed in two birds, a Cliff Swallow and a Ring-billed Gull.

Power tower facility (Ivanpah):

Ivanpah is the only facility in this study that produces solar flux, which is intense radiant energy focused by the mirror array on the power-generating tower. Objects that pass through this flux, including insects and birds, encounter extreme heat, although the extent of heating depends on many variables, including the duration of exposure and the precise location in the flux beam.

From Ivanpah, 141 birds were collected and examined. Collection dates spanned a period of one year and five months (July 2012 to December 2013) and included at least seven months of construction during which time the towers were not actively fluxing (2013). There were 49 species represented (Table 4). Those found in the greatest numbers were Yellow-rumped Warblers (*Setophaga coronata;* 14), House Finches (*Carpodacus mexicanus*; 13), Mourning Doves (*Zenaida macroura*; 11) and American Coots (*Fulica americana*; 7). Yellow-rumped Warblers and House Finches were found exclusively at the power tower site.

Solar flux injury was identified as the cause of death in 47/141 birds. Solar flux burns manifested as feather curling, charring, melting and/or breakage and loss. Flight feathers of the tail and/or wings were invariably affected. Burns also tended to occur in one or more of the following areas; the sides of the body (axillae to pelvis), the dorsal coverts, the tops and/sides of the head and neck and the dorsal body wall (the back). Overlapping portions of feathers and light-colored feathers were often spared (Figures 3 and 4).

Figure 3: contour feather from the back of a House Finch with Grade 3 solar flux injury. The feather has curling and charring limited to the exposed tip.

Figure 4: Feather from a Peregrine Falcon with Grade 2 solar flux injury. Note burning of dark feather bands with relative sparing of light bands.

The yellow and red rumps of Yellow-rumped Warblers and House Finches respectively remained strikingly unaffected (See Figure 1). Charring of head feathers, in contrast, was generally diffuse across all color patterns. A pattern of spiraling bands of curled feathers across or around the body and wings was often apparent.

Table 5. Cause of death (COD) data

Cause of Death	Ivanpah	Genesis	Desert Sunlight	Total
Solar Flux	47	0	0	47
Impact trauma	24	6	19	49
Predation trauma	5	2	15	22
Trauma of undetermined cause	14	0	0	14
Electrocution	1	0	0	1
Emaciation	1	0	0	1
Undetermined (remains in poor condition)	46	17	22	85
No evident cause of death	3	6	5	14
Total	141	31	61	233

Eight birds were assigned a feather damage Grade of 1 with curling of less than 50% of the flight feathers. Six of these had other evidence of acute trauma (75%). Five birds were Grade 2, including three birds that were found alive and died shortly afterwards. Of these birds, 2 (the birds found dead) also had evidence of acute trauma. Twenty-eight birds were Grade 3; with charring of body feathers. Of these birds, 21/28

(28%) had other evidence of acute trauma. Remaining carcasses (6) were incomplete and a grade could not be assigned.

Twenty-nine birds with solar flux burns also had evidence of impact trauma. Trauma consisted of skull fractures or indentations (8), sternum fractures (4), one or more rib fractures (4), vertebral fractures (1), leg fracture (3), wing fracture (1) and/or mandible fracture (1). Other signs of trauma included acute macroscopic and/or microscopic internal hemorrhage. Location found was reported for 39 of these birds; most of the intact carcasses were found near or in a tower. One was found in the inner heliostat ring and one was found (alive) on a road between tower sites. The date of carcass collection was provided for 42/47. None were found prior to the reported first flux (2013).

Figure 5: The dorsal aspect of the wing from a Peregrine Falcon (the same bird as shown in Figure 4) with Grade 2 lesions. Note extensive curling of feathers without visible charring. This bird was found alive, unable to fly, emaciated and died shortly thereafter. These findings demonstrate fatal loss of function due to solar flux exposure in the absence of skin or other soft tissue burns.

Among the solar flux cases, a variety of bird species were affected though all but one (a raptor) was a passerine (Appendix 2). House Finches and yellow-rumped Warblers were most often represented (10/47 and 12/47 respectively). For the birds in which species could be determined (41/47), insects were a major

dietary component in all but two species. These were an unidentified hummingbird (*Selasphorus*) species (known to include insects in the diet) and a Peregrine Falcon (a species that feeds on small birds).

Four birds were reportedly found alive and taken to a wildlife rehabilitation center where they died one to a few days later (exact dates were not consistently provided). Three had Grade 2 feather burns and one had Grade 3 feather burns. None had other evidence of trauma. Body condition was reduced in all of the birds (two considered thin and two emaciated) based on a paucity of fat stores and depletion of skeletal muscling. The four birds were of four different species and consisted of three passerines and one raptor.

The second most commonly diagnosed cause of death at the Ivanpah facility was impact (or blunt force) trauma (24/141 birds). Necropsy findings were as previously described at the Desert Sunlight facility. Impact marks were reported on heliostat mirrors adjacent to the carcasses in 5 cases and mirrors were described as being vertically-oriented in 5 cases. Specific carcass locations were reported for 18 of the birds. Those birds were found in a variety of areas; below heliostats (8/18), in or near tower and powerblock buildings (4/18), on roads (2/18), below power lines (2/18), in the open (1/18) and by a desert tortoise pen (1/18).

Predation was determined to be the cause of death for five of the birds. A coot and a Mourning Dove were found with extensive trauma and hemorrhage to the head and upper body consisting of lacerations, crush trauma and/or decapitation. One of the birds (an American Coot) was found near a kit fox shelter site. One bird (Northern Mockingbird) was found near the fence line and the third (a Mourning Dove) in an alley way. Two more birds (an unidentified sparrow and an American Pipit) were observed being eaten by one of the resident Common Ravens.

Discussion of Cause of Death of Birds Found at the Solar Power Plants

Impact trauma:

Sheet glass used in commercial and residential buildings has been well-established as a hazard for birds, especially passerines (Klem 1990, 2004, 2006; Loss et al. 2014). A recent comprehensive review estimated that between 365-988 million birds die annually by impacting glass panels in the United States alone (median estimate 599 million; Loss et al. 2014). Conditions that precipitate window strike events include the positioning of vegetation on either side of the glass and the reflective properties of the window. Glass panels that reflect trees and other attractive habitat are involved in a higher number of bird collisions.

The mirrors and photovoltaic panels used at all three facilities are movable and generally directed upwardly, reflecting the sky. At the Ivanpah facility, when heliostats are oriented vertically (typically for washing or installation, personal communication, RAK) they appear to pose a greater risk for birds. Of the eight birds reported found under a heliostat, heliostats were vertically-oriented in at least 5 cases. (D Klem Jr., DC Keck, KL Marty, AJ Miller Ball, EE Niciu, and CT Platt. 2004. Effects of window angling, feeder placement, and scavengers on avian mortality at plate glass. Wilson Bulletin, 116(1):69-73; D Klem Jr. 2006. Glass: A deadly conservation issue for birds. Bird Observer 34(2):73-81; D Klem Jr. 1990.

Collisions between birds and windows: mortality and prevention. Journal of Field Ornithology 61:120–128; Loss, S.R., T. Will, S.S.Loss, and P.P. Marra. 2014. Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability. Condor 116: 8-23). Studies with aquatic insects have found that vertically-oriented black glass surfaces (similar to solar panels) produced highly polarized reflected light, making them highly attractive (Kriska, G., P. Makik, I. Szivak, and G. Horvath. 2008. Glass buildings on river banks as "polarized light traps" for mass-swarming polarotactic caddis flies. Naturwissenschaften 95: 461-467).

A desert environment punctuated by a large expanse of reflective, blue panels may be reminiscent of a large body of water. Birds for which the primary habitat is water, including coots, grebes, and cormorants, were over-represented in mortalities at the Desert Sunlight facility (44%) compared to Genesis (19%) and Ivanpah (10%). Several factors may inform these observations. First, the size and continuity of the panels differs between facilities. Mirrors at Ivanpah are individual, 4 x 8' panels that appear from above as stippling in a desert background (Figure 6). Photovoltaic panels at Desert Sunlight are long banks of adjacent 27.72 x 47.25" panels (70 x 120 cm), providing a more continuous, sky/water appearance. Similarly, troughs at Genesis are banks of 5 x 5.5' panels that are up to 49-65 meters long.

Figure 6: The Ivanpah Solar Electric Generating System as seen via satellite. The mirrored panels are 5 x 8 feet.

There is growing concern about "polarized light pollution" as a source of mortality for wildlife, with evidence that photovoltaic panels may be particularly effective sources of polarized light in the environment (see Horvath et al. 2010. Reducing the maladaptive attractiveness of solar panels to polarotactic insects. Conservation Biology 24: 1644-1653, and ParkScience, Vol. 27, Number 1, 2010; available online at: http://www.nature.nps.gov/parkscience/index.cfm?ArticleID=386&ArticleTypeID=5; as well as discussion of this issue in the Desert Sunlight Final Environmental Impact Statement, Chapter 4, pp. 14-15).

Variables that may affect the illusory characteristics of solar panels are structural elements or markings that may break up the reflection. Visual markers spaced at a distance of 28 cm or less have been shown to reduce the number of window strike events on large commercial buildings (City of Toronto Green Development Standard; Bird-friendly development guidelines. March 2007). Mirrors at the Ivanpah facility are unobscured by structures or markings and present a diffuse, reflective surface. Photovoltaic panels at Desert Sunlight are arranged as large banks of small units that are 60 x 90 cm. The visually uninterrupted expanse of both these types of heliostat is larger than that which provides a solid structure visual cue to passerines. Parabolic troughs at Genesis have large, diffusely reflective surfaces between seams that periodically transect the bank of panels at 5.5' intervals. Structures within the near field, including the linear concentrator and support arms, and their reflection in the panels and may provide a visual cue to differentiate the panel as a solid structure.

The paper by Horvath et al cited above provides experimental evidence that placing a white outline and/or white grid lines on solar panels significantly reduced the attractiveness of these panels to aquatic insects, with a loss of only 1.8% in energy-producing surface area (p. 1651). While similar detailed studies have yet to be carried out with birds, this work, combined with the window strike results, suggest that significant reductions in avian mortality at solar facilities could be achieved by relatively minor modifications of panel and mirror design. This should be a priority for further research.

Finally, ponds are present on the property of the Desert Sunlight and Genesis facilities. The pond at Genesis is netted, reducing access by migratory birds, while the pond at Desert Sunlight is open to flighted wildlife. Thus, birds are both attracted to the water feature at Desert Sunlight and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of a diffusely reflected sky or horizonal polarized light source as a body of water.

Stranding and Predation:

Predation is likely linked to panel-related impact trauma and stranding. Water birds were heavily over-represented in predation mortalities at Desert Sunlight. Of the 15 birds that died due to predation, 14 make their primary habitat on water (coots, grebes, a cormorant, and an avocet). A single White-winged Dove was the only terrestrial-based predation mortality in the submitted specimens. This is in contrast to blunt trauma mortalities at Desert Sunlight in which 8 of the 19 birds determined to have died of impact trauma were water species.

Locations of the birds when found dead were noted on several submissions. Of the birds that died of predation for which locations were known, none were located near ponds. The physiology of several of

these water birds is such that locomotion on land is difficult or impossible. Grebes in particular have very limited mobility on land and require a run across water in order to take off (Jehl, J. R., 1996. Mass mortality events of Eared Grebes in North America. Journal of Field Ornithology 67: 471-476). Thus, these birds likely did not reach their final location intentionally. Ponds at the PV and trough sites are fenced, prohibiting terrestrial access by predators. Birds on the water or banks of the pond are inaccessible to resident predators. Therefore, it is unlikely that the birds were captured at the pond and transported by a predator into the area of the panels. Attempts to land or feed on the panels because of their deceptive appearance may have injured the birds to the point that they could not escape to safety, or inadvertently stranded the birds on a substrate from which they could not take flight. We believe that an inability to quickly flee after striking the panels and stranding on the ground left these birds vulnerable to opportunistic predators. At least two types of predators, kit foxes and ravens, have been observed in residence at the power tower and PV facilities and ravens have been reported at the trough site (personal communication and observation, RAK). Additionally, histories for multiple birds found at the tower site document carcasses found near kit fox shelters or being eaten or carried by a raven.

Solar Flux:

Avian mortality due to exposure to solar flux has been previously explored and documented (McCrary, M. D., McKernan, R. L., Schreiber, R. W., Wagner, W. D., and Sciarrotta, T. C. Avian mortality at a solar energy power plant. Journal of Field Ornithology, 57(2): 135-141). Solar flux injury to the birds of this report, as expected, occurred only at the power tower facility. Flux injury grossly differed from other sources of heat injury, such as electrocution or fire. Electrocution injury requires the bridging of two contact points and is, therefore, seen almost exclusively in larger birds such as raptors. Contact points tend to be on the feet, carpi and/or head and burns are often found in these areas. Electrocution causes deep tissue damage as opposed to the surface damage of fire or solar flux. Other sequelae include amputation of limbs with burn marks on bone, blood vessel tears and pericardial hemorrhage. Burns from fires cause widespread charring and melting of feathers and soft tissues and histopathologic findings of soot inhalation or heat damage to the respiratory mucosa. None of these were characteristics of flux injury. In the flux cases small birds were over-represented, had burns generally limited to the feathers and internal injuries attributable to impact. Flux injury inconsistently resulted in charring, tended to affect feathers along the dorsal aspects of the wings and tail, and formed band-like patterns across the body (Divincenti, F. C., J. A. Moncrief, and B. A. Pruitt. 1969. Electrical injuries: a review of 65 cases. The Journal of Trauma 9: 497-507).

Proposed mechanisms of solar flux-related death follow one or a combination of the following pathways:

- impact trauma following direct heat damage to feathers and subsequent loss of flight ability
- starvation and/or thermoregulatory dysfunction following direct heat damage to feathers
- shock
- soft tissue damage following whole-body exposure to high heat
- ocular damage following exposure to bright light.

Necropsy findings from this study are most supportive of the first three mechanisms.

Loss of feather integrity has effects on a bird's ability to take off, land, sustain flight and maneuver. Tail feathers are needed for lift production and maneuverability, remiges are needed for thrust and lift and feathers along the propatagium and coverts confer smoothness to the avian airfoil. Shortening of primary flight feathers by as little as 1.6 cm with loss of secondary and tertiary remiges has been shown to eliminate take-off ability in house sparrows further demonstrating the importance of these feathers (Brown, R. E., and A. C. Cogley, 1996. Contributions of the propatagium to avian flight: Journal of Experimental Zoology 276: 112-124). Loss of relatively few flight feathers can, therefore, render a bird unable or poorly-able to fly. Birds encountering the flux field at Ivanpah may fall as far as 400 feet after feather singeing. Signs of impact trauma were often observed in birds with feather burns and are supportive of sudden loss of function (Beaufrere, H., 2009. A review of biomechanic and aerodynamic considerations of the avian thoracic limb. Journal of Avian Medicine and Surgery 23: 173-185).

Birds appear to be able to survive flux burns in the short term, as evidenced by the collection of several live birds with singed feathers. Additionally, Forensic Lab staff observed a falcon or falcon-like bird with a plume of smoke arising from the tail as it passed through the flux field. Immediately after encountering the flux, the bird exhibited a controlled loss of stability and altitude but was able to cross the perimeter fence before landing. The bird could not be further located following a brief search (personal observation, RAK and EOE). Birds that initially survive the flux exposure and are able to glide to the ground or a perch may be disabled to the point that they cannot efficiently acquire food, escape predators or thermoregulate. Observations of emaciation in association with feather burns in birds found alive is supportive of debilitation subsequent to flux exposure. More observational studies and follow-up are required to understand how many birds survive flux exposure and whether survival is always merely short-term. As demonstrated by the falcon, injured birds (particulary larger birds), may be ambulatory enough to glide or walk over the property line indicating a need to include adjacent land in carcass searches.

There was evidence of acute skin burns on the heads of some of the Grade 3 birds that were found dead. But interestingly, tissue burn effects could not be demonstrated in birds known to have survived short periods after being burned. Hyperthermia causing instantaneous death manifests as rapid burning of tissue, but when death occurs a day or later there will be signs of tissue loss, inflammation, proteinic exudate and/or cellular death leading to multisystemic organ failure. The beginnings of an inflammatory response to injury can be microscopically observed within one to a few hours after the insult and would have been expected in any of the four birds found alive. Signs of heat stroke or inhalation of hot air should have been observable a day or more after the incident. Rather, in these cases extensive feather burns on the body largely appeared to be limited to the tips of the feathers with the overlapping portions insulating the body as designed. This, in conjunction with what is likely only a few seconds or less spent in the flux, suggests that skin or internal organ damage from exposure to high temperatures in solar flux may not be a major cause of the observed mortality.

Ocular damage following light exposure was also considered but could not be demonstrated in the submitted birds. In the four birds that initially survived, there were no signs of retinal damage, inflammation or other ocular trauma. Given the small sample size, this does not preclude sight impairment as a possible sequela but clinical monitoring of survivors would be needed to draw more definitive conclusions.

Other/Undetermined:

Powerline electrocution was the cause of death for one bird (a juvenile Common Raven) at the Ivanpah facility. Electrocution at these solar facilities is a potential hazard but, thus far, appears to be an uncommon cause of death.

Smashed birds (13/233) were found at all three locations. Detailed carcass collection information was provided for 6; all were found on roads. Though poor carcass quality in all cases precluded definitive cause death determination, circumstances and carcass condition suggest vehicle trauma as the cause of deaths. The relatively low numbers of vehicle collisions may be attributed to slow on-site vehicle speeds and light traffic. Vehicle collisions, therefore, do not appear to be a major source of mortality and would be expected to decrease as construction ends.

There was a large number of birds (85/233) for which a cause of death could not be determined due to poor carcass condition. The arid, hot environment at these facilities leads to rapid carcass degradation which greatly hinders pathology examination. Results were especially poor for birds from the Genesis facility, where the cause of death(s) for 23/31 (74%) could not be determined. These results underscore the need for carcasses to be collected soon after death. More frequent, concerted carcass sweeps are advised.

Insect mortality and solar facilities as "mega-traps"

An ecological trap is a situation that results in an animal selecting a habitat that reduces its fitness relative to other available habitats (Robertson, B.A. and R.L. Hutto. 2006. A framework for understanding ecological traps and an evaluation of existing evidence. Ecology 87: 1075-1085; Robertson, B.A., J.S. Rehage, and Sih, A. 2013. Ecological novelty and the emergence of evolutionary traps. Trends in Ecology and Evolution 28: 552-560).

A wide variety of circumstances may create ecological traps, ranging from subtle (songbirds attracted to food resources in city parks, where they are vulnerable to unnaturally high populations of predators) to direct (birds are attracted to oil-filled ponds, believing it to be water, and become trapped). It appears that solar flux facilities may act as "**mega-traps,"** which we define as artificial features that attract and kill species of multiple trophic layers. The strong light emitted by these facilities attract insects, which in turn attract insect-eating birds, which are incapacitated by solar flux injury, thus attracting predators and creating an entire food chain vulnerable to injury and death.

OLE staff observed large numbers of insect carcasses throughout the Ivanpah site during their visit. In some places there were hundreds upon hundreds of butterflies (including monarchs, *Danaus plexippus*) and dragonfly carcasses. Some showed singeing, and many appeared to have just fallen from the sky. Careful observation with binoculars showed the insects were active in the bright area around the boiler at the top of the tower. It was deduced that the solar flux creates such a bright light that it is brighter than the surrounding daylight. Insects were attracted to the light and could be seen actively flying the height of the tower. Birds were also observed feeding on the insects. At times birds flew into the solar flux and ignited. Bird carcasses recovered from the site showed the typical singed feathers. The large populations of insects

may also attract indigenous bat species, which were seen roosting in structures at the base of the power tower.

Monarch butterflies in North America – both east and west of the Rocky Mountains – have been documented to be in decline (see the North American Monarch Conservation Plan, available at: http://www.mlmp.org/Resources/pdf/5431_Monarch_en.pdf). Proposed causes include general habitat loss and specific loss of milkweed, upon which the butterflies feed and reproduce. Considering the numerous monarch butterfly carcasses seen at the Ivanpah facility, it appears that solar power towers could have a significant impact on monarch populations in the desert southwest. Analysis of the insect mortality at Ivanpah, and systematic observations of bird/insect interactions around the power tower, is clearly needed.

Bird species affected by solar flux include both insectivores (e.g. swallows, swifts, flycatchers, and warblers) and raptors that prey on insect-feeding birds. Based on observations of the tower in flux and the finding of large numbers of butterflies, dragonflies and other insects at the base of the tower and in adjacent buildings it is suspected that the bright light generated by solar flux attracts insects, which in turn attracts insectivores and predators of insectivores. Waterbirds and other birds that feed on vegetation were not found to have solar flux burns. Birds were observed perching and feeding on railings at the top of the tower, apparently in response to the insect aggregations there.

Further, dead bats found at the Ivanpah site could be attracted to the large numbers of insects in the area. Nineteen bats from the condenser area of the power tower facility have been submitted to NFWFL for further evaluation. These bats belong to the Vespertilionidae and Molossidae families, which contain species considered by the Bureau of Land Management to be sensitive species in California. Preliminary evaluation revealed no apparent singing of the hair, and analysis is ongoing.

Solar flux and heat associated with solar power tower facilities

Despite repeated requests, we have been unsuccessful in obtaining technical data relating to the temperature associated with solar flux at the Ivanpah facility. The following summarizes the information we have gathered from other sources.

Figure 7 Ivanpah solar power facilities http://ivanpahsolar.com/about

The Ivanpah solar energy generating facility consists of mirrors that reflect sunlight to a tower. In the tower sits a boiler that generates steam which then powers a turbine.

At the top of a 459 foot tall tower sits a boiler (solar receiver) that is heated by the sun rays reflected by 300,000 mirrors, called solar heliostats. When the concentrated sunlight strikes the boiler tubes, it heats the water to create superheated steam. The high temperature steam is then piped from the boiler to a turbine where electricity is generated (http://ivanpahsolar.com/about visited on 01/20/2014).

If all the solar heliostats are focused on the solar tower the beams multiply the strength of sunlight by 5000 times, and this generates temperatures at the solar tower in excess of 3600° Fahrenheit (> 1982° Celsius). Since steel melts at 2750° Fahrenheit (1510° Celsius), only a percentage of heliostats are focused on the solar receiver so that) the optimal temperature at the tower is approximately 900° Fahrenheit (~482° Celsius) ("How do they do it" Wag TV for Discovery Channel, Season 3, Episode 15, "Design Airplane Parachutes, Create Solar Power, Make Sunglasses" Aired August 25, 2009).

Figure 8: Seville solar power facility (http://inhabitat.com/sevilles-solar-power-tower)

A solar steam plant in Coalinga that also uses heliostat technology for extracting oil is on record stating that the steam generator is set to about 500° Celsius. (http://abclocal.go.com/kDSn/story?section=news%2Fbusiness&id=8377469 Viewed Jan 21, 2013)

Temperatures measured by the authors at the edge of the solar complex on the surface of a heliostat were approximately 200° Fahrenheit (~93° Celsius). Therefore, there is a gradient of temperature from the edge of the solar field to the tower that ranges from 200° to 900° Fahrenheit.

There is a phenomenon that occurs when the heliostats are focused on the tower and electricity is being generated. The phenomenon can be described as either a circle of clouds around the tower or, at times, a cloud formed on the side that is receiving the solar reflection. It appears as though the tower is creating clouds. Currently we propose two hypotheses of why this "cloud" is formed. The first hypothesis is simply the presumption that the high heat associated with towers is condensing the air, and forming the

Figure 9: Tower 1 (bright white) is shown under power. Tower 2 (black) is not operating.

clouds. The second hypothesis is that this phenomenon does not represent clouds at all rather it is a place in space where the heliostats that are not being used to generate heat are focused. Under this scenario, it is a place where the mirrors focus the excess energy not being used to generate electricity.

Ivanpah employees and OLE staff noticed that close to the periphery of the tower and within the reflected solar field area, streams of smoke rise when an object crosses the solar flux fields aimed at the tower. Ivanpah employees used the term "streamers" to characterize this occurrence.

When OLE staff visited the Ivanpah Solar plant, we observed many streamer events. It is claimed that these events represent the combustion of loose debris, or insects. Although some of the events are likely that, there were instances in which the amount of smoke produced by the ignition could only be explained by a larger flammable biomass such as a bird. Indeed OLE staff observed birds entering the solar flux and igniting, consequently becoming a streamer.

OLE staff observed an average of one streamer event every two minutes. It appeared that the streamer events occurred more frequently within the "cloud" area adjacent to the tower. Therefore we hypothesize that the "cloud" has a very high temperature that is igniting all material that traverses its field.
One possible explanation of this this phenomenon is that the "cloud" is a convergent location where heliostats are "parked" when not in use. Conversely it undermines the condensation hypothesis, given that birds flying through condensation clouds will not spontaneously ignite.

Temperatures required to burn feathers

Many of the carcasses recovered from the Ivanpah Solar plant after the plant became operational showed singing of feathers as shown in Figure 10.

Figure 10: Singed feathers from a Northern Rough-winged Swallow

In order to investigate at what temperature feathers burn/singe, we exposed feathers to different air temperatures. Each feather was exposed to a stream of helium and air for 30 seconds. The results indicate that at 400° Celsius (752° Fahrenheit) after 30 seconds the feather begins to degrade. But at 450° and

Figure 11: Results of exposing feathers to different temperatures (in degrees Celsius)

500° Celsius (842° and 932° Fahrenheit respectively) the feathers singed as soon as they made contact with the superheated air (Figure 11). Therefore, when singed birds are found, it can be inferred that the temperatures in the solar flux at the time a bird flew through it was at least 400° Celsius (752° Fahrenheit). This inference is consistent with the desired operating temperature of a power tower solar boiler (482° Celsius).

The fact that a bird will catch on fire as it flies through the solar flux has been confirmed by a Chevron engineer who works at the Coalinga Chevron Steam plant, a joint venture of Chevron and BrightSource Solar. (http://abclocal.go.com/kDSn/story?section=news%2Fbusiness&id=8377469 Viewed Jan 21, 2013)

Conclusions and Recommendations

In summary, three main causes of avian mortality were identified at these facilities; impact trauma, predation and solar flux. Birds at all three types of solar plants were susceptible to impact trauma and predators. Solar flux injury was unique to the power tower facility. Solar facilities, in general, do not appear to attract particular species, rather an ecological variety of birds are vulnerable. That said, certain mortality and species trends were evident, such as waterbirds at Desert Sunlight, where open water sources were present.

Specific hazards were identified, including vertically-oriented mirrors or other smooth reflective panels; water-like reflective or polarizing panels; actively fluxing towers; open bodies of water; aggregations of insects that attracted insectivorous birds; and resident predators. Making towers, ponds and panels less attractive or accessible to birds may mitigate deaths. Specific actions include placing perch-guards on power tower railings near the flux field, properly netting or otherwise covering ponds, tilting heliostat mirrors during washing and suspending power tower operation at peak migration times.

Visual cues should be retrofitted to existing panels and incorporated into new panel design. These cues may include UV-reflective or solid, contrasting bands spaced no further than 28 cm from each other. This arrangement has been shown to significantly reduce the number of passerines hitting expanses of windows on commercial buildings. Spacing of 10 cm eliminates window strikes altogether. Further exploration of panel design and orientation should be undertaken with researchers experienced in the field (Daneil Klem Jr. of Muhlenberg College) to determine causes for the high rate of impact trauma, and designs optimized to reduce these mortalities.

Challenges to data collection included rapid degradation of carcass quality hindering cause of death and species determination; large facilities which are difficult to efficiently search for carcasses; vegetation and panels obscuring ground visibility; carcass loss due to scavenging; and inconsistent documentation of carcass history. Searcher efficiency has been shown to have varying influences on carcass recovery with anywhere from 30% to 90% detection of small birds achieved in studies done at wind plants (Erickson et al., 2005). Scavengers may also remove substantial numbers of carcasses. In studies done on agricultural fields, up to 90% of small bird carcasses were lost within 24 hours (Balcomb, 1986; Wobeser and Wobeser, 1992). OLE staff observed apparently resident ravens at the Ivanpah power tower. Ravens are efficient scavengers, and could remove large numbers of small bird carcasses from the tower vicinity. (Erickson, W. P., G. D. Johnson, and D. P. Young, Jr., 2005, A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions: U S Forest Service General Technical Report PSW, v. 191, p. 1029-1042; Balcomb, R., 1986, Songbird carcasses disappear rapidly from agricultural fields: Auk, v. 103, p. 817-820; Wobeser, G., and A. G. Wobeser, 1992, Carcass disappearance and estimation of mortality in a simulated die-off of small birds: Journal of Wildlife Diseases, v. 28, p. 548-554.)

Given these variables it is difficult to know the true scope of avian mortality at these facilities. The numbers of dead birds are likely underrepresented, perhaps vastly so. Observational and statistical studies to account for carcass loss may help us to gain a better sense of how many birds are being killed. Complete histories would help us to identify factors (such as vertical placement of mirrors) leading to mortalities. Continued monitoring is also advised as these facilities transition from construction to full operation. Of especial concern is the Ivanpah facility which was not fully-functioning at the time of the latest carcass submissions. In fact, all but 7 of the carcasses with solar flux injury and reported dates of collection were found at or prior to the USFWS site visit (October 21-24, 2013) and, therefore, represent flux mortality from a facility operating at only 33% capacity. Investigation into bat and insect mortalities at the power tower site should also be pursued.

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Appendix 1. List of all 71 species recovered from the three solar energy sites. In this table, remains of closely related taxa that could not be definitively identified (e.g. Cinnamon/Blue-winged Teal and Black-throated/Sage Sparrow) are assigned to the biogeographically more likely taxon. In all such cases, the possible taxa are ecologically similar. All of these species are MBTA-listed.

SPECIES		Zone	Residency	Sites	MNI
Cinnamon Teal	*Anas cyanoptera*	water	migrant	DS,IV	5
Pied-billed Grebe	*Podilymbus podiceps*	water	migrant	DS	1
Western Grebe	*Aechmorphorus occidentalis*	water	migrant	DS	9
Eared Grebe	*Podiceps nigricollis*	water	migrant	DS,GN	5
Brown Pelican	*Pelecanus occidentalis*	water	migrant	DS	2
Double-crested Cormorant	*Phalacrocorax auritus*	water	migrant	DS	2
Great Blue Heron	*Ardea herodias*	water	migrant	GN	1
Black-crowned Night-Heron	*Nycticorax nycticorax*	water	migrant	DS	1
Cooper's Hawk	*Accipiter cooperii*	air	migrant	IV	1
Red-shouldered Hawk	*Buteo lineatus*	terr	migrant	IV	1
American Kestrel	*Falco sparverius*	air	resident	GN,IV	2
Peregrine Falcon	*Falco peregrinus*	air	resident	IV	1
American Coot	*Fulica americana*	water	migrant	DS, IV	12
Yuma Clapper Rail	*Rallus longirostris yumanensis*	water	resident	DS	1
Sora	*Porzana carolina*	water	migrant	DS,IV	2
American Avocet	*Recurvirostra americana*	water	migrant	DS	1
Spotted Sandpiper	*Actitis maculatus*	water	migrant	IV	2
Ring-billed Gull	*Larus delawarensis*	water	migrant	GN	2
California Gull	*Larus californianus*	water	resident	GN	1
Greater Roadrunner	*Geococcyx californianus*	terr	resident	IV	5
Yellow-billed Cuckoo	*Coccyzus americanus*	terr	migrant	IV	1
Mourning Dove	*Zenaida macroura*	terr	resident	DS, IV	14
White-winged Dove	*Zenaida asiatica*	terr	resident	DS,GN	2
Barn Owl	*Tyto alba*	terr	resident	IV	1
Lesser nighthawk	*Chordeiles acutipennis*	air	resident	DS,GN,IV	7
Common Poorwill	*Phalaenoptilus nuttallii*	air	resident	DS,IV	2
White-throated Swift	*Aeronautes saxatalis*	air	resident	IV	1
Costa's Hummingbird	*Calypte costae*	air	resident	DS	1
Allen's/Rufous Hummingbird	*Selasphorus sp.*	air	migrant	IV	1
Northern Flicker	*Colaptes auratus*	terr	resident	IV	1
Ash-throated Flycatcher	*Myiarchus cinerascens*	air	resident	DS,IV	2
Say's Phoebe	*Sayornis saya*	air	resident	GN	2
Black Phoebe	*Sayornis nigricollis*	air	resident	DS	1
Loggerhead shrike	*Lanius ludovicianus*	terr	resident	DS,IV	5
Warbling Vireo	*Vireo gilvus*	terr	migrant	IV	1
Common Raven	*Corvus corax*	terr	resident	DS,IV	3
Horned Lark	*Eremophila alpestris*	terr	migrant	DS	1
Tree Swallow	*Tachycineta bicolor*	air	migrant	DS,GN,IV	5

SPECIES		Zone	Residency	Sites	MNI
Cliff Swallow	*Petrochelidon pyrrhonota*	air	resident	GN	5
No. Rough-winged Swallow	*Stelgidopteryx serripennis*	air	migrant	IV	2
Verdin	*Auriparus flaviceps*	terr	resident	IV	3
Blue-gray Gnatcatcher	*Polioptila caerulea*	terr	resident	IV	1
Northern Mockingbird	*Mimus polyglottos*	terr	resident	IV	1
American Pipit	*Anthus rubescens*	terr	migrant	IV	4
Orange-crowned Warbler	*Oreothlypis celata*	terr	migrant	IV	1
Lucy's Warbler	*Oreothlypis luciae*	terr	resident	IV	1
Yellow-rumped Warbler	*Setophaga coronata*	air	migrant	IV	14
Black-throated Gray Warbler	*Setophaga nigrescens*	terr	migrant	IV	1
Hermit Warbler	*Setophaga occidentalis*	terr	migrant	GN	1
Townsend's warbler	*Setophaga townsendi*	terr	migrant	DS,IV	4
Yellow Warbler	*Setophaga petechia*	terr	migrant	IV	1
Black-and-white Warbler	*Mniotilta varia*	terr	migrant	IV	1
MacGillivray's Warbler	*Oporornis tolmei*	terr	migrant	IV	1
Wilson's Warbler	*Cardellina pusilla*	terr	migrant	DS,IV	4
Common Yellowthroat	*Geothlypis trichas*	terr	migrant	DS	1
Western Tanager	*Piranga ludoviciana*	terr	migrant	DS,IV	4
Black-headed Grosbeak	*Pheucticus melanocephalus*	terr	migrant	DS,GN	2
Lazuli Bunting	*Passerina caerulea*	terr	migrant	IV	1
Blue Grosbeak	*Passerina caerulea*	terr	resident	IV	1
Green-tailed Towhee	*Pipilo chlorurus*	terr	migrant	IV	1
Brewer's Sparrow	*Spizella breweri*	terr	resident	IV	3
Chipping Sparrow	*Spizella passerina*	terr	resident	GN,IV	4
Black-throated Sparrow	*Amphispiza bilineata*	terr	resident	DS,IV	4
Savannah Sparrow	*Passerculus sandwichensis*	terr	migrant	DS,IV	3
White-crowned Sparrow	*Zonotrichia leucophrys*	terr	migrant	IV	6
Pine Siskin	*Spinus pinus*	terr	migrant	IV	1
House Finch	*Carpodacus mexicanus*	terr	resident	IV	13
Great-tailed Grackle	*Quiscalus mexicanus*	terr	resident	DS,IV	5
Brown-headed Cowbird	*Molothrus ater*	terr	resident	DS,GN,IV	8
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	terr	migrant	DS	1
Bullock's Oriole	*Icterus bullockii*	terr	resident	GN	2

Species recovered from one site: 47
two sites: 18
three sites: 5

Appendix 2. Species with solar flux burns

Common Name	Scientific name	
Yellow-rumped warbler	*Setophaga coronata*	12
House finch	*Carpodacus mexicanus*	10
Chipping sparrow	*Spizella passerina*	2
Unidentified warbler	*Parulidae*	2
Verdin	*Auriparus flaviceps*	2
Great-tailed grackle	*Quiscalus mexicanus*	2
Lucy's warbler	*Oreothlypis luciae*	1
Wilson's warbler	*Cardellina pusilla*	1
MacGillivray's warbler	*Oporornis tolmei*	1
Black-throated gray warbler	*Setophaga nigrescens*	1
Townsend's warbler	*Setophaga townsendi*	1
Orange-crowned warbler	*Oreothlypis celata*	1
Blue-gray gnatcatcher	*Polioptila caerulea*	1
Unidentified swallow	*Hirundinidae*	1
Northern rough-winged swallow	*Stelgidopteryx serripennis*	1
Warbling vireo	*Vireo gilvus*	1
Unidentified hummingbird	*Selasphorus sp.*	1
Unidentified passerine	Passeriformes	1
Unidentified finch	*Carpodacus sp.*	1
Lazuli bunting	*Passerina caerulea*	1
Unidentified sparrow	*Spizella species*	1
Unidentified blackbird	*Icteridae*	1
Peregrine falcon	*Falco peregrinus*	1

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EXHIBIT 7

Correction

ECOLOGY, SUSTAINABILITY SCIENCE

Correction for "Solar energy development impacts on land cover change and protected areas," by Rebecca R. Hernandez, Madison K. Hoffacker, Michelle L. Murphy-Mariscal, Grace C. Wu, and Michael F. Allen, which appeared in issue 44, November 3, 2015, of *Proc Natl Acad Sci USA* (112:13579–13584; first published October 19, 2015; 10.1073/pnas.1517656112).

The authors note that on page 13579, right column, first full paragraph, lines 12–16, the following statement published incorrectly: "If up to 500 GW of USSE may be required to meet United States-wide reduction of 80% of 1990 greenhouse gas emissions by 2050, 71,428 km^2 of land may be required (roughly the land area of the state of South Carolina) assuming a capacity factor of 0.20 (an average capacity factor for PV; Table S1)." The statement should instead appear as: "For example, up to 500 GW of USSE may be required to meet United States-wide reduction of 80% of 1990 greenhouse gas emissions by 2050 (33). This requires about 14,285 km^2 of land [roughly the area of the state of Connecticut, (9)], underscoring the possible vast area requirements for energy needs in the United States." Additionally, the authors note ref. 33 was omitted from the published article. The full reference appears below.

9. Hernandez RR, Hoffacker MK, Field CB (2014) Land-use efficiency of big solar. *Environ Sci Technol* 48(2):1315–1323.
33. Mai T, et al. (2012) Exploration of high-penetration renewable electricity futures. *Vol. 1 of Renewable Electricity Futures Study*, eds Hand MM et al. (National Renewable Energy Laboratory, Golden, CO).

www.pnas.org/cgi/doi/10.1073/pnas.1602975113

Solar energy development impacts on land cover change and protected areas

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Edited by B. L. Turner, Arizona State University, Tempe, AZ, and approved September 16, 2015 (received for review September 4, 2015)

Decisions determining the use of land for energy are of exigent concern as land scarcity, the need for ecosystem services, and demands for energy generation have concomitantly increased globally. Utility-scale solar energy (USSE) [i.e., ≥1 megawatt (MW)] development requires large quantities of space and land; however, studies quantifying the effect of USSE on land cover change and protected areas are limited. We assessed siting impacts of >160 USSE installations by technology type [photovoltaic (PV) vs. concentrating solar power (CSP)], area (in square kilometers), and capacity (in MW) within the global solar hot spot of the state of California (United States). Additionally, we used the Carnegie Energy and Environmental Compatibility model, a multiple criteria model, to quantify each installation according to environmental and technical compatibility. Last, we evaluated installations according to their proximity to protected areas, including inventoried roadless areas, endangered and threatened species habitat, and federally protected areas. We found the plurality of USSE (6,995 MW) in California is sited in shrublands and scrublands, comprising 375 km^2 of land cover change. Twenty-eight percent of USSE installations are located in croplands and pastures, comprising 155 km^2 of change. Less than 15% of USSE installations are sited in "Compatible" areas. The majority of "Incompatible" USSE power plants are sited far from existing transmission infrastructure, and all USSE installations average at most 7 and 5 km from protected areas, for PV and CSP, respectively. Where energy, food, and conservation goals intersect, environmental compatibility can be achieved when resource opportunities, constraints, and trade-offs are integrated into siting decisions.

concentrating solar power | conservation | greenhouse gas emissions | land use | photovoltaics

The need to mitigate climate change, safeguard energy security, and increase the sustainability of human activities is prompting the need for a rapid transition from carbon-intensive fuels to renewable energy (1). Among renewable energy systems, solar energy has one of the greatest climate change mitigation potentials with life cycle emissions as low as 14 g CO_2-eq·kW·h^{-1} [compare this to 608 g CO_2-eq·kW·h^{-1} for natural gas (2)]. Solar energy embodies diverse technologies able to capture the sun's thermal energy, such as concentrating solar power (CSP) systems, and photons using photovoltaics (PV). In general, CSP is economically optimal where direct normal irradiance (DNI) is 6 kW·h·m^{-2}·d^{-1} or greater, whereas PV, able to use both diffuse and DNI, is economically optimal where such solar resources are 4 kW·h·m^{-2}·d^{-1} or greater. Solar energy systems are highly modular ranging from small-scale deployments (≤1 MW; e.g., residential rooftop modules, portable battlefield systems, solar water heaters) to centralized, utility-scale solar energy (USSE) installations (≥1 MW) where a large economy of scale can meet greater energy demands. Nonetheless, the diffuse nature of solar energy necessitates that large swaths of space or land be used to collect and concentrate solar energy into forms usable for human consumption, increasing concern over potential adverse impacts on natural ecosystems, their services, and biodiversity therein (2–5).

Given the wide range of siting options for USSE projects, maximizing land use efficiency and minimizing land cover change is a growing environmental challenge (6–8). Land use efficiency describes how much power or energy a system generates by area (e.g., watts per square meter, watt-hours per square meter, respectively). For example, USSE installations have an average land use efficiency of 35 W·m^{-2} based on nameplate capacity under ideal conditions (9). The ratio of the realized generation of an installation to maximum generation under ideal conditions over a period is the capacity factor. Using these two terms, we can quantify land requirements for USSE at larger spatial scales. If up to 500 GW of USSE may be required to meet United States-wide reduction of 80% of 1990 greenhouse gas emissions by 2050, 71,428 km^2 of land may be required (roughly the land area of the state of South Carolina) assuming a capacity factor of 0.20 (an average capacity factor for PV; Table S1). This underscores the possible vast area requirements for meeting energy needs in the United States and elsewhere. Increasing the land use efficiency of each installation—e.g., decreasing space between rows of PV modules or CSP mirrors—and prudent siting decisions that incorporate the weighting of environmental trade-offs and synergies can reduce land cover change impacts broadly (10).

Land cover change owing to solar energy has received increasing attention over concerns related to conflicts with biodiversity goals (2–4) and greenhouse gas emissions, which are released when

Significance

Decisions humans make about how much land to use, where, and for what end use, can inform innovation and policies directing sustainable pathways of land use for energy. Using the state of California (United States) as a model system, our study shows that the majority of utility-scale solar energy (USSE) installations are sited in natural environments, namely shrublands and scrublands, and agricultural land cover types, and near (<10 km) protected areas. "Compatible" (≤15%) USSE installations are sited in developed areas, whereas "Incompatible" installations (19%) are classified as such owing to, predominantly, lengthier distances to existing transmission. Our results suggest a dynamic landscape where land for energy, food, and conservation goals overlap and where environmental cobenefit opportunities should be explored.

Author contributions: R.R.H. designed research; R.R.H. and M.K.H. performed research; R.R.H. and M.K.H. contributed new reagents/analytic tools; R.R.H. and M.K.H. analyzed data; and R.R.H., M.K.H., M.L.M.-M., G.C.W., and M.F.A. wrote the paper.

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biomass, including soil, is disturbed or removed during the lifetime of a power plant (11, 12). Siting USSE installations in places already impacted by humans (e.g., parking lots, rooftops) reduces the likelihood that adverse environmental impacts will occur and can exceed generation demands for renewable energy goals in places with moderate- to high-quality solar resources (8, 10, 13), including California. When sites within the built environment are inaccessible, siting that minimizes land use and land cover change within areas acting as carbon sinks, avoids extirpation of biodiversity, and does not obstruct the flow of ecosystem services to residents, firms, and communities, can serve to mitigate adverse environmental impacts (2, 3, 9, 10, 14, 15). Siting within the built environment also reduces the need for complex decision making dictating the use of land for food or energy (16).

Recent studies have underscored the role that proximity of threats to protected areas plays in meeting conservation goals (16–20). Protected areas may preclude habitat loss within boundaries; however, a prevailing cause of degradation within protected areas is land use and land cover change in surrounding areas. Specifically, protected areas are effective when land use nearby does not obstruct corridor use, dispersion capabilities, nor facilitate invasions of nonnative species through habitat loss, fragmentation, and isolation—including those caused by renewable energy development. Quantifying both internal and external threats is necessary for assessing vulnerability of individual protected areas to conversion and landscape sustainability overall. Siting decisions can be optimized with decision support tools (10, 14) that differentiate areas where direct (e.g., land cover change) and proximate effects (e.g., habitat fragmentation) are lowest on the landscape.

Several studies have made predictions regarding which specific land cover types may be impacted by solar energy development (7, 21); however, few studies have evaluated actual siting decisions and their potential or realized impact on land cover change (9, 11). In this study, our objectives were to (*i*) evaluate potential land cover change owing to development of utility-scale PV and CSP within the state of California (United States) and describe relationships among land cover type and the number of installations, capacity, and technology type of USSE; (*ii*) use the decision support tool, the Carnegie Energy and Environmental Compatibility (CEEC) model (10), to develop a three-tiered spatial environmental and technical compatibility index (hereafter called Compatibility Index; "Compatible," "Potentially Compatible," and "Incompatible") for California that identifies environmentally low-conflict areas using resource constraints and opportunities; and (*iii*) compare utility-scale PV and CSP installation locations with the Compatibility Index and their proximity to protected areas to quantify solar energy development decisions and their impact on land cover change (see *Supporting Information* for details).

We selected the state of California as a model system owing to its relatively early, rapid, and ambitious deployment of solar energy systems, 400,000 km^2 of land area (greater than Germany and 188 other countries), large human population and energy demands, diverse ecosystems comprising 90% of the California Floristic Province biodiversity hot spot, and its long-standing use in elucidating the interrelationship between land and energy (9, 10, 22, 23).

Results

We identified 161 planned, under construction, and operating USSE installations throughout 10 land cover types (Figs. 1 and 2) among 16 total in the state of California (Table S2). Broadly, PV installations are concentrated particularly in the Central Valley and the interior of southern California, whereas CSP power plants are sited exclusively in inland southern California (Figs. 1 and 2). For all technology types, the plurality of capacity (6,995 MW) is found in shrubland and scrubland land cover type,

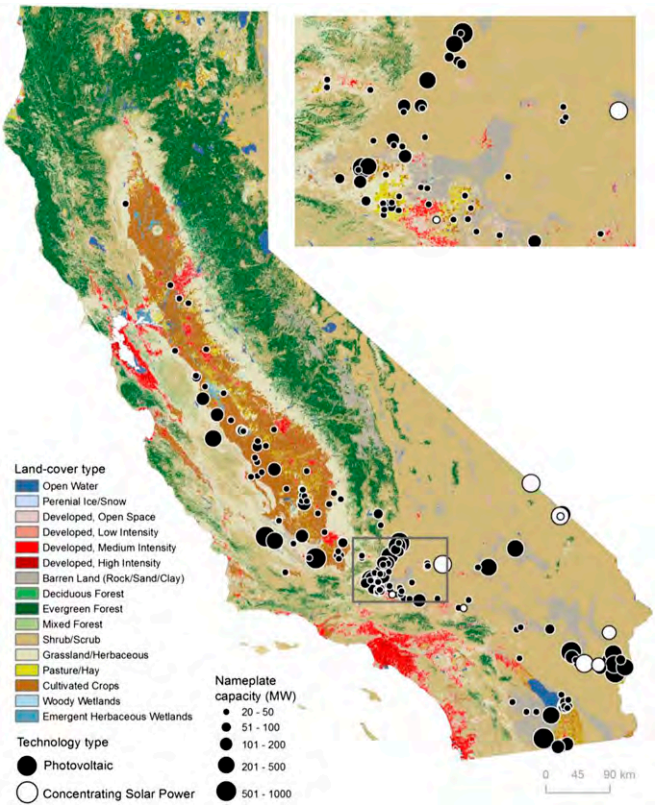

Fig. 1. Map showing land cover types across California and the size and location of USSE installations.

necessitating 375 km^2 of land (Table 1). This area is approximately two times greater than USSE development occurring within cultivated croplands, representing 4,103 MW of capacity within 118 km^2. Over 2,000 MW of existing or proposed USSE capacity is sited within the built environment, particularly within relatively lower density areas.

PV power plants are found in 10 land cover types; the plurality of capacity is sited within shrubland/scrublands (6,251 MW; Table 1), representing 26.0% of all PV installations (Fig. 2). Capacity for utility-scale PV installations is also represented within cultivated croplands (3,823 MW), barren land (2,102 MW), developed (2,039 MW), and grassland/herbaceous (1,483 MW) land cover types. Within the developed land cover types, open space is most used (1,205 MW) for utility-scale PV capacity. For CSP, 1,000 MW are located within 34 km^2 of barren land land cover types, and conjointly within shrubland/scrublands (744 MW, 32 km^2).

Using the decision support tool, CEEC (Fig. 3), we identified 22,028 and 77,761 km^2 of Compatible and Potentially Compatible area, respectively, in California for developing PV (Fig. S1). Generation-based potential within Compatible areas—comprising 5.4% of California's area—is 8,565 TW·h·y^{-1} for fixed-tilt modules and up to 11,744 TW·h·y^{-1} for dual-axis modules. For CSP technologies, we found 6,274 and 33,489 km^2 of Compatible and Potentially Compatible area. Generation-based potential for CSP within Compatible areas—comprising 1.5% of California's area—is 5,947 TW·h·y^{-1}.

USSE installations vary in the environmental compatibility of their actual or proposed site (Fig. 4 *A* and *B*). The majority (71.7%) of PV USSE installations are in Potentially Compatible areas, whereas 11.2% are located in Compatible areas. PV installations classified as Incompatible are due to distances from existing transmission infrastructure exceeding 10 km (45.9%), slope exceeding the recommended threshold (41.9%), and to a

Table 1. USSE installations and land cover type

	Nameplate capacity, MWdc				Area, km^2			
Land cover type	PV	%	CSP	%	PV	%	CSP	%
Barren land (rock/sand/clay)	2,102	12	**1,000**	**48**	77	11	**34**	**45**
Cultivated crops	3,823	22	280	14	110	15	8	11
Developed (all)	2,039	12	50	2	70	10	1	1
Developed, high intensity	50	0	0	0	1	0	0	0
Developed, medium intensity	624	4	0	0	17	2	0	0
Developed, low intensity	160	1	0	0	9	1	0	0
Developed, open space	1,205	7	50	2	43	6	1	1
Emergent herbaceous wetlands	60	0	0	0	1	0	0	0
Grass/herbaceous	1,483	9	0	0	72	10	0	0
Pasture/hay	1,397	8	0	0	37	5	0	0
Shrubland/scrubland	**6,251**	**36**	744	36	**343**	**48**	32	43

The nameplate capacity [in megawatts (MWdc)], footprint (in square kilometers), and number of photovoltaic (PV) and concentrating solar power (CSP) USSE installations (>20 MW) in California (in planning, under construction, operating) by land cover type. Bold data represent the greatest value among all land cover types.

lesser degree, owing to development on endangered and threatened species habitat (9.7%) and federally preserved land (3.2%; Fig. 4 *A* and *B*). For CSP installations, 55.5% are located in either Compatible or Potentially Compatible areas. Siting incompatibilities for CSP were either due to slope (25.0%) or distance from transmission lines (75.0%). PV and CSP installations on Compatible areas range in capacity between 20 and 200 MW, and are located within the Central Valley and inland southern California regions, excepting one PV facility in Yolo County (Fig. 4*A*). PV facilities on Incompatible land are found throughout all of California and, excepting one facility (250 MW; San Luis Obispo County), are 200 MW in capacity or less.

PV and CSP USSE installations average 7.2 ± 0.9 and 5.3 ± 2.3 km, respectively, from the closest protected area (Fig. 5). Federally protected areas are the nearest protected area type (7.8 ± 1.0) to land use and land cover change for PV development, whereas both endangered and threatened species habitat (5.7 ± 2.4) and federally protected areas (5.3 ± 2.3) are nearest for CSP development. Of PV installations, 73.7% were less than 10 km and 47.4% were less than 5 km away from the nearest protected area. Of CSP installations, 90.0% were less than 10 km away and 60.0% were less than 5 km away from the nearest protected area.

Discussion

Evaluation of siting decisions for USSE is increasingly relevant in a world of mounting land scarcity and in which siting decisions are as diverse as their deployment worldwide. For example, China has emphasized utility-scale, ground-mounted PV and residential, small-scale solar water heating installations (24), whereas Germany is notable for achieving up to 90% development within the built environment (25). In California, a large portion of USSE installations is sited far from existing transmission infrastructure. New transmission extensions are expensive, difficult to site due to social and environmental concerns, and require many years of planning and construction. Such transmission-related siting incompatibilities not only necessitate additional land cover change but also stand in the way of cost-efficient and rapid renewable energy deployment.

Environmental regulations and laws, which vary drastically from one administrative area to the next, may also cause incongruities in siting decisions. Inherent ambiguities of such policies allows for further inconsistencies. A study in southern Italy (11) found that two-thirds of authorizations for USSE were within environmentally "unsuitable" areas as defined by municipal and international criteria (e.g., United Nations Educational, Scientific and Cultural Organization sites), with adverse implications for land cover change-related CO_2 emissions. Studies (7, 21) including our own reveal that regulations and policies to date have deemphasized USSE development in California, the United States, and North America, respectively, within the built environment and near population centers in favor of development within shrublands and scrublands. California's shrublands and scrublands comprise, in part, the California Floristic Province, a biodiversity hot spot known for high levels of species richness and endemism and where 70% or more of the original extent of vegetation has been lost due to global environmental change-type threats, including land cover change (26, 27). In biologically rich areas like this, land cover change has the potential to greatly impact ecological value and function. Globally, the extent of shrubland and scrubland is vast; therefore, in areas where biodiversity is low, goods and services of shrublands may include diverse recreational opportunities, culturally and historically significant landscapes, movement corridors for wildlife, groundwater as a drinking source, and carbon (sequestration), which may also be adversely impacted by land cover conversion (28).

Proximity impacts result from the fragmentation and degradation of land near and between protected areas, reducing ecological flows of energy, organisms, and goods (16–20). In a study of 57

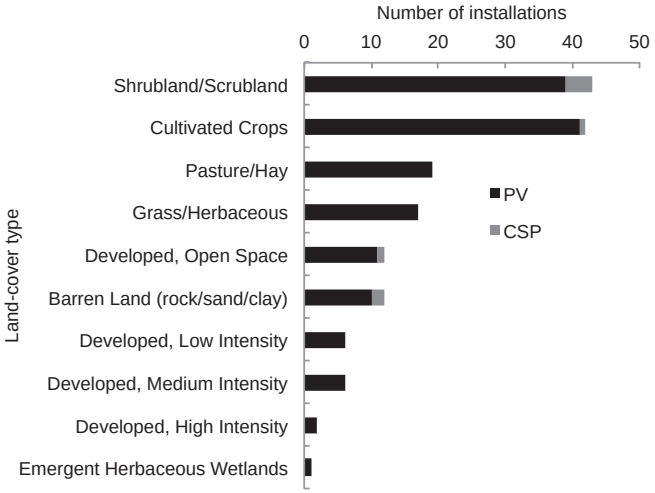

Fig. 2. Number of photovoltaic (PV) and concentrating solar power (CSP) installations (planned, under construction, operating) by land cover type in California; represented in order of most installations to least for both technologies.

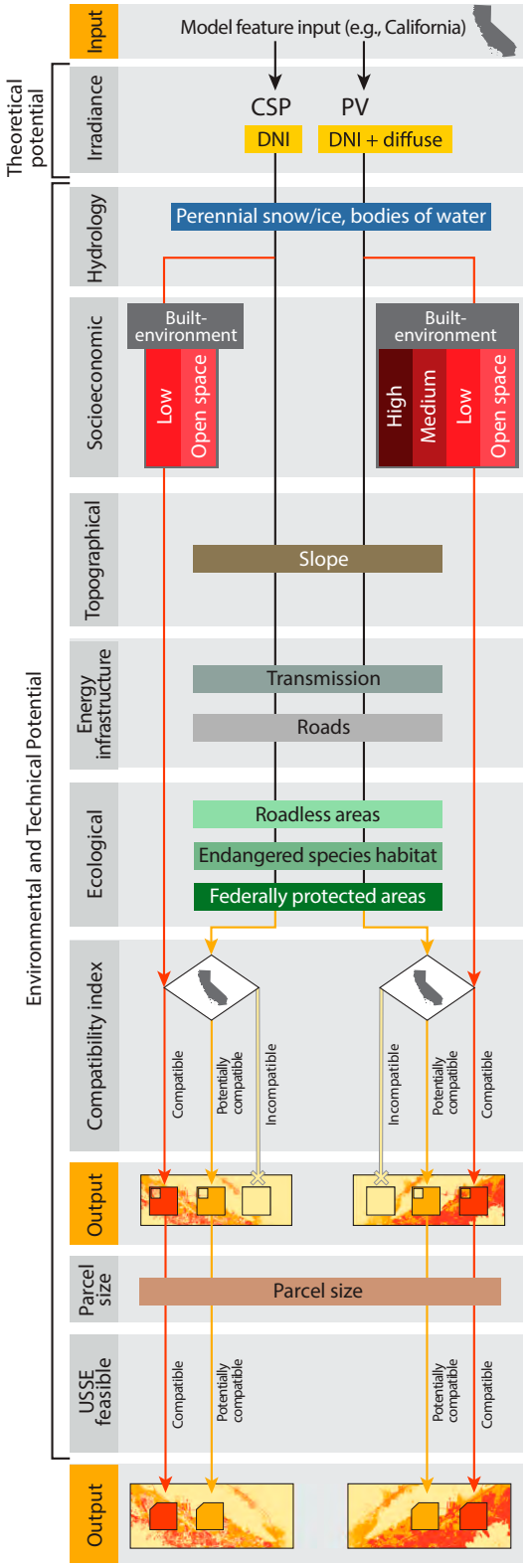

Fig. 3. Workflow of the Carnegie Energy and Environmental Compatibility (CEEC) model, a decision support tool, showing model inputs (resource opportunities and constraints), Environmental and Technical Compatibility Index, and model outputs.

US protected areas, Hansen et al. (16) found such zones extended an average of 18 times (in area) beyond the park area (e.g., Mojave National Preserve, three times protected area, i.e., ~30 km radially beyond preserve boundary). Additionally, Hamilton et al. (17) used distances of 5, 25, and 75 km from all US protected area boundaries to represent three spatial scales (i.e., buffers) of proximity impacts owing to US land cover and land use change. Last, the US Fish and Wildlife Service's Partners for Fish and Wildlife Program, seeks to reduce adverse proximity impacts by augmenting protected areas with private land restoration, targeting land within a maximum distance of 75 km from existing protected areas. Thus, our results confirm USSE development in California engenders important proximity impacts, for example, encompassing all three spatial scales from Hamilton et al. (17) and decreasing land available for US Fish and Wildlife Service partner restoration programs.

Industrial sectors—including energy and agriculture—are increasingly responsible for decisions affecting biodiversity. Concomitantly, target-driven conservation planning metrics (e.g., percentage of remaining extant habitat does not fall below 40%), geospatial products (e.g., decision support tools), and the monetization of carbon and ecosystem services are increasing and may be effective in compensating for the lack of target-driven regulation observed in policy (29).

Last, development decisions may overlook environmental resources unprotected by policies but valued by interest groups [e.g., important bird areas, essential connectivity areas, vulnerability of caliche (i.e., mineralized carbon) in desert soils, biodiversity hot spots, percent habitat loss]. Several elements of the environment providing ecosystem services that humans depend upon remain widely unprotected by laws and regulations and vastly understudied. By integrating land conservation value earlier in the electricity procurement and planning process, preemptive transmission upgrades or expansions to low-impact regions could improve the incentive to develop in designated zones, avoiding future incompatible development. However, zones themselves must also be carefully designated. The landscape-scale Desert Renewable Energy Conservation Plan initially provided a siting framework—including incidental take authorizations of endangered and threatened species—for streamlining solar energy development within the 91,000 km^2 of mostly desert habitat in public and private lands and designated as the Development Focus Area (DFA). After accounting for unprotected environmental attributes like biodiversity, Cameron et al. (14) identified ~7,400 km^2 of relatively low-value conservation land within the Mojave Desert Ecoregion (United States) that can meet California's 33% renewable portfolio standard for electricity sales seven times over. Since this publication, the Desert Renewable Energy Conservation Plan's DFA has now been restricted to only public lands, which some argue to be more intact, and to the ire of certain local interest groups and government agencies. Hernandez et al. (10) developed a satellite-based decision support tool, the CEEC model, that showed that generation-based technical potential of PV and CSP within the built environment could meet California's total energy demand 4.8 and 2.7 times over, respectively. Development decisions may also overlook synergistic environmental cobenefit opportunities. Environmental cobenefit opportunities include the utilization of degraded or contaminated lands, colocation of solar and agriculture, hybrid power systems, and building-integrated PV (2).

This study found that nearly 30% of all USSE installations are sited in croplands and pastures; signifying perhaps an increasing affinity for using agricultural lands for renewable energy, specifically within the Central Valley of California, renowned for agricultural productivity globally. The growing demand for food, affordable housing, water, and electricity puts considerable pressure on available land resources, making recent land use decisions in this region a noteworthy case study for understanding the food–energy–water nexus that should be explored. Opportunities to minimize land use change include colocating renewable energy systems with food production and converting degraded and salt-contaminated lands, unsuitable for agriculture, to sites for

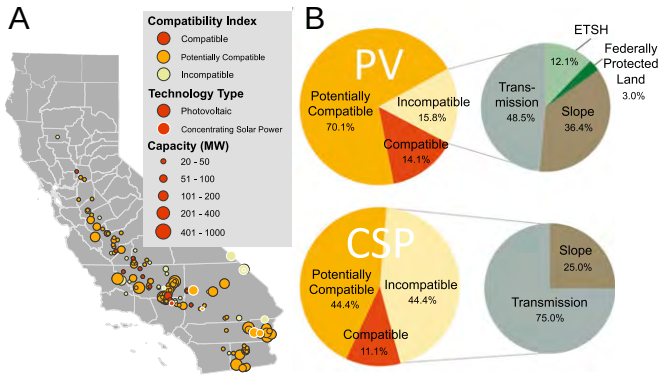

Fig. 4. (*A*) Map of California showing utility-scale solar energy (USSE) (planned, under construction, operating) installations' compatibility by technology [i.e., photovoltaic (PV), concentrating solar power (CSP)], site, and capacity (in megawatts). (*B*) Percentage of USSE installations sited in Compatible, Potentially Compatible, and Incompatible areas. For USSE installations in incompatible sites, we provide the percentage of each incompatibility type.

renewable energy production. Using unoccupied spaces such as adjacent to and on top of barns, parking lots, and distribution centers in agricultural areas is another win–win scenario. In sub-Saharan Africa, integrating solar energy into a drip irrigation system has enhanced food security by conserving water, enhancing reliability of power, and conserving land and space (30). As the development of renewable energy and the production of food are expected to grow, so will the need to understand and evaluate their interactions with the land supporting this expansion in other landscapes.

Conclusion

A growing body of studies underscores the vast potential of solar energy development in places that minimize adverse environmental impacts and confer environmental cobenefits (2, 10, 14, 15, 21). Our study of California reveals that USSE development is a source of land cover change and, based on its proximity to protected areas, may exacerbate habitat fragmentation resulting in direct and indirect ecological consequences. These impacts may include increased isolation and nonnative species invasions, and compromised movement potential of species tracking habitat shifts in response to environmental disturbances, such as climate change. Furthermore, we have shown that USSE development within California comprises siting decisions that lead to the alteration of natural ecosystems within and close to protected areas in lieu of land already impacted by humans (7, 21). Land use policies and electricity planning that emphasizes the use of human-impacted places, complies with existing environmental regulations at the federal, state, and municipal level, and considers environmental concerns over local resource constraints and opportunities, including those of communities, firms, and residents, may prove an effective approach for avoiding deleterious land cover change. Empirical analyses using decision support tools, like CEEC, can help guide development practices toward greater environmental compatibility through improved understanding of the impacts of policy and regulatory processes to date.

Methods

To achieve our objectives, we (*i*) created a multiinstitution dataset of 161 USSE installations in the state of California and compared these data to land cover data; (*ii*) developed a spatial Compatibility Index (i.e., Compatible, Potentially Compatible, and Incompatible) for California using the CEEC model that identifies environmentally low-conflict areas for development, integrating environmental and technical resource constraints and opportunities; (*iii*) compared USSE installation locations with the Compatibility Index to enumerate the number of installations sited within each area type; and (*iv*) compared USSE installation locations with their proximity to protected areas, including Inventoried Roadless Areas, Endangered and Threatened Species Habitat, and Federally Protected Areas (*Supporting Information*). All analyses were conducted using ArcGIS (10.x) and R (R: A Language and Environment for Statistical Computing).

To evaluate land cover change owing to USSE development, we collected data on PV and CSP USSE installations in California that vary in development stage (i.e., planned, under construction, operating) and range in nameplate capacity, selecting a subset of all USSE that range from 20 to 873 MW, 20 MW being a legislative capacity threshold for transmission connection affecting development action. Data for each installation included nameplate capacity under standard test conditions (in megawatts), land footprint (in square kilometers), technology type, and point location (latitude, longitude). Data were collected exclusively from official government documents and records (see *Supporting Information* for details). We define the land footprint as the area directly affected during the construction, operation, and decommissioning phases of the entire power plant facility, excluding existing transmission corridors, land needed for raw material acquisition, and land for generation of energy required for manufacturing. Installations that did not meet data quality criteria (e.g., lacking exact location) were excluded, resulting in a total of 161 USSE installations (see *Supporting Information* for details). Data were collected beginning in 2010 and updated until May 2014. Installations in our dataset vary in their development stage and therefore include installations that may change in attribute or may never reach full operation. Given that we are interested in decisions regarding siting, we included siting data for planned installations, despite their potential uncertainty, as these reflect the most current siting practices that may not be fully represented in decisions for installations that are already under construction or operating.

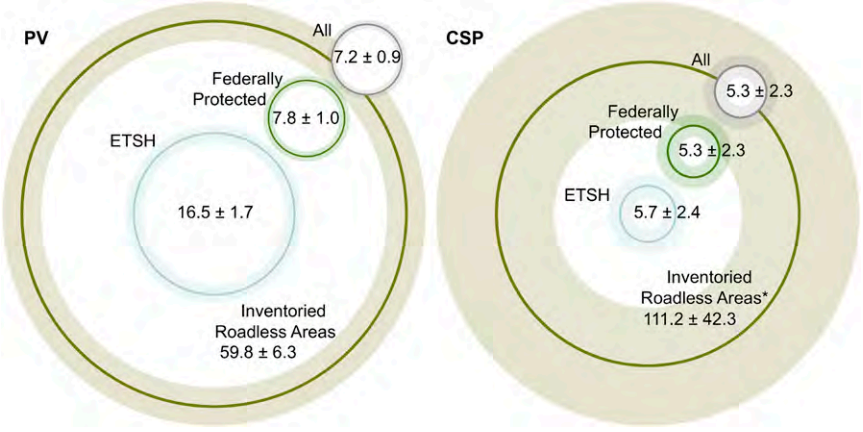

Fig. 5. Proximity of PV and CSP USSE installations to Endangered and Threatened Species Habitat, Federally Protected Areas, Inventoried Roadless Areas, and the closest for all protected area types. Circles are to scale, relatively (with the exception of Inventoried Roadless Areas for CSP), showing 95% confidence intervals (shaded area).

To evaluate land cover change by USSE development, we compared the point location of each USSE power plant from our dataset (by their latitude and longitude) to the land cover type according to the National Land Cover Dataset (NLCD) (30-m resolution) and allocated the reported total footprint of the installation as land cover change within this land cover type. All 16 land cover types, as described by the NLCD, are represented in California, including developed areas within the built environment (Table S3). Developed areas are further classified according to imperviousness of surfaces: open-space developed (<20% disturbed surface cover; e.g., large-lot single-family housing units, golf courses, parks), low-intensity developed (20–49% disturbed cover), medium-intensity developed (50–79% disturbed cover), and high-intensity developed (80–100% disturbed cover; e.g., apartment complexes, row houses, commercial and industrial facilities).

The CEEC model (10) is a decision support tool used to calculate the technical potential of solar electricity generation and characterize site suitability by incorporating user-specified resource opportunities and constraints (Fig. 3 and Tables S2–S5). The CEEC model uses the National Renewable Energy Laboratory's satellite-based diffuse/direct normal radiation and direct normal radiation models, which estimate average daily insolation (in kilowatt-hours per square meter per day) over 0.1° surface cells (~10 km in size), to identify areas with annual average solar resources adequate for PV ($\geq$4 kW·h·m^{-2}·d^{-1}) and CSP ($\geq$6 kW·h·m^{-2}·d^{-1}) technologies, respectively (Table S1).

Among these areas, bodies of open water and perennial ice and snow were excluded as potential sites. We indexed the resulting area for solar energy infrastructure—independently for PV and CSP—as follows: Compatible, Potentially Compatible, and Incompatible (*Supporting Information*). Because solar energy potential within California's developed areas can meet the state's current energy consumptive demand 2.7 times over, decrease or eliminate land cover change, and reduce environmental impacts (10), we defined all four developed land cover classes as Compatible, excepting CSP in high and medium intensity as, to date, CSP technologies have not been deployed there owing to the relatively lower modularity of CSP.

Potentially Compatible areas augment site selections beyond Compatible areas. As slopes of 3% and 5% or less are most suitable for CSP and PV installations, respectively—owing to reduced costs and impact associated with surface grading—we used the National Elevation Dataset (varies from 3- to 30-m resolution; US Geological Survey) to exclude areas without these criteria. To minimize costs and impacts linked to new construction activities and materials, Potentially Compatible areas were also restricted to areas within 10 and 5 km of transmission lines (California Energy Commission) and roads (TIGER), respectively (*Supporting Information*, Fig. 3, and Table S4). We excluded areas where road construction is prohibited ("Federal Roadless Areas"; US Department of Forest and Agriculture), critical habitat of threatened and endangered species (US Fish and Wildlife Service), and federally protected areas (i.e., GAP Statuses 1 and 2, Protected Areas Database of the United States, US Geological Survey; Table S1). We reported generation-based potential for PV and CSP at the utility-scale, i.e., within areas identified as Compatible and Potentially Compatible and within areas meeting a minimum parcel size as needed for a 1-MW installation. Incompatible areas are not classified as Compatible and Potentially Compatible areas. To quantify impacts of solar energy development decisions, we spatially characterized the number, capacity, technology type, and footprint of USSE power plants dataset within the Compatibility Index and analyzed the reasons for incompatibility.

To quantify impact of proximity to protected areas from USSE development, we calculated the distance between each USSE facility data point (by technology type) to the nearest protected area by type (i.e., inventoried roadless areas, critical habitat of threatened and endangered species, and federally protected areas) using the "Near (Analysis)" in ArcGIS, and subsequently calculated the average of all distances (by protected area type) and 95% confidence intervals. For "all" protected area types, we used the shortest distance between each USSE facility data point and the three protected area types, and subsequently calculated the average of these shortest distances and 95% confidence intervals.

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EXHIBIT 8

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Article

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Land-Sparing Opportunities for Solar Energy Development in Agricultural Landscapes: A Case Study of the Great Central Valley, CA, United States

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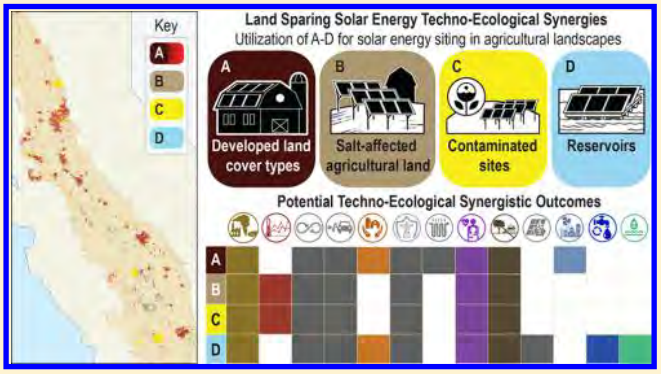
Supporting Information

ABSTRACT: Land-cover change from energy development, including solar energy, presents trade-offs for land used for the production of food and the conservation of ecosystems. Solar energy plays a critical role in contributing to the alternative energy mix to mitigate climate change and meet policy milestones; however, the extent that solar energy development on nonconventional surfaces can mitigate land scarcity is understudied. Here, we evaluate the land sparing potential of solar energy development across four nonconventional land-cover types: the built environment, salt-affected land, contaminated land, and water reservoirs (as floatovoltaics), within the Great Central Valley (CV, CA), a globally significant agricultural region where land for food production, urban development, and conservation collide. Furthermore, we calculate the technical potential (TWh year^{-1}) of these land sparing sites and test the degree to which projected electricity needs for the state of California can be met therein. In total, the CV encompasses 15% of CA, 8415 km^2 of which was identified as potentially land-sparing for solar energy development. These areas comprise a capacity-based energy potential of at least 17 348 TWh year^{-1} for photovoltaic (PV) and 2213 TWh year^{-1} for concentrating solar power (CSP). Accounting for technology efficiencies, this exceeds California's 2025 projected electricity demands up to 13 and 2 times for PV and CSP, respectively. Our study underscores the potential of strategic renewable energy siting to mitigate environmental trade-offs typically coupled with energy sprawl in agricultural landscapes.



INTRODUCTION

In the 21st century, agricultural landscapes are a complex nexus in which land, energy, and water are increasingly limited and interconnected.[1−4] Food production is intrinsically dependent on the diminishing supply of fresh water and viable land.[5,6] The pumping of water for irrigation, dependent on declining aquifers,[7] and other agricultural activities necessitates vast amounts of energy.[8] In the United States, the most agriculturally productive country globally, expenses related to energy (e.g., fertilizer production and equipment manufacture and use) are one of the primary limitations of food production, while U.S. dependency on foreign energy imports imposes additional limitations.[4] Additionally, organic emissions and those from carbon-intensive energy sources pose serious health and environmental risks to farming communities and geographically nested urban population centers.[9−12] In response to such limitations and risks,[4] solar energy is increasingly adopted by farmers and other agricultural stakeholders in ways that may spare land (e.g., building integrated photovoltaics [PVs]) for food and fiber production or, conversely, place additional pressure on arable land by displacing such land for energy production.[13,14]

Unlike conventional energy sources, solar energy can be integrated into pre-existing agricultural infrastructure and under-utilized spaces without adversely affecting commodity production or space required for such activities (e.g., edges of fields, corners of center pivot irrigation fields, and barn rooftops).[13,15,16] Farms require energy to support machinery, electric fencing, pumping and water filtration for irrigation,

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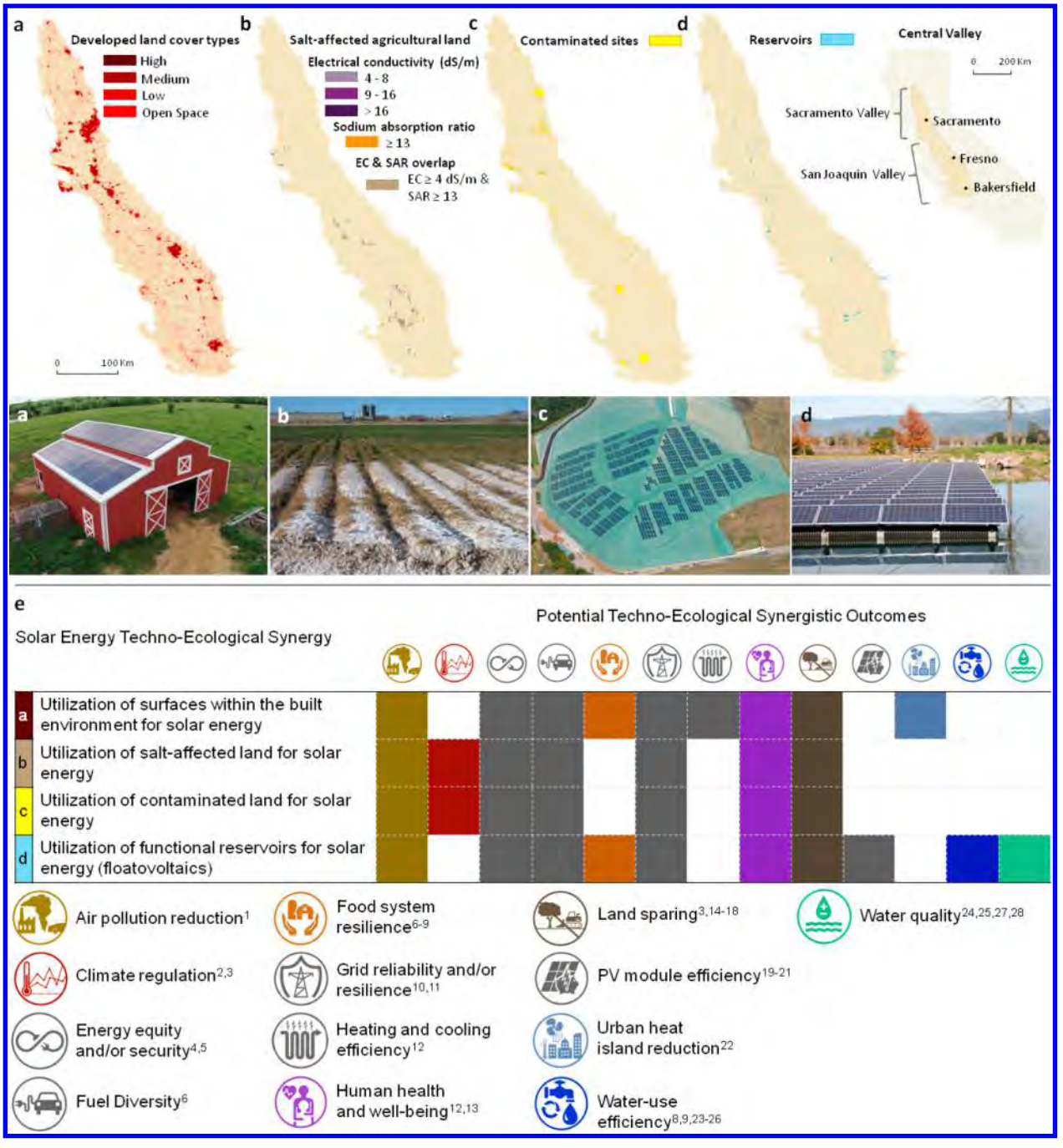

Figure 1. Land sparing solar energy siting opportunities within a 21st century agricultural landscape, i.e., California's Central Valley including within and over (a) the built environment, (b) salt-affected soils, (c) contaminated land, and (d) reservoirs. Contaminated sites are shown accurately according to their actual area but not shape. We posit that these land-sparing siting opportunities for solar energy development may also function individually (e) as a techno-ecological synergy (TES), a framework for engineering mutually beneficial relationships between technological and ecological systems that engender both techno-centric outcomes (gray icons) as well as support for sustainable flows of ecosystem goods and services (colored icons). Numbers refer to citations that provide justification for all potential techno-ecological synergistic outcomes. Larger versions of the map images are available in Figure S4. Photograph credit from left to right: (a) Cromwell Solar in Lawrence, Kansas by Aron Cromwell; (b) Donald Suarez, USDA Salinity Laboratory; (c) Carlisle Energy; (d) Far Niente Winery. All photographs are used with permission. Maps were made using ESRI ArcGIS Desktop (version 10.4) software.

drying and storing crops, lighting, powering heaters, and cooling livestock farmhouses. Previous studies have shown that on-farm solar schemes can provide farmers with reduced electricity pricing while requiring minimal water inputs (relative to other energy sources), thereby improving overall food availability and affordability.[2,13,14]

However, when large solar industrial complexes are developed on natural or prime agricultural lands, nontrivial land-use and land-cover change (LULCC) may result.[17−19] In California, Hernandez et al. (2015) found 110 km^2 of cultivated cropland and 37 km^2 of pasture was converted into use for ground-mounted utility-scale solar energy (USSE, ≥ 1 megawatt [MW]). In the municipality of Leece, Italy; De

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Marco et al. (2014) found that 51% of solar energy installations greater than 20 kW in capacity (n = 42) are sited in unsuitable areas, notably natural and agricultural areas, including century-old olive grooves.[19] Reversion of a site used for solar energy generation back to agriculture is typically unlikely, complicated by long-term application of herbicides, stabilizers, gravel, chemical suppressants, and soil compaction from power plant construction and maintenance activities. Further, land lease agreements and payback periods often exceed 15 years.[20]

The sustainability of energy, food, and water resources and the preservation of natural ecosystems are determined, in part, by how efficiently humans utilize land.[21] While most research has focused on the negative environmental impacts of ground-mounted USSE installations,[17,22] there is increasing attention on the design and enterprise of solar energy that produce both technological outcomes favorable for humans (e.g., energy security and fuel diversity) and benefits supporting ecosystem goods and services, including land sparing.[23] In this study, we define land sparing as siting decisions for solar energy infrastructure that obviate the need for LULCC that may have otherwise occurred within prime agricultural land and natural environments, respectively, including intermediates between these land-cover types. We posit that this framework, known techno-ecological synergy (TES), proposed by Bakshi et al. (2015),[24] and other studies suggest that several potential techno-ecological outcomes may be concomitantly achieved when nonconventional surfaces within agricultural landscapes are used for siting solar energy. Specifically, the utilization of geographically nested (1) urban population centers, i.e., the built environment (i.e., developed areas characterized by impermeable surfaces and human occupation), (2) land with salt-affected soils, (3) contaminated land, and (4) reservoirs may serve as recipient environments for solar energy infrastructure. These sites may also confer techno-ecological outcomes necessary for meeting sustainability goals in landscapes characterized by complex, coupled human and natural systems, such as those within agricultural landscapes. We explore these potential techno-ecological outcomes first, emphasizing the critical role these recipient environments may play in land sparing, which is the focus of our analysis (Figure 1).

Built Environments for Synergistic Solar Energy Development. Modern agricultural landscapes span 40% of Earth's surface[25] and are characterized by complex, heterogeneous mosaics in which natural, agricultural, and built-up elements, infrastructure, and policies intersect.[19,26,27] Areas characterized as the built environment within agricultural landscapes have considerable potential to accommodate solar energy development: a TES that may spare land for agricultural production and conservation locally,[17,21,28] reduce urban heat island effects,[29] and enhance human health and well-being, energy efficiency, and cost savings to consumers[30] (Figure 1). In the state of California (CA), installing small solar energy technology and USSE, including photovoltaic (PV) and concentrating solar power (CSP) technologies, throughout the built environment could meet the state's projected 2020 energy needs 3 to 5 times over.[17] Integrated PV (e.g., on rooftops, vertical walls, and over parking lots) has the lowest land footprint relative to all other energy sources (0 ha [ha]/TWh/year), incurring no LULCC, thus making developed areas environmentally optimal for PV systems. Additionally, solar panels within urban areas may lower local temperatures from increased surface albedo.[29] Integrating solar energy installations within such human-dominated environments generates cost savings directly from generation but also precludes energy losses from transmission and additional construction (e.g., grading, roads, and transmission) and raw material needs (e.g., grid connections, office facilities, and concrete) required for displacive ground-mounted USSE systems. For example, innovative ways of integrating PV technology, such as panels on or alongside transportation corridors (e.g., solar road panels[31] and photovoltaic noise barriers) and clear modules replacing windows will only increase its appeal within the built environment.[15,16,32,33]

Salt-Affected Lands for Synergistic Solar Energy Development. Naturally occurring high concentrations of salt (saline soils; Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, and HCO_3^{-}) or sodium (sodic soils; Na^{+}, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^{-}, CO_3^{-}, Cl^{-}, and SO_4^{2-}) combined with poor irrigation and farming practices can lead to dramatic losses in crop yield and, in severe cases, the cessation of agricultural productivity. An excess quantity of dissolved salt or sodium minerals in soil and water inhibits food production, threatens water quality, and facilitates sedimentation problems and soil erosion. Plant growth is limited by salinity due to the osmotic effect in which excess salts (e.g., chloride [Cl^{-}] and sulfate [SO_4^{2-}]) tightly attach to water molecules, inhibiting plant roots from absorbing "available" water due to the high passage resistance of the electric current. Different salts can affect growth uniquely where plant success is dependent on both the salt compound makeup and the individual plant's tolerance. A high sodium ratio (proportion of sodium [Na^{+}] relative to calcium [Ca^{2+}] and magnesium [Mg^{2+}]) is related to soil dispersion influenced by an excess of cations (Na^{+}) attaching to clay particles causing soil swelling and expansion. Overtime, sodic soils begin to solidify and lose their structure as they fluctuate between dry and moist periods, reducing soil permeability. Salinization impacts about 19.5% (45 million ha) of irrigated land, 2.1% (32 million ha) of dryland agriculture globally,[34] and costs the United States approximately $12 billion a year.[35] Developing solar energy on salt-affected land may reduce air pollution (e.g., when substituted for carbon-intensive energy sources), while a concomitant restoration of biophysical capacity of salt-affected land (e.g., composted municipal solar waste amendments[36] and native halophytic vegetation out-planting) may support climate regulation. Techno-centric outcomes of solar energy on salt-affected land may include energy equity, fuel diversity, and grid reliability.[37−39] Heckler[40] estimates soil lost to salt degradation will continue to increase at a yearly rate of about 0.8−16%, underscoring the potential long-term opportunity of salt-affected land as a potential land-sparing TES of solar energy (Figure 1).

Contaminated Land for Synergistic Solar Energy Development. Reclaiming land to provide sustainable energy has numerous potential techno-ecological outcomes including addressing public health risks, supporting climate regulation (e.g., following reclamation activities), and mitigating air pollution when solar energy generation is substituted for carbon-intensive sources of energy (Figure 1). Contaminated lands include brownfields, federal or nonfederal superfunds, and lands identified by the Resource Conservation and Recovery Act (RCRA), the Abandoned Mine Lands Program, and the Landfill Methane Outreach Program. Brownfields are areas previously designated for industrial or commercial use in which there are remnants of hazardous substances, pollutants, or contaminants. Superfund sites involve the most severely

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hazardous wastes requiring federal or state government attention. The RCRA ensures toxic waste storage facility sites responsibly and properly treat, store, or dispose of hazardous waste where cleanup expectations and requirements are determined by individual state governments. Once responsibly reclaimed, a process typically facilitated by government efforts, the land can be repurposed for commercial or industrial development. Contaminated sites typically left idle for extended periods of time, have low economic value, and are challenging to cultivate,[41,42] none of which undermine their potential for solar energy development. Examples of toxic wastelands that have been repurposed for solar energy development projects include sites formerly involving chemical and explosive manufacturing, steel production, tar and chemical processing, geothermal heating and cooling, and garbage disposal.[43] In the United States, the RE-Powering Initiative encourages renewable energy development on contaminated lands, and since the inception of the program, 1124 MW of renewable energy capacity is produced on 171 contaminated land sites.[44]

Floatovoltaics for Synergistic Solar Energy Development. Irrigation is the largest source of water consumption globally.[45,46] Brauman et al. (2013) found extensive variability in crop water productivity within global climatic zones indicating that irrigated croplands have significant potential to be intensified (i.e., food produced [kcal] per unit of water [L]) through improved water management.[47] The siting of solar energy panels that float on the surface of water bodies, such as reservoirs and irrigation canals, may minimize evaporation, reduce algae growth, cool water temperatures, and improve energy efficiency by reducing PV temperatures through evaporative cooling (Figure 1). There are vast opportunities for floatovoltaic deployment; collectively, lakes, ponds, and impoundments (water bodies formed by dams) cover more than 3% of the earth's surface area.[48] Reservoirs allow for relatively seamless solar energy integration compared with natural bodies of water, such as rivers, because their surfaces are relatively placid. This reduces the likelihood that panels will collide with each other or drift and break apart, allowing for easy maintenance. Additionally, unlike rivers and lakes, reservoirs are often located where energy demands are relatively high. Floatovoltaics integrate well into agricultural systems by allaying competition with land resources and providing energy and water savings. Farmers increasingly rely on agricultural ponds as water storage for irrigation, livestock, and aquaculture.[48] On-farm reservoirs are often wide but shallow making them more susceptible to water loss through evaporation.[49] Algae growth, a nutrient pollutant, is another costly nuisance for irrigation ponds that can clog pumps, block filters, and produce odors,[50] conditions attributed to further water losses that can be expensive and challenging for farmers to address. Solar panels reduce light exposure and lower water temperatures, minimizing algae growth and the need to filter water.[51−53] Finally, when solar panels are placed over cool water instead of land, PV module efficiency may increase 8−10%[54] where increased thermal transfer limits resistance on the circuit allow the electrical current to move faster.[55,56]

The Central Valley: A Model System for Land-Energy Interactions. The Central Valley (CV) is an ideal region in which to study land sparing benefits of solar energy TESs and to inform on broader issues related to the intersection between energy and land.[57] Located in one of the world's five mediterranean climate regions, California is valued as the largest agricultural producer within the United States, responsible for over half of the country's fruits and nuts, and is productive year-round.[58,59] This region also includes, in part, the California Floristic Province, an area supporting high concentrations of native and endemic species.[60] Over the last 150 years, the CV has experienced expansive LULCC owing to agricultural and urban development, which has accelerated habitat loss and fragmentation in areas of native prairies, marshes, vernal pools, oak woodlands, and alkali sink scrublands.[61] Within the last 30 years, LULCC has also occurred within agricultural land owing to energy development and urbanization, a large percent of which were considered prime farmlands.[61]

To date, there are few studies assessing the potential of solar energy within agricultural landscapes in ways that may concomitantly facilitate synergistic outcomes on technological and ecological systems beyond avoided emissions.[62,63] In this study, we sought to (1) evaluate the land sparing potential of solar energy development across four nonconventional land-cover types: the built environment, salt-affected land, contaminated land, and water reservoirs, as floatovoltaics, within the Great Central Valley (CV, CA) and (2) quantify the theoretical and technical (i.e., generation-based) potential of PV and CSP technologies within the CV and across these potential solar energy TESs to determine where technical potential for development is greatest geographically. Further, we sought to (3) determine the spatial relationship of land sparing areas with natural areas, protected areas, and agricultural regions designated as important to determine the proximity of these opportunities to essential landscapes that may have otherwise be selected for energy siting and development. Next, we (4) analyze the spatial density of contaminated sites within 10 km of the most populated CV cities to elucidate relationships between attributes (number and size) of nearby contaminated sites potentially favorable for solar energy generation and urban development centers because urban density is an explicative factor determining electricity consumption for cities.[64] Lastly, we (5) test the degree to which current and projected (2025) electricity needs for the state of California can be met across all four potential land sparing opportunities.

METHODS

Theoretical and Technical Solar Energy Potential for PV and CSP Technologies. The theoretical, or capacity-based, solar energy potential is the radiation incident on Earth's surfaces that can be utilized for energy production, including solar energy.[65] We used two satellite-based radiation models developed by the National Renewable Energy Laboratory (NREL) and Perez et al.[66] to estimate the theoretical solar energy potential of PV and CSP technologies operating at their full, nominal capacity over 0.1° surface cells (~10 km in size).

Photovoltaic technologies use both direct and indirect radiation, while CSP uses only direct-beam radiation. Therefore, the radiation model we used for CSP capacity-based energy estimates is representative of direct normal irradiance (DNI) only, whereas the PV model incorporates both DNI and diffuse irradiance. Areas with DNI values of less than 6 kWh m^{-2} day^{-1} were not considered economically adequate for CSP deployment and therefore excluded from solar potential estimates (Figure S1).

To evaluate the technical, or generation-based, solar energy potential within identified areas for land-sparing PV development, we multiplied the theoretical potential by a capacity

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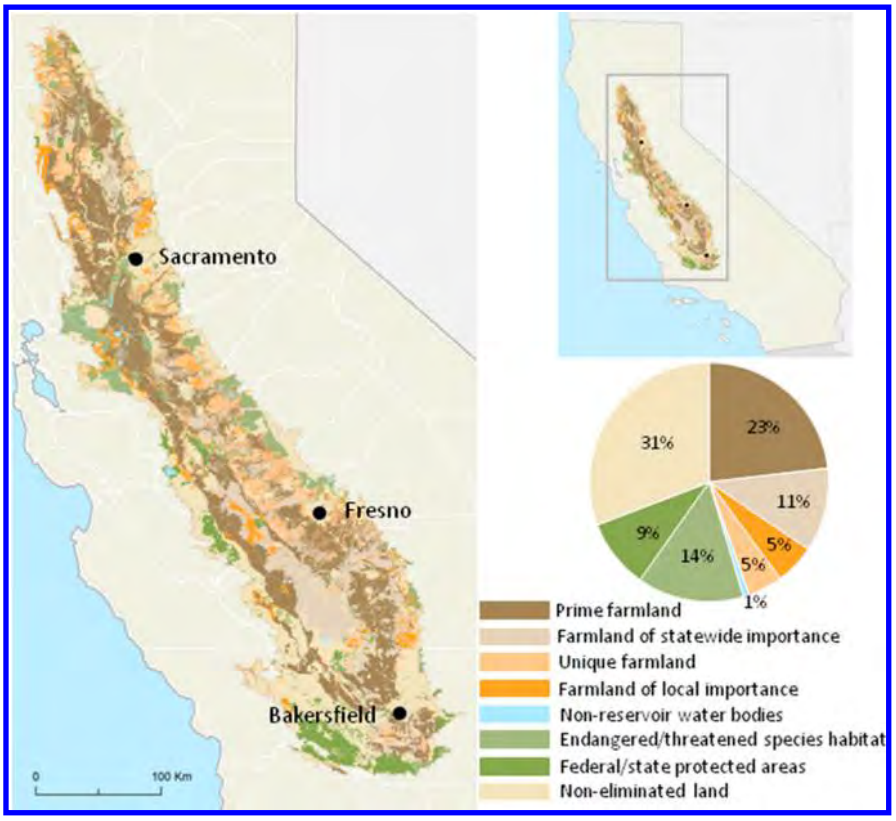

Figure 2. Map of California showing land-cover types eliminated when identifying solar energy potential over salt-affected soil. The pie graph depicts the relative proportion of area that each land cover type makes up within the Central Valley, which is not visible in the map due to overlap (e.g., areas identified as both endangered species habitat and state-protected). Land-cover types include: important farmlands (prime, unique, and of state-wide or local importance), nonreservoir bodies of water, endangered and threatened species habitat, federally and state-protected land, and non-eliminated land that was further evaluated for solar energy potential. The map was made using ESRI ArcGIS Desktop (version 10.4) software.

factor. The capacity factor values are derived from a satellite-based, spatially explicit capacity factor model[67] that has identical cells as the radiation models described above. The PV capacity factor model comprises estimates for three primary technology subtypes including fixed mount, south facing with a 25° tilt (TILT25); one-axis tracking, rotating east−west with a ± 45° maximum tracking angle (AX1FLAT); and two-axis tracking, rotating east−west and north−south of the sun across the horizon (AX2). For CSP generation-based calculations, we incorporated a five DNI class value scheme resembling estimates for a trough system.[68] Full details are provided in the Supplementary Methods.

Next, we calculated solar energy potential for both small and large-scale solar energy projects, where a minimum parcel size of 28 490 m^2 and 29 500 m^2 were required for PV and CSP facilities, respectively, producing 1 MW or more. These values are based on the average USSE land-use efficiency of 35.1 and 33.9 W m^{-2} for PV and CSP, respectively.[69] All CSP installations are utility-scale, and therefore, only these data are reported.

Solar Energy Potential of Land Sparing Opportunities in the Central Valley. We delineated the CV (58 815 km^2) based on the Great Central Valley Region[70] (Figure 1), composed of the geographic subdivisions of the Sacramento Valley, San Joaquin Valley, and all Outer South Coast Ranges encompassed within the San Joaquin Valley polygon. We overlaid the PV and CSP radiation models with the four land sparing land-cover types within the CV and calculated total area (km^2) and solar energy potentials (TWh $year^{-1}$). Across the salt-affected land solar energy TESs, we eliminated lands protected at the federal and state levels and threatened and endangered species habitats (Figure 2). Furthermore, all water bodies (e.g., wetlands and rivers), occurring in salt affected areas, with the exception of reservoirs, were removed as they may function as essential habitats for birds and other wildlife. Salt-affected soils within farmlands identified as primary, unique, or of state-wide or local importance[71] were also not included in the final estimates for solar energy potential. See the Supplementary Methods for explicit details on data and analysis for each land-cover type.

Spatial Relationships between Synergies and across Land-Cover Types. To ensure that energy potentials were not double-counted (e.g., salt-affected lands within the built environment), we calculated the spatial overlap across three solar energy TESs. Specifically, we observed overlap of land sparing potential among the built environment, salt-affected regions, and reservoirs. We did not include Environmental Protection Agency (EPA) contaminated sites because such data is not absolutely spatially explicit, but instead, each site is modeled circularly, in known total area, outward from a centroid based on known latitude and longitude coordinates, which may not represent each site's actual boundaries. Overlap between contaminated sites and land classified as salt-affected may be the most unlikely as most actions at these sites focus on preventing human contact.[41] Nonetheless, we did count 17 (189.5 km^2), 3 (2.5 km^2), and 740 (332.8 km^2) contaminated sites that may potentially overlap with salt-affected land, reservoirs, and the built environment, respectively, but we did

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Table 1. Contaminated Site Attributes across the Ten Most-Populated Cities Within the Central Valley, CA

city	city population	city area (km^2)	contaminated sites within city	contaminated sites within 10 km of city	contaminated site area within 10 km (km^2)
Fresno	494 665	112	38	58	21
Sacramento	466 488	98	83	140	47
Bakersfield	347 483	142	10	32	8
Stockton	291 707	62	53	95	35
Modesto	201 165	37	19	55	28
Elk Grove	153 015	42	27	71	52
Visalia	124 442	36	36	46	9
Concord	122 067	31	9	60	107
Roseville	118 788	5	8	60	75
Fairfield	105 321	37	10	26	34

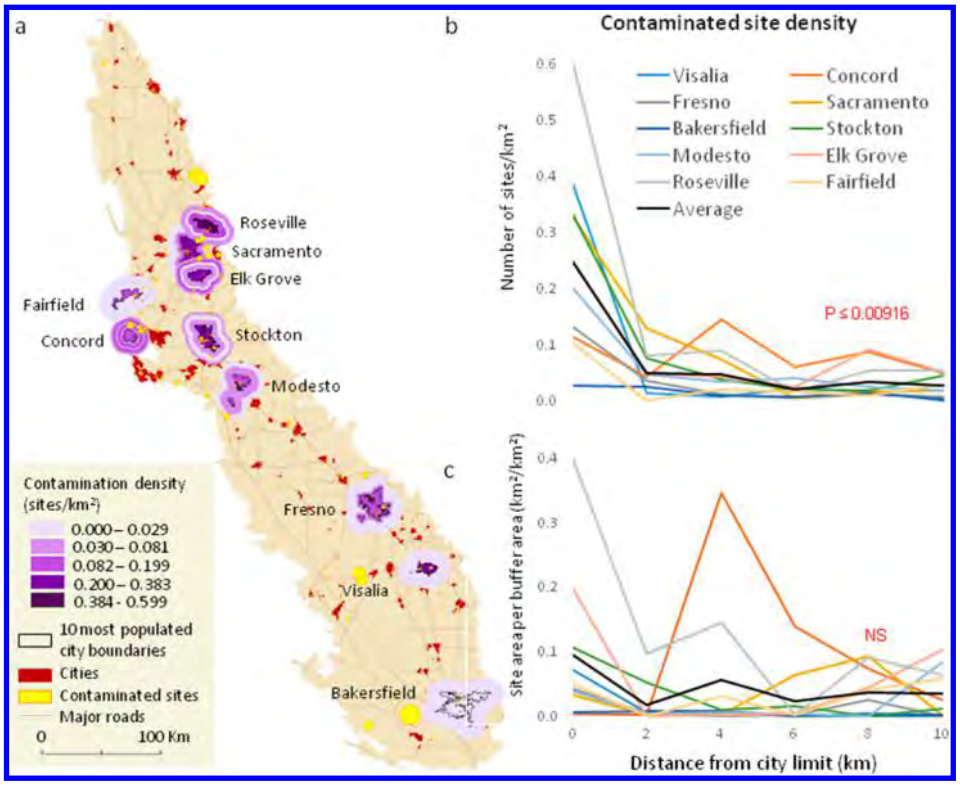

Figure 3. (a) Density of contaminated sites (circular points representing their total area but not shape; number of sites per square kilometer) within the Central Valley's (beige polygon) 10 most-populated cities: (1) within city limits (black line) and (2) across 0–2, 2–4, 4–6, 6–8, and 8–10 km buffers beyond city borders (purple buffers). Graphs show (b) the density of contaminated sites (sites per square kilometer) and (c) the total area of sites as a function of distance from city limits of the 10 most-populated cities in California's Central Valley. Land within each city boundary has a significantly greater number of contaminated sites based on total count (posthoc Tukey test, $P \leq 0.00916$) than buffer classes beyond the city perimeter (number of sites per square kilometer). No significant relationship exists between contamination site area and distance from urban cores. The map was made using ESRI ArcGIS Desktop (version 10.4) software.

not account for this overlap in the final values. We also enumerated spatial relationships between synergistic sites and other land-cover types throughout our analysis to determine the proximity of these opportunities to essential landscapes that may have otherwise been selected for energy siting and development.

Spatial Density and Proximity of Contaminated Lands to Human Populations. To elucidate relationships between attributes (number and size) of nearby contaminated sites potentially favorable for solar energy generation and urban development centers, we first identified the 10 most-populated cities within the Central Valley. We added 5 buffer distances around the perimeter of each city at 2 km increments up to 10 km (i.e., 2, 4, 6, 8, and 10 km). Within cities and each of these buffered rings (e.g., area between 4 and 6 km beyond city limits), we calculated the area and divided the number and area of contaminated sites that fall within each buffer by its associated area (site km^{-2} and site area [km^2] km^{-2}). We included any sites located outside of the CV within 10 km of the city analyzed. Contaminated sites that were in a 10 km radius of more than one of the 10 highly populated city were included in each density analysis. We used generalized linear models (GLMs) to test the effects of distance class on contaminated site metrics (i.e, count and area) and to observe if sites are generally located near, further away, or have no association with urban development centers, which serve as a proxy for electricity demand. Contaminated sites that were within a 10 km radius of multiple cities were observed

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Table 2. Number of Times over PV and CSP Solar Energy Technologies Can Meet California'S Projected Electricity Consumption Needs for 2025 (321 TWh) Based on Land-Sparing Opportunities within the Central Valley, CA: (1) Developed, (2) Salt-Affect Soil, (3) Reservoirs, and (4) Contaminated Sites[a]

		PV				CSP	
		distributed and USSE		USSE only		USSE	
land-cover type[b]		capacity-based (times over)	generation-based (times over)	capacity-based (times over)	generation-based (times over)	capacity-based (times over)	generation-based (times over)
Central Valley		378.6	68.1−83.4	378.6	68.1	398.2	129.7
DNI ≥ 6 kWh m^{-2} day^{-1}		–	–	–	–	135.4	46.9
developed	high intensity	2.8	0.5−0.60	1.5	0.3	–	–
	medium intensity	10.8	1.9−2.35	7.5	1.3−1.6	–	–
	low intensity	9.3	1.7−2.02	1.6	0.3−0.4	0.2	0.1
	open space	19.2	3.5−4.2	6.2	1.1−1.4	1.9	0.7
salt-affected soil	EC ≥ 4 and ≤8	0.6	0.1	0.6	0.1	0.2	0.1
	EC > 8 and ≤16	0.8	0.1−0.2	0.8	0.1−0.2	0.3	0.1
	EC > 16	0.1	0.0	0.1	0.0	0.0	0.0
	SAR ≥ 13	0.2	0.0	0.2	0.0	0.0	0.0
	overlap (EC ≥ 4 and SAR ≥ 13)	3.9	0.7−0.9	3.9	0.7−0.9	1.4	0.4
reservoirs		0.7	0.1−0.2	0.6	0.1	–	–
contaminated		7.1	1.3−1.6	7.0	1.3−1.6	3.0	1.0
total		55.4	9.9−12.1	30.1	5.4−6.6	7.0	2.4
overlapping areas		1.3	0.2−0.3	0.6	0.1	0.1	0.0
total (accounting for overlapping areas)		54.1	9.7−11.8	29.5	5.3−6.5	6.9	2.4

[a]Capacity-based potential is representative of the full energy potential offered from the sun, whereas the generation-based potential estimates the energy potential given current technology capabilities including three PV system types (tilt, one-axis tracking, and two-axis tracking panels) and a CSP trough technology. [b]Total energy potentials account for overlaps in land-cover types to avoid double-counting.

separately and therefore accounted for more than once. See the Supplementary Methods for further details.

RESULTS AND DISCUSSION

We found that 8415 km^2 (equivalent to over 1.5 million American football fields) and 979 km^2 (approximately 183 000 American football fields) of non-conventional surfaces may serve as land-sparing recipient environments for PV and CSP solar energy development, respectively, within the great CV and in places that do not conflict with important farmlands and protected areas for conservation (Figure 1 and Tables 1 and Supplementary Table 1). This could supply a generation-based solar energy potential of up to 4287 TWh $year^{-1}$ for PV and 762 TWh $year^{-1}$ for CSP, which represents 2.8 (CSP) − 14.4% (PV) of the CV area. We accounted for 203 km^2 of overlap across the built-environment, reservoirs, and salt-affected areas, the latter after eliminating land classified as protected areas (federal and state), critical and threatened habitats, and important farmlands from salt-affected soils.

In total, the CV encompasses 58 649 km^2 of CA, about 15% of the total land area in the state, and has a theoretical potential of 121 543 and 127 825 TWh annually for PV and CSP, respectively (Table S1). Considering areas with solar radiation high enough to economically sustain a CSP solar energy facility (locations with a DNI of 6 kWh m^{-2} $year^{-1}$), less than one-third (~19 000 km^2) of the CV is suitable for CSP deployment, and a capacity-based potential of about 44 000 TWh $year^{-1}$.

Among the potential solar energy TESs we studied, the built environment offers the largest land sparing potential in area with the highest solar energy potential for PV systems (Figure 1a), representing between 57% (USSE only) and 76% (small-scale to USSE) of the total energy potential for PV. If only USSE PV systems are considered for development, roughly half of the total built environment is suitable, a constraint owing to areas not meeting minimum parcel requirements for a one MW installation (28 490 m^2 or greater). Specifically, installing PV systems across the built environment could provide a generation-based potential of 2413 TWh $year^{-1}$ utilizing fixed-tilt modules and up to 3336 TWh $year^{-1}$ for dual-axis modules (Table S2). Using CSP technology, both the low-intensity developed and the open spaces within the built environment could yield 242 TWh $year^{-1}$ of generation-based solar energy potential (Table S1). For CSP, the built environment represents 30% of all energy opportunity for the land-sparing solar energy TESs we studied.

Land with salt-affected soils, another potential land sparing solar energy TES, comprises 850 km^2 of the CV, excluding areas identified as important for agriculture and conservation (Figure 2). This remaining salt-affected land makes up 1.5% of the CV region. Generally, regions with high concentrations of salt also have unsuitable levels of sodium. Indeed, we found that 70% of sodic and saline soils overlap; occurring in the same place (Table S2). Geographically, most salt-affected land sparing opportunities suitable for solar energy development are within the interior region of the CV, away from the built environment (Figure 1c).

We found that 2% (1098 km^2) of the CV is composed of contaminated lands with a generation-based potential of 407 and 335 TWh $year^{-1}$ for PV and CSP, respectively. A total of 60% of these sites are clustered within and near (<10 km) the 10 most-populated cities, a buffer area composed of 21% of the CV (inclusive of buffer areas of cities extending beyond the CV border; Figure 3a and Table 1). We found that across the top 10 most-populated cities, population was significantly positively related to the number of contamination sites (GLM, t value of 2.293, P = 0.025916). We also found that land within each city

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boundary has a significantly greater number of contaminated sites based on total count (post-hoc Tukey test, $P \leq 0.00916$; Figures 3b and S2) than buffer classes beyond the city perimeter (number of sites per square kilometer; Figure 3b). We found no statistical relationship between contamination site area and distance from urban cores (Figure 3c). Note that in addition to the 953 contaminated sites quantified for solar energy potential, 51 more sites are included in the density analysis that reside outside of the CV boundary but are within 10 km of cities and 46 of the contaminated sites (Table 1) are accounted for multiple times because they are within the 10 km radius of multiple cities. Lastly, contaminated lands are particularly attractive for USSE projects, and indeed, 412 and 411 of the 953 contaminated sites from the EPA data set pass the minimum area requirement for supporting utility-scale PV and CSP technologies, respectively (Figure 3). Although our emphasis here was relationships between contaminated sites and urban development cores, more-robust analyses exploring spatial relationships between contaminated sites and population at the regional scale may be useful.

Reservoirs comprise 100 km^2 of available surface area for solar energy, just 0.2% of the total land area in the CV. The integration of fixed-tilt PV panels across all reservoir surface area would provide a generation-based energy potential of 39 TWh $year^{-1}$ (Table S1). There are roughly 4300 reservoirs within the CV, 2427 (56%) and 986 (23%) of which are classified as water storage and reservoirs, respectively (Figure S3). These water body types are the greatest targets for floatovoltaic development, and together, they make up roughly 66% of the total surface area of all reservoirs in the CV. While 66% of reservoirs identified in the CV are highest priority, the remaining 38% are treatment, disposal, and evaporator facilities, aquaculture, and unspecified reservoirs (Figure S3). In CA, farmers and water pump stations consume 19 TWh of electricity annually;[72] based on estimated energy potential for floatovoltaics, reservoirs provide enough surface area to supply 2 times the electricity needs of farmers or water pump stations for CA (19 TWh).[72]

California's projected annual electricity consumption needs for 2025, based on moderate assumptions, is 321 TWh.[73] The land-sparing solar energy TESs we explore in this study could meet CA's projected 2025 needs for electricity consumption between 10−13 times over with PV technologies and over two times over with CSP technologies (Table 2). In fact, each land-sparing TES individually can be used to meet the state's energy needs with the exception of reservoirs, which would provide enough surface area to produce electricity to meet 10−20% of CA's 2025 demands. However, reservoirs do offer enough surface area and potential to meet electricity needs within California's agriculture sector (i.e., 19 TWh annually).[72] CSP systems are confined to limited areas within the CV and therefore offer relatively less energy potential than PV; yet still, contaminated lands alone offer adequate space for CSP technologies to meet projected electricity needs for 2025.

Our study found contaminated sites are clustered within or near highly populated cities, many with populations that are projected to rapidly expand owing to urban growth. Thus, contaminated sites may serve as increasingly desirable recipient environments for solar energy infrastructure within the CV of California and agricultural landscapes elsewhere. The mission of the Environmental Protection Agency's (EPA) RE-Powering initiative is to increase awareness of these contaminated sites by offering tools, guidance, and technical assistance to a diverse community of stakeholders. Already, this program has facilitated development from 8 renewable energy projects in 2006 to nearly 200 today.[44] Across the United States alone, there are over 80 000 contaminated sites across 175 000 km^2 of land identified as having renewable energy potential, emphasizing the opportunity to repurpose under-utilized space. Given the globally widespread policy-based adoption of managing hazards in place, allowing for the less than complete remediation of environmental hazards on contaminated sites; the benefits of this TES must be weighed against risks assessed from indefinite oversight and monitoring.[41]

There are few studies or cost−benefit analyses on solar energy over functional water bodies that empirically and quantitatively assess the potential for synergistic outcomes related to water (e.g., water quality), energy, and land. Farmers frequently build water reservoirs to cope with limits on water allotment during drought periods,[74] offering opportunities for dual-use space for solar panels. Although floatovolaics are increasing in popularity, particularly in Asia, where the largest floating solar installation exists,[75] more-comprehensive environmental impact assessments are needed to quantify beneficial outcomes (e.g., reductions in evaporative loss) and address risks. One concern is that avian species may perceive PV modules as water, known as the "lake effect," leading to unintended collisions and possibly injury or mortality.

In 2015, installed capacity of solar energy technologies globally reached 220 GW driven by relatively high average annual growth rates for PV (45.5%, 1990−2015) and CSP (11.4%) compared with other renewable energy systems.[76,77] At these rates, trade-offs between land for energy generation and food production in an era of looming land scarcity may be high[9] when developed without consideration of impacts to land, including food and natural systems. For example, in the United States alone, an area greater than the state of Texas is projected to be impacted by energy development and sprawl, making energy the greatest driver of LULCC at a pace double the historic rate of residential and agricultural development by 2040.[28] California aims to derive half of its electricity generation (160 TWh) from renewable energy sources by 2030, and we show that the CV region can supply 100% of electricity needs from solar energy without compromising critical farmlands and protected habitats.

The extent to which agricultural landscapes can sustain increasing demand for agricultural products and transition to becoming a major solution to global change type threats instead of contributing to them depends on several factors; however, the manner in which land, energy, and water resources are managed within such landscapes is arguably the decisive factor.[4,78] Our study reveals that the great CV of California could accommodate solar energy development on nonconventional surfaces in ways that may preclude loss of farmland and nearby natural habitats that also support agricultural activities by enhancing pollinator services (e.g., wild bees) and crop yields.[79,80] Given the diffuse nature of solar energy, advances in battery storage would likely only enhance the economic and environmental appeal of the four solar energy TES we evaluated.[81,82] The realization of this potential may also confer other techno-ecological synergistic outcomes (as characterized in Figure 1), and additional research could be conducted to improve the certainty and accuracy of these potential benefits. For example, the degree to which realization of solar energy potential in agricultural landscapes on nonconventional surfaces contributes to food system resilience[83] by alleviating competi-

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tion of valuable land among farmers, raising property values, generating clean energy for local communities, enhancing air quality, and providing new job opportunities[14,62] remains largely unexplored.

Other factors impacting the sustainability of agricultural landscapes include the level of funding to support research and development, collaboration across public and private sectors to advance technology and innovation, and policies that bolster decisions and action leading to appropriate renewable energy siting. Research efforts have increasingly focused on identifying where and how renewable energy systems can be sustainably integrated into complex landscapes with environmentally vulnerable ecosystems,[21,22,84−86] but less emphasis has been on decisions with agricultural landscapes[19,78,84,85] despite its importance to food security and nutrition. In the US, the National Science Foundation is prioritizing the understanding of food, energy, and water interactions, identifying it as the most pressing problem of the millennium, but land has remained underemphasized in these programs.[87] Policies that result in cash payments to growers and solar energy developers for land sparing energy development could facilitate, indirectly, the conservation of important farmlands and natural areas. Federal policy could provide the financial support to state and local governments to protect natural and agriculturally critical areas, and decisions can be tailored at these administrative levels to accommodate the land use and water rights unique to the region.

California's Great Central Valley is a vulnerable yet indispensable region for food production globally. Our analysis reveals model options for sustainable solar energy development via use of nonconventional surfaces, i.e., the built environment, salt-affected land, contaminated land, and water reservoirs, as floatovoltaics. These land sparing solar energy development pathways may be relevant to other agricultural landscapes threatened by trade-offs associated with renewable energy development and sprawl.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge on the ACS Publications website at DOI: 10.1021/acs.est.7b05110.

Detailed information about methods and data used for analysis in this study. Figures showing the effect of distance from the 10 most-populated cities, water reservoirs in the Central Valley, theoretical solar radiation potential, and maps of land-sparing solar energy. Tables showing utility-scale solar energy potential and photovoltaic energy potential.(PDF)

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Notes

The authors declare no competing financial interest.

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